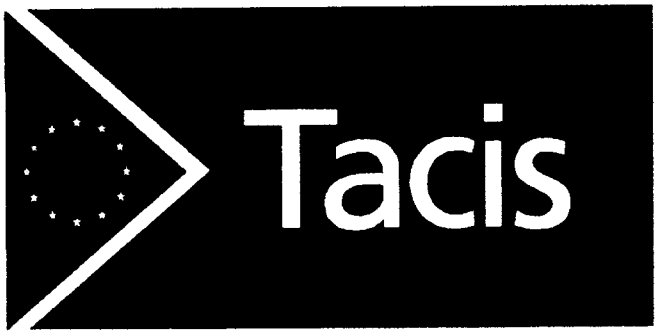

TRACECA Programe:
Regional traffic database and forecasting model

Inception Report

April 1996

European Union
Tacis Programme

TRACECA:
Regional Traffic Database and Forecasting Model

(Project No. WW.93.05/05.01/B008)

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CONTENTS

1. PROJECT SYNOPSIS

1.1 This Inception Report deals with the Tacis project 'Regional Traffic Forecasting Model, and a Review of International Route Capacity' (Project No. WW 93.05/05.01/B008). This report covers the period from January 1996, when the project started, to March 1996.

1.2 Table 1.1 shows the 'Logical Framework' for the project.

Table 1.1 Logical Framework for the Project

Wider Objectives: to assist in the prioritising of transport investment options in the region through the introduction of a quantitative planning tool which can simulate the impacts.

Specific Project Objectives:

- introduction and establishment of computer-based planning tools, in the eight TRACECA states including:
  - a common regional database of transport and trade flows and transport infrastructure and transport costs;
  - a multi-modal model for analysing scenarios and developing forecasts;
- application of the tools to:
  - create comprehensive multi-modal synoptics of existing and forecast future flows;
  - highlight bottlenecks of all types;
  - identify preferred locations for multi-modal transfer centres;
  - identify and catalogue specific road/rail/maritime and multimodal projects for detailed feasibility studies;
- transfer of know-how in transport database design and modelling.

Outputs/Activities:

- an Inception Mission and Inception Report (month 3);
- Phase 1A involving data acquisition and storage followed by Progress Report I (month 8);
- Phase 1B consisting of the development of scenarios and database, followed by Progress Report II (month 13);
- Phase 2 including synoptic forecasts and development of investment options, followed by Progress Report III (month 15);
- Phase 3 which is the handover of the software and support missions, followed by a draft Final Report (month 18) and Final Report (month 21).

Inputs:

- technical assistance;
- computers and other office equipment;
- database, forecasting and office-oriented computer software.

2. ANALYSIS OF PROJECT: START SITUATION

PROJECT CONTEXT

2.1 The TRACECA programme (Transport Corridor Europe Caucasus Asia) brings together eight Republics of Central Asia and the Caucasus which were southern republics of the former Soviet Union: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tadjikistan, Turkmenistan and Uzbekistan. TRACECA is part of the Tacis interstate programme.

2.2 The objectives of the programme are to:

- stimulate co-operation among the participating Republics in the field of trade and transport;
- to promote the development of the Europe - Trans-Caucasus - Central Asia transport corridor.

2.3 In the former Soviet Union the transport and trade links between these Republics and the rest of the world were poorly developed. The changes in trading patterns following the break-up of the Soviet Union have led to a need to improve these links, particularly with Europe.

MAIN PROBLEMS/DEFICIENCIES

2.4 The main problems/deficiencies in the project identified in the mobilisation/inception stage are:

- the region is in rapid transition: consequently there is a significant general level of uncertainty in institutional structures and responsibilities;
- lack of preparedness for TRACECA amongst official organisations (including Tacis Co-ordinating Units): during the Inception Mission our project representative was in some cases the first contractor to visit a

country under the TRACECA programme (no doubt this situation will improve in the future);

- very different institutional frameworks in each country (see section on Situation of Local Operator);
- difficulty of finding a suitable partner organisation in each country (see section on Target Groups);
- unrealistic expectations of the money available for local work under the contract, particularly at the official counterpart level, where Tacis rules prohibit any payments;
- likely variable degree of data availability in the different states.

SITUATION OF LOCAL OPERATOR

2.5 The 'local operator' is what we have termed the official counterpart organisation responsible for the project in the country. This would normally be the Ministry of Transport or equivalent.

2.6 Until the dissolution of the Soviet Union in 1991, the eight republics covered by TRACECA had the same institutional structure. In the subsequent five years since independence many institutional changes have occurred, but at different speeds and in different directions. The situation found during the Inception Mission is summarised in Table 2.1.

Table 2.1 - Local Official Counterpart Organisations

Country	Organisation
Armenia	Ministry of Transport
Azerbaidjan	Ministry of Economy
Georgia	Co-ordinating Council for Transport
Kazakhstan	Ministry of Transport
Kyrgyzstan	Ministry of Transport
Tadjikistan	Ministry of Economy
Turkmenistan	Cabinet of Ministers
Uzbekistan	Cabinet of Ministers

TARGET GROUPS

2.7 The target groups for the project are those organisations that would be able to receive, operate and maintain the database and forecasting model. We have termed these 'local technical partner organisations' (or 'local partners' for short).

2.8 In the Soviet era technical and economic studies were undertaken by a number of specialised research or design institutes. The institutes in the transport sector had only a limited experience in traffic forecasting, because anything more than mere traffic projections was handled by the central planners.

2.9 Many of the transport sector institutes have now lost strength after government subsidies have been cut drastically. The weakest institutes have disappeared. Others have lost good specialists. In the private sector, new consulting firms are developing, but are in their infancy and are unlikely to provide the stability required to develop any forecasting models transferred to them.

COMMITMENTS

2.10 The local official counterpart organisations will be expected to provide administrative support to the project, for example by assisting in the issue of visas of foreign experts and in making official data available to the Consultants.

2.11 The local technical partner organisations will provide staff, office space and services (as needed) and will provide a secure environment for the handover of equipment and technology.

3. PROJECT PLANNING

RELATION/CO-ORDINATION WITH OTHER PROJECTS

3.1 The project has many potential links with other projects, in addition to the obvious parallels with other TRACECA projects. The experience and contacts gained by the Field Manager in the EBRD Central Asia Outline Transport Strategy have been invaluable in the Inception Mission.

3.2 Significant interfaces exist with the following TRACECA projects:

- 'Intermodal Transport Systems' (BCEOM): as this consultant is also a partner in this study data exchange will be relatively easy;
- 'Implementation of Pavement Management System' (Kocks Consult): the potential for sharing data collection is being explored;
- 'Human Resources Training/Maritime' (HPTI): the potential for sharing traffic data and forecasts is being explored;
- 'Infrastructure Maintenance Railways Caucasus' (TEWET): the potential for sharing data and forecasts is being explored;
- 'Infrastructure Maintenance Railways Central Asia' (DE-Consult): which could provide data on railways networks;
- 'Trade Facilitation, Customs Procedures and Freight Forwarding' (Scott Wilson Kirkpatrick): this project may need data on major border crossing flows;
- 'Port Network Plan and Improvement Programme' (Ramboll): which could eventually provide port infrastructure and traffic data.

3.3 We have contacted these consultants to establish how information could best be shared. Further contacts will take place in the field during the next phase of work.

3.4 Other projects which could be particularly relevant are:

- ADB road feasibility studies in Kazakhstan and Kyrgyzstan;
- EBRD road project in Turkmenistan;
- EBRD port project and study for Aktau (Kazakhstan) and Turkmenbashi (Turkmenistan);
- JICA study in western Kazakhstan;
- Road-side services study in Uzbekistan;
- Tacis projects in Azerbaijan: Railways Management and Organisational Structure; Pre-feasibility study of the Baku-Astara Road; Development of the Caspian Shipping Company;
- World Bank road project in Armenia;
- Tacis Caspian Sea Level study.

3.5 In addition the Consultants will consult with the main international organisations working on the question of the Europe-Asia transport network:

- UN/ESCAP, based in Bangkok, which has launched the ALTID project (Asian Land Transport Infrastructure Development);
- UN/ECE and UNCTAD, both based in Geneva, which together support the Central Asial External Trade, Transit and Transport Initiative.

PROJECT GOALS

3.6 The project goals are:

- to develop a database on transport flows for the region;

- to develop a forecasting model which is robust, transparent and easily used;

- to transfer the technology and know-how in a way that ensures sustainability.

PROJECT APPROACH

Local Partners

3.7 The objective of the project is to develop a tool for traffic forecasting adapted to the needs of the TRACECA region and to transfer the know-how to specialists in each country so that they can make use of it in the future. It is therefore essential that these specialists are part of permanent units which could keep and develop the know-how and technology transferred during the project.

3.8 The forecasting model will be based on a database containing primarily information coming from state agencies. Data collection will in most countries require government co-operation. The database should normally be accessible to a wider audience than just the group of specialists using the forecasting model.

3.9 These considerations lead to envisage a two-tier approach to work in the states:

- **a local technical partner organisation** which has the skills for participating in model implementation, using the model and keeping it for future use;

- **an official counterpart organisation** heading a working group consisting of representatives of various sub-sectors and government agencies which will arrange data collection, monitor the development of the model and the database, and ensure proper use of the know-how.

3.10 In practice, if the technical partner organisation happens to be a state agency, the role of the working group may be rather limited. On the other hand, it may be that the working group could cover a number of TRACECA projects.

3.11 The proposed organisation for this project is as follows:

- regional office: Almaty, with the Research Institute for Road Transport (AO NIIAT), which will also ensure the technical work for Kazakhstan;
- Armenia: the Ministry of Transport and Communication wishes that most of the work takes place within the ministry itself;
- Azerbaidjan: as no institute or consulting group is in a position to work as technical partner, the Department of Transport and Communications in the Ministry of Economy proposed to organise the project work within the ministry;
- Georgia: the recently created Co-ordinating Council for Transport took responsibility for the project and is expected to designate a technical partner;
- Kyrghyzstan: the technical partner proposed is the project institute 'Kyrghyzdortransproyekt' (to be confirmed by the Ministry of Transport);
- Tadjikistan: a working group is to be set up at the Ministry of Economy and External Economic Relations: the technical partners will be the state design and research institute 'Tadjikgiprotransstroy';
- Turkmenistan: the main responsibility for the project will be with the Division of Transport and Communication of the Cabinet of Ministers. The technical partner will be the Turkmen State Institute of Transport and Communication;
- Uzbekistan: the proposed partner is 'Gosprognosstat' the state organisation in charge of forecasting and statistics.

Database and Model development

3.12 The approach described in the technical proposal has been confirmed. Our plan is to develop the model and database in the home office and field office. The database and model will then be implemented in the eight Republics, with the provision of the necessary computer hardware. Appendices A and B contains further details of our technical approach.

Data Collection

3.13 The main concern during the Inception Mission was to establish the best means of data collection and identifying the most effective organisations to carry this out. The overall approach for data collection is to make maximum use of data available in local organisations supplemented by information collected for other related projects. Surveys are likely to required to fill data gaps, to validate existing sources and to update existing data.

3.14 The preliminary list of data requirements is given in Appendix C. During the Inception Mission the following observations were made:

- as might be expected, the railways collect most of the information needed for the model but extensive processing will be needed to put these data into a useful format;
- for road infrastructure, the information is rather patchy in most countries. Even where data are available, such as in Kazakhstan, it will be necessary to check the accuracy with some samples;
- many statistics on road freight still follow the Soviet format and it is not yet clear to what extent they can be used in the new - more market-based - environment. Also in Soviet times data was obtained from administrative sources which may no longer be comprehensive;
- concerning transport flows between countries, the best source of data is likely to be from customs returns. However detailed data may not be available in all countries: even where they are a labourious processing will be needed. In the case of Georgia the Tacis-sponsored Business Communication Centre keeps a valuable database of imports and exports derived from customs statistics, specifying which transport mode is used to the border and beyond. We are examining whether the experience gained in Georgia could be used in other countries.

3.15 In accordance with the project programme initial work on data collection has already commenced. In the light of our initial appraisal during the inception\mobilisation of the project our approach to data collection comprises the following actions:

- collation of existing standard data sets on trade outputs and transport demands from previous studies and existing documents including the Central Asia Outline Transport Strategy work;

- collation of data from international agencies including UN\ESCAP and UNCTAD: a visit to UN\ESCAP has already taken place;

- collation of existing data sets held by the official counterpart organisations. Our experience suggests that a questionnaire with non-specific questions based on limited knowledge of existing data sets will not be the most efficient measures of gathering this data. Hence, we have taken considerable care to design a questionnaire that is specific in its requests for data sets likely to be available. The design of this focused questionnaire is already being piloted in Kazakhsan;

- identification and, where the timescale permits, collation of data sets being collected as part of other TRACECA projects;

- collection of new data to update, validate and infill gaps. Arrangement for these surveys will be made immediately following the collation of existing data into a preliminary data document (prior to entry in the database) - work on this collation is currently underway.

3.16 We are clear that achievement of all these tasks will require work to be undertaken is parallel including our project manager, field manager, database and model development analyst together with a transport economist to assist specifically in the data collection stage.

INTENDED RESULTS OR OUTPUTS

3.17 The main output of the project will be to set up a database and forecasting model that will be suitable for long-term transport planning studies, notably for investments in infrastructure.

3.18 The software for the model and database will be distributed to the eight TRACECA states, together with the necessary computer hardware. Training in the use of these tools will be provided as well as carrying out specific national case studies.

3.19 Know-how in transport database design and modelling will be transferred at the regional office in Almaty.

PLANNING FOR THE DURATION OF THE PROJECT

3.20 The programme and content of the study as described in the Technical Proposal. Figure 3.1 summarises the planning for the whole project. Although the production of this Inception Report has been slightly delayed the overall programme remains unchanged.

Greater Input of Local Consultants

3.21 Our review of resources available has indicated that greater local expert input will be necessary. Therefore, in parallel with this Inception Report we are proposing changes to the financial arrangements for this project. These changes have the objective of giving us greater local expert resources to carry out the required work within the overall budget limit, by reducing the allocation of two reimbursable items 'Local Offices Rental' and 'Computer Equipment and Software'.

3.22 Project planning tables in the required format are given in Appendix D. These tables do not reflect the amendments we have proposed to the financial arrangements under this contract (as they have not yet been approved). The result of the proposed changes would be to increase the Senior Local Expert input from 700 to 900 days and the Junior Local Expert input from 1000 to 1700 days. Revised tables will be included in the next progress report to reflect any changes approved.

CONSTRAINTS, RISKS AND ASSUMPTIONS

3.23 It is clear that the database, model and forecasts will need to be tailored carefully to make best use of available data and to ensure that the data collection achievable within the confines of the study budget is optimised. We are proposing an increase in the local staff input to assist us in addressing this risk as referred to in para 3.21.

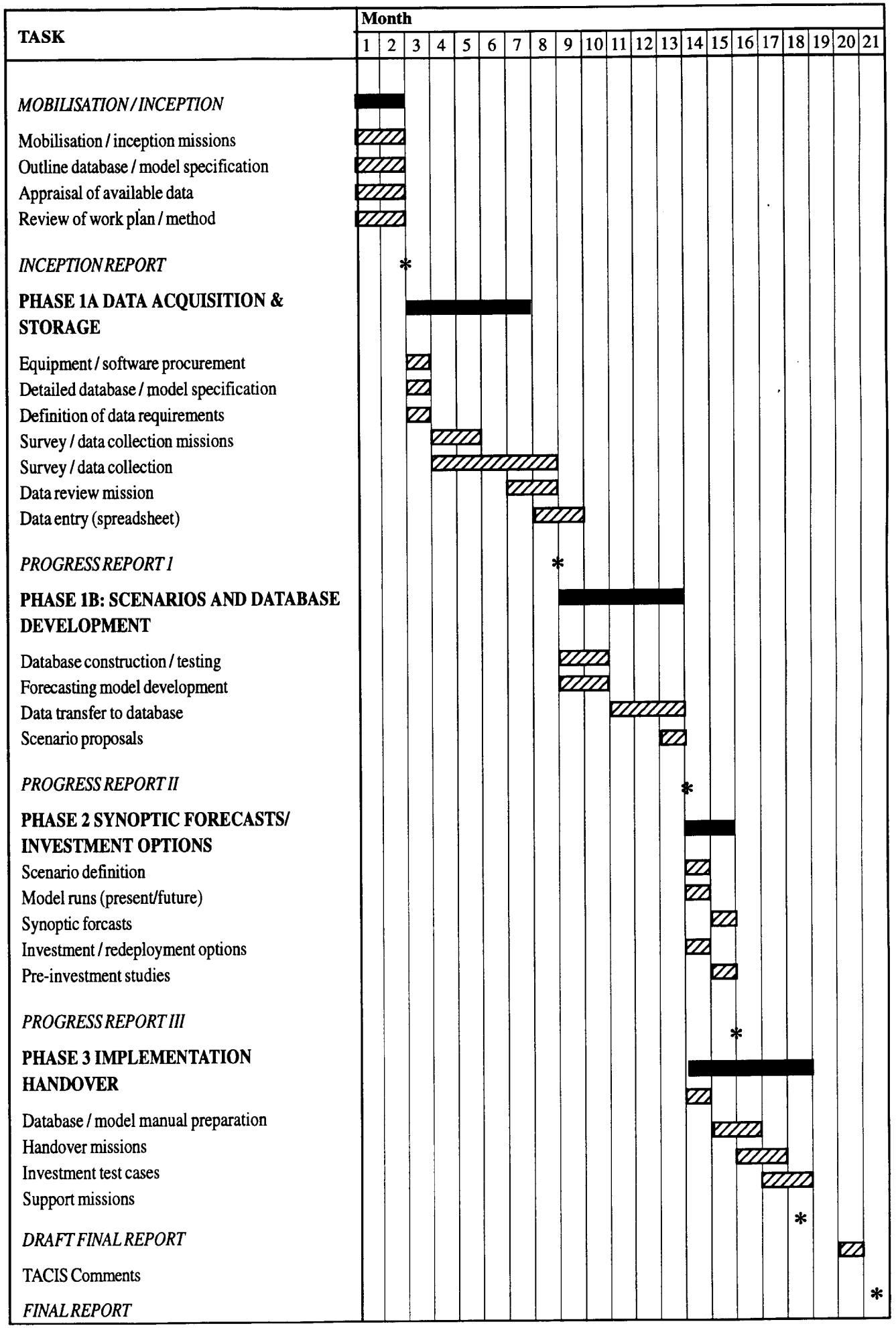

FIGURE 3.1: Study Content and Programme

3.24 Ultimately, the value of the project will be judged in terms of the extent to which all countries utilise the database and model and share data in making joint trade and infrastructure investment decisions. We recognise the importance, therefore, of avoiding this 'regional planning' project as being seen as rather abstract compared to many other projects in the TRACECA programme. An associated issue here is the extent to which a single forecasting model can work effectively over such a large area, given the significant regional distortions in economic behaviour.

3.25 A key factor in overcoming these issues is the careful research and targeting of existing data sets through our experience and the local knowledge and co-operation of the local technical partner organisations.

3.26 The main assumption is that the authorities in the countries concerned will be interested in co-operating effectively in the study. The project is rather abstract and has little immediate benefit, compared to many other projects in the TRACECA programme.

PLANNING FOR THE NEXT REPORTING PERIOD

3.27 The next phase of work is Phase 1A: Data Acquisition and Storage which includes the following main tasks:

- procuring equipment and computer software for the Regional Office;
- developing a more detailed database and forecasting model specification;
- defining the data requirements;
- setting up data collection and surveys;
- reviewing the data collected and entering them on the computer in a preliminary spreadsheet form.

3.28 These tasks will involve a number of visits to the TRACECA States.

3.29 At the end of this work Progress Report I will be issued.

COMPARISON WITH TOR

3.30 The Terms of Reference - as interpreted in our Technical Proposal - appear to be satisfactory and there seems to be no requirement for an amendment.

APPENDIX A - DATABASE

APPENDIX A - DATABASE

A.1 The common regional database will be set up to accept data collected for the development of the forecasting model. It will not have the scale of coverage or detail demanded by the Central European Transport Information Reporting System (CETIR) database, but will use a structure and format such that datasets are compatible.

A.2 It is anticipated that the database will facilitate easy and coherent access to data to the queries typical of transport practitioners. It should therefore, for example:

- show observed flows for a given commodity on a link;
- show production for all commodities for a zone in a given year;
- list all links operating a given mode with a capacity above a stated threshold.

A.3 We propose to use two of the database sections described in the CETIR database as the basis for the TRACECA database:

- zones/points;
- networks.

A.4 Figure A.1 shows the proposed database and relationships between files. Data files are shown as boxes with relationships indicated as solid lines. Because the database is relational, revision of the way data is referenced can be achieved.

A.5 Inclusion of data fields does not necessarily guarantee the availability or collection of that data.

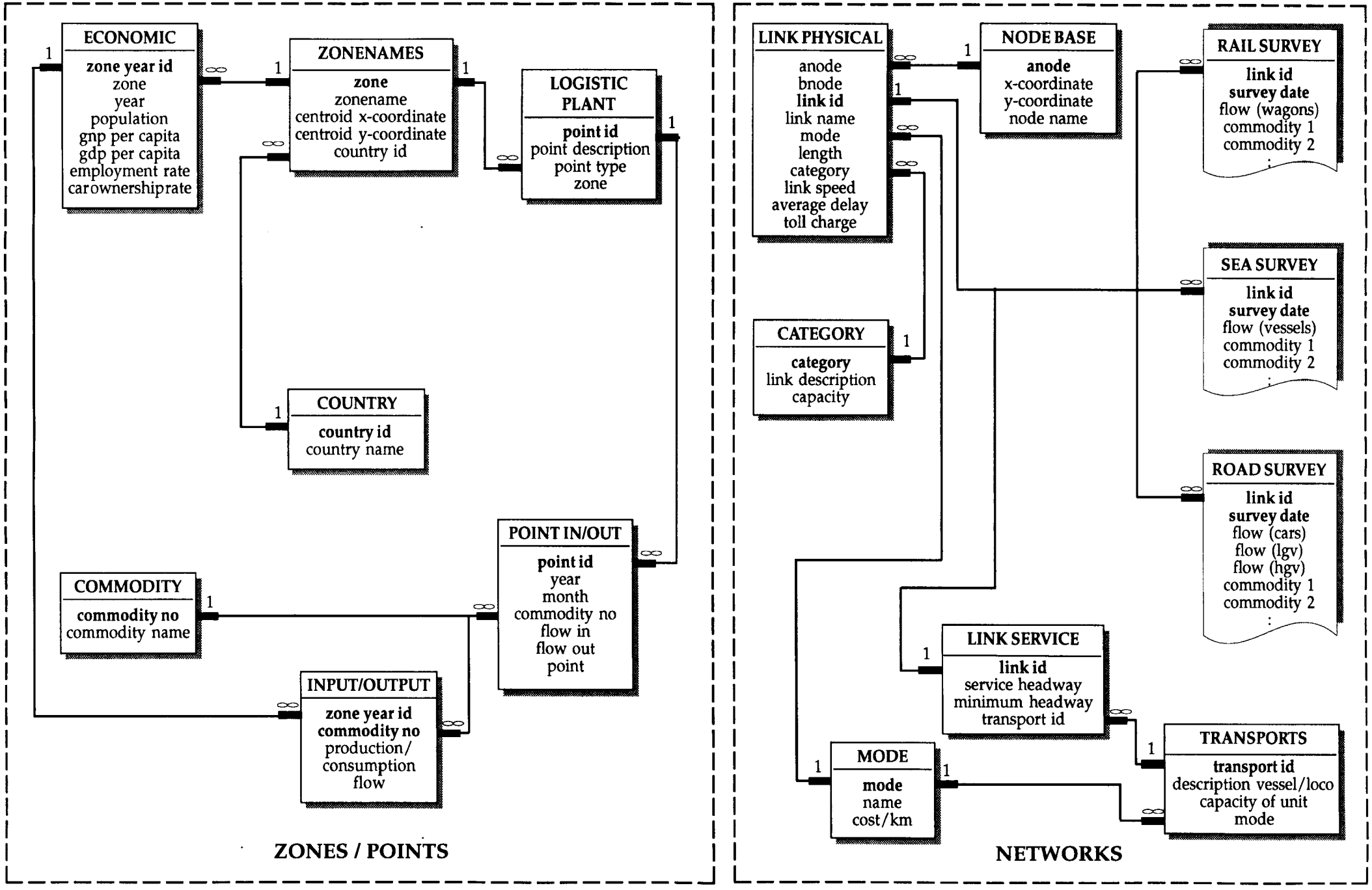

Figure A1: **Outline Database Structure**

Zones/Points

A.6 The *Zonenames* data file will represent the core of this structure. This file will contain non-changing information regarding the definition of the zone. The *Economic* data file will contain the bulk of the freight movement generation data, but will need to be linked to a year to ensure that data is specific to both time and place. Generation and attraction data from these zones in a year will be held in data file *Input/output.* Where data for a specific point within a zone is obtained (such as the output from a steel mill), this information will be stored in *logistic plant* yet referenced back to the zone within which it exists. Clearly data on every point (or for every data field) will not be collected; the database is designed to provide storage for information at the most dis-aggregate level of collection even though its use in this project may not be at this level.

Network

A.7 The *Link physical* data file formulates the focus of this section. It will be necessary for every link to be provided an identifying number (link id) based on the two nodes at each end. Data referring to the link's physical characteristics, such as mode, length, speed, cost and incurred delays will be included. Based on a category code defining the grade of link for that mode type, a type description and capacity (e.g. high grade dual carriageway highway: 200,000 tonnes/day) may be extracted for the link. Information on the modes will be held in the *Mode* data file.

A.8 Information on the carrying capacity of different types of road, rail and sea service will be stored as collected.

A.9 Survey information gathered will vary significantly by mode. Therefore we propose to utilise separate data files for each referenced to the link identification number. Where a survey is or has been conducted, data for all commodity types is expected (even if some results are zero) and therefore all commodities are represented as fields. The record will be unique by use of the survey date in conjunction with link identification number, permitting storage of more than one survey on a link at different times.

APPENDIX B - FORECASTING MODEL

APPENDIX B - FORECASTING MODEL

B.1 The forecasting model will be developed to assist strategic planning of the freight network of the study area, and assess the impact of various forecast scenarios in the region. Figures B.1 and B.2 (at the end of this Appendix) show the proposed zones and networks. Figures B.3 and B.4 are flow charts of the modelling processes.

B.2 The model will be based on the existing SATURN modelling suite developed by WS Atkins and Leeds University Institute for Transport Studies. SATURN has been used by over 300 organisations throughout the world.

B.3 The following text describes:

- development of base year matrices;
- development of modal choice and assignment model;
- the forecasting process.

Base Year Matrices

B.4 Freight flows will be allocated into approximately twenty commodity categories. A matrix of annual freight tonnage flows between zones for each commodity will be produced.

B.5 Economic, demographic and industrial data will be extracted along with annual production and consumption values for each zone. Subject to the availability of data we can establish a relationship between the zonal data and production and consumption of each commodity.

B.6 We may conduct surveys to confirm traffic levels. For road traffic this will typically require vehicle counts but may include customs related data at border crossings. Rail-related and sea-related data is expected to be available via railway and port operators. These data will be combined to produce an initial base year annual observed matrix of strategic freight flows.

B.7 We propose to split our observed matrix for each commodity, into two separate matrices; one with a commercially derived distribution and one with a non-commercial distribution (dictated by trade agreements etc.). We will use the commercial matrix and commercial production and consumption at zones to calibrate a model (based on trip-length distribution) to determine tonnage flow between zones as a function of shipment cost (in time and money) between the zones.

B.8 In order to determine which, if any, observed trips are non-commercially derived, all observed trips may be used in the derivation of this trip-length distribution function. Trips that are then not consistent with the relationship developed for all trips as a whole may be investigated further as likely to have some non-economic influence. This type of approach is extremely pragmatic, and given time and information limitations may accelerate the process of determining a set of suitable base year commodity matrices.

B.9 The production/consumption models will be operated based on input data. Production and consumption being distributed on a 'non-commercial' basis will be deducted. This will provide a 'commercial' consumption and production for each commodity for each zone. We will then apply our trip distribution functions to these to build a matrix of trips between all zones for each commodity. These matrices will be for 'commercial' freight movements. As they will have been developed from formulae, this type of matrix is known a as synthetic matrix. For each commodity the synthetic matrix will be compared to the observed matrix. Because the observed matrix is not necessarily complete and behaviour between zones is not explicable totally by mathematical functions, the two matrices will not be identical. A closeness of fit for the two matrices will however demonstrate the adequacy of the trip-length distribution model (and network cost weightings) to explain trip distribution. Where differences are not acceptable changes will be made to the model functions, model parameters and network until the suitability the synthetic matrix can be verified.

B.10 The 'non-commercial' matrix will then be added back onto the synthetic 'commercial' matrix. The resultant matrix will be the total synthetic base year annual flow matrix for one commodity.

Development of Modal Choice and Assignment Model

B.11 The network will be built entirely from the SATURN software suite. All modes will have networks with individual links with fixed speeds, capacities and where appropriate, delays to freight. Networks of different modes will be connected at interchange points which will allow the transfer of freight between modes. There will be a penalty based on the delay and cost of interchange, which will be dependant on commodity. Each commodity will also have its own time and distance parameters to replicate the relative importance of these elements in route and mode choice.

B.12 Other non-economic characteristics that may influence route choice will be attributed to each link as necessary. These characteristics will be quantified into generalised costs by a commodity-specific parameter and added to the overall costs for that link. Consequently options exist to influence route choice for specific commodities based on security, irregularity of journey time, seasonal closures etc.

B.13 'Access Links' will be used to get freight onto the networks, and will be coded to hold charging data for freight using specific modes. Thus modal constant costs, such as the initial charge involved to access rail will be covered within the Access Links. These costs will diminish relative to total cost over distance and thus allow the model to influence modal choice based on distance travelled. Again, these links will be subject to commodity specific charges. Links unsuitable for certain commodities can be closed specifically to them.

B.14 As the networks for all modes will be connected through interchanges, *modal choice will occur simultaneously with, and as an integral part of the assignment.* The model will use 24 hour capacities and flows; annual flow matrices will be factored to 24 hour matrices prior to assignment. Extraction of tonnage using specific links (and thus that mode) will be taken from analysis of that link. We are proposing to use a *stochastic user equilibrium assignment* which will introduce a marginal variation in route costs during assignment. Thus a route that is only slightly more costly than a competitive route will attract some trips. This overcomes the potentially unrealistic results that may arise from a straight *all-or-nothing assignment* when using a relatively coarse zoning system.

B.15 Link capacities will be derived as total capacity over 24 hours, but the existence of local freight traffic making journeys within the area covered by large zones but

nevertheless on the modelled network as well as non-freight traffic will reduce the capacity available. This 'background traffic' will be estimated from counts. Links will then be classified as to the likely volume of background traffic they carry based on a local assessment. Background traffic will be loaded first within the SATURN network.

B.16 For railway and sea traffic, capacity is ultimately controlled by the minimum headway between services or rolling stock/vessel availability. Increased flows may well permit more services to be run and result in a reduction in headway delay to freight up to the point that the maximum service can be provided. An estimation as to the level of background traffic on rail and sea services, and its influence, may be possible from the data collected by the service provider.

B.17 The 24 hour commodity matrices will be assigned to the network. Flows on links will be 24 hour tonnages. These flows will be converted to other data-types, such as vehicle flows, using factors obtained from surveys. We will use observed link flows to validate the base year model.

Forecasting

B.18 A macro-economic forecast will be developed to set up the scenarios for testing. Zonal economic, demographic and industrial data will be obtained based on these scenarios. We will use the relationships established in the base year to produce forecast productions and consumptions for each zone and commodity. The 'non-commercial' matrix for each commodity will be forecast based on an assessment of the overall scenario and these productions and consumptions removed from those derived, in a similar manner to that adopted in the base year.

B.19 The inter-zonal tonnage flow models (trip length distribution models) developed in the base year will allocate production to consumption for the remaining 'commercial' freight. This process will refer to generalised costs of trip making taken from the forecast network. Changes will include specific network alterations and adjustments to network-based economic parameters (e.g. value of transit time/cost of delay). Both the 'commercial' and 'non-commercial' matrix types will be combined to produce a forecast matrix for each commodity.

B.20 Matrices will again be factored to 24 hour flows and assigned, and converted to numbers of vehicles, wagons and vessels for analysis.

B.21 In forecasting, background traffic may be 'growthed' based on global estimations. Where network changes occur likely to affect background traffic, links will be re-categorised. Bottlenecks will be identified by inspection. Where evidence is generated within either the base year or forecast year that severe congestion is occurring producing unreasonable additional cost, a review of the input matrix will be carried out. If appropriate, matrices will be manually adjusted to reflect destination and/or routeing changes as a result of network congestion. This may include freight that is transported by systems external to the model as a result of internal congestion (such as transfers to ocean transport or air). Where matrices are considered realistic under congested conditions, distribution and re-assignment will be computed by the model.

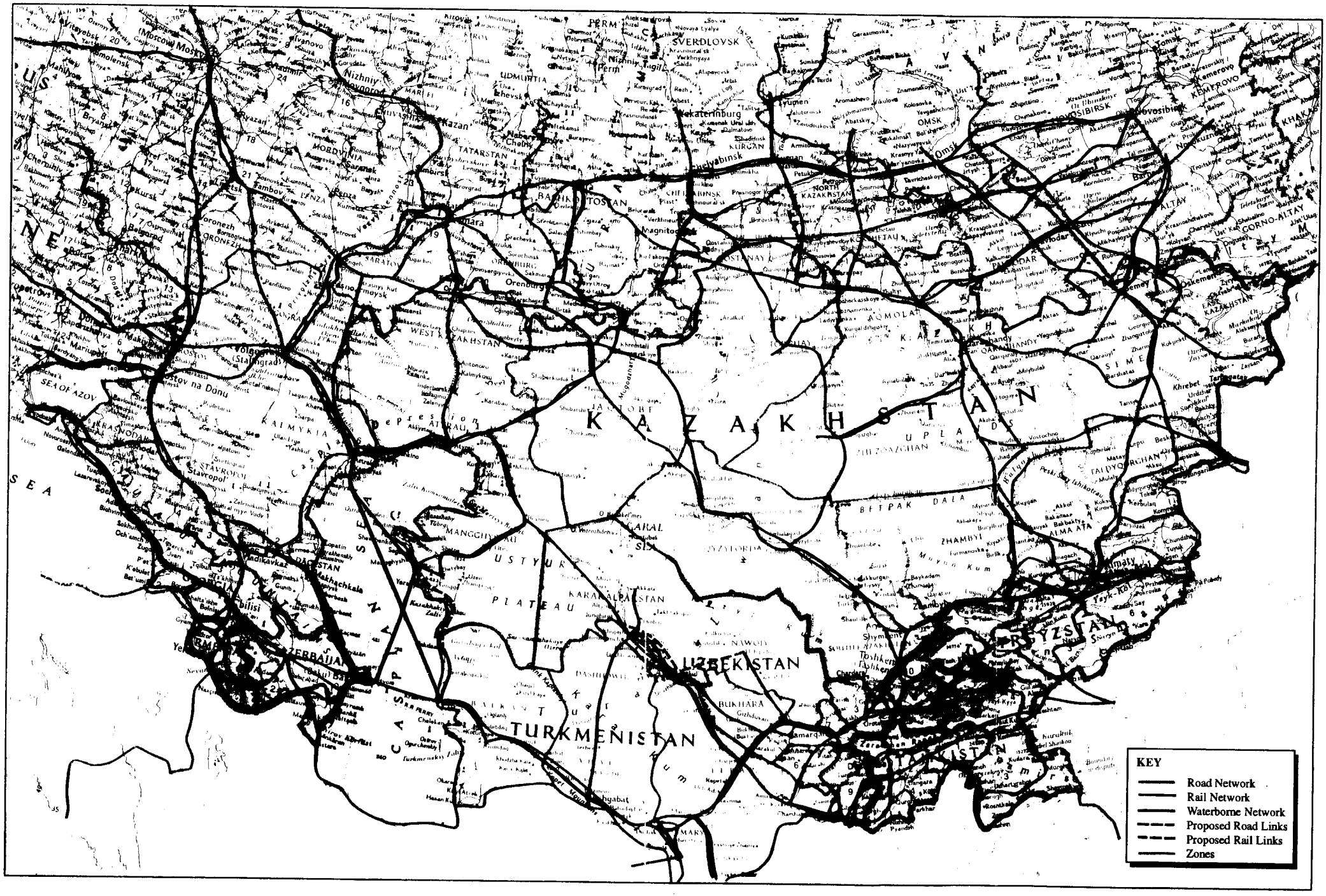

Figure B.1: **Proposed Road, Rail and Water Links and Zones**

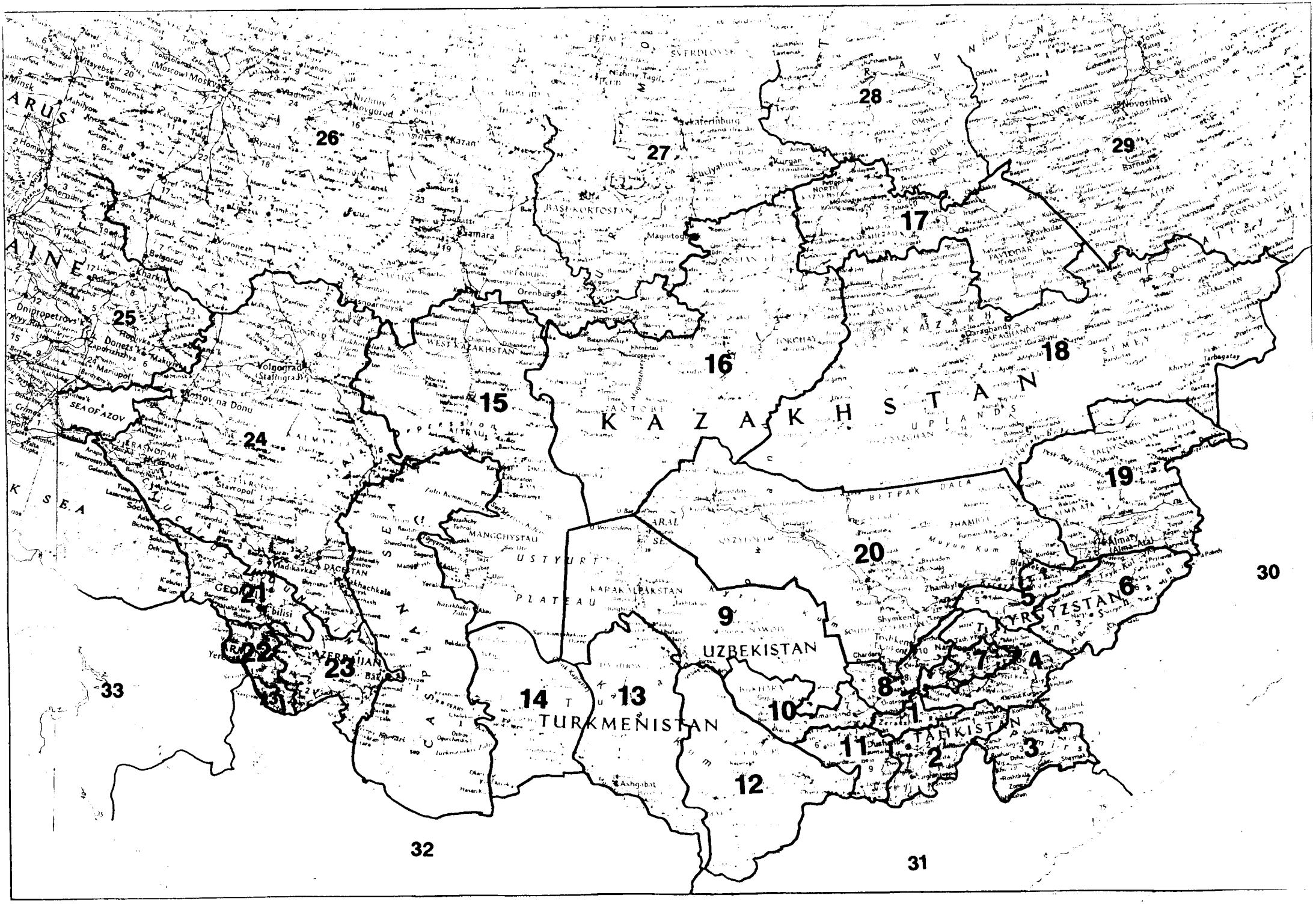

Figure B.2: **Proposed Zones**

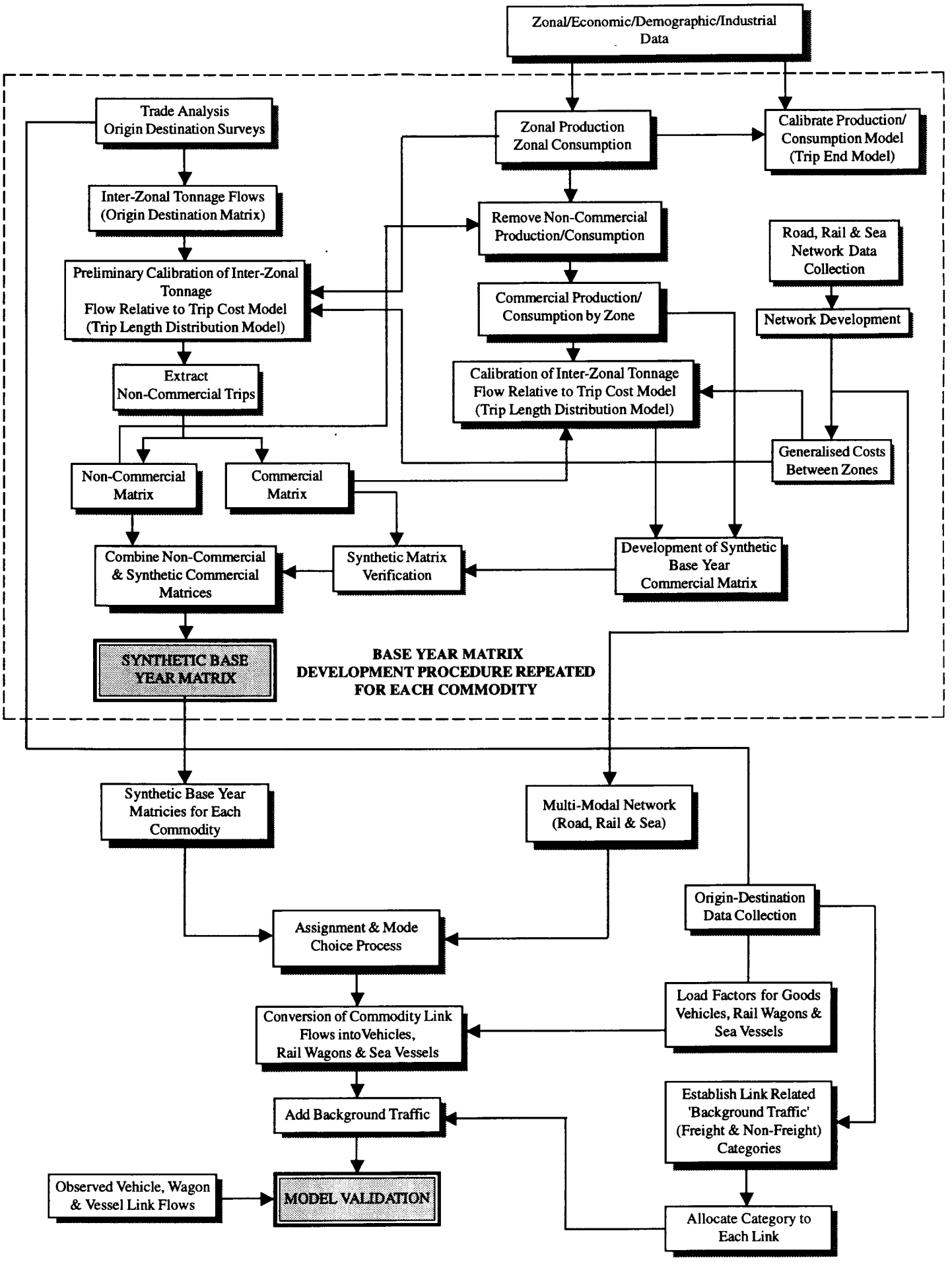

Figure B.3: **BASE YEAR MODEL VALIDATION FLOW CHART**

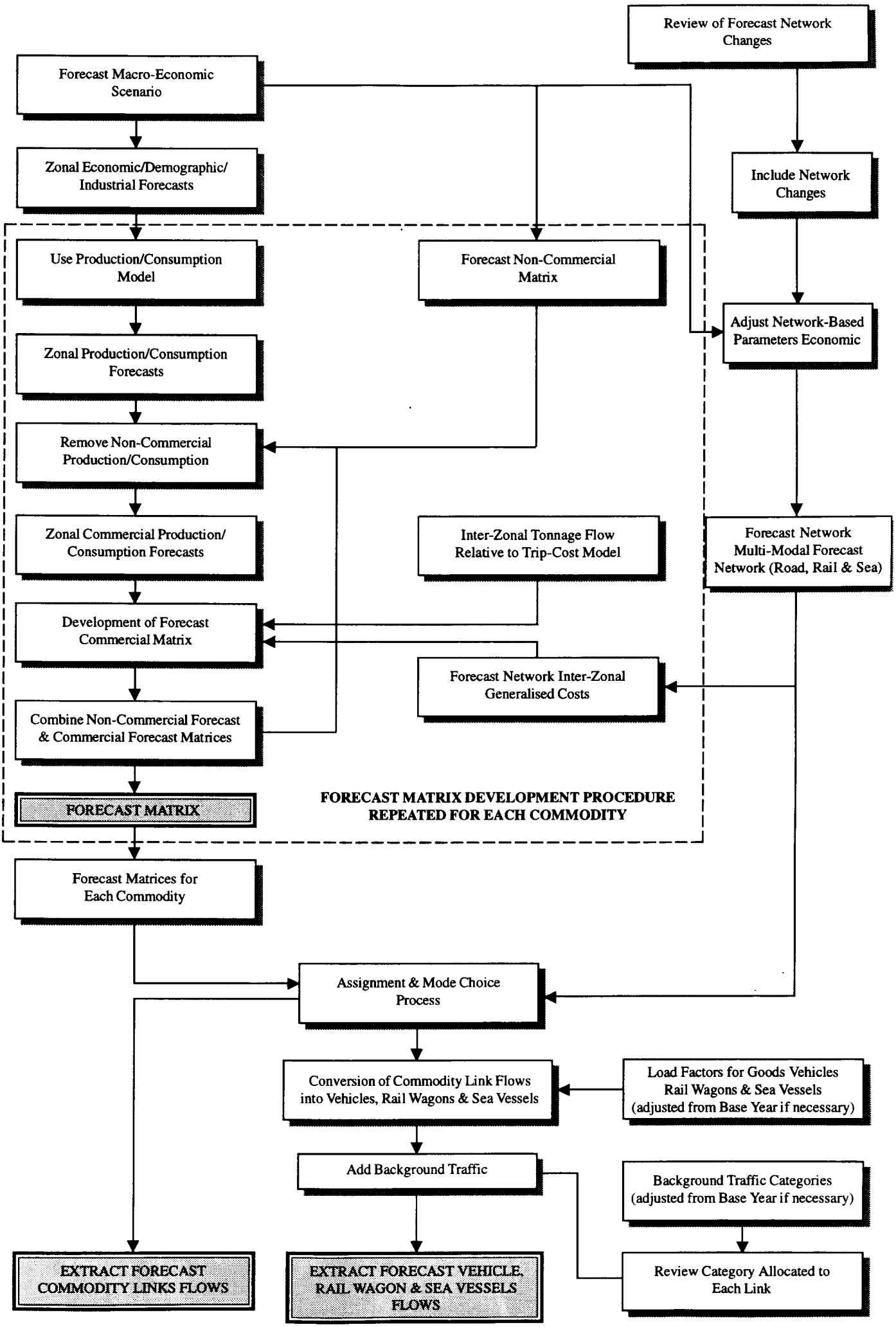

Figure B.4: **MODEL FORECASTING FLOW CHART**

APPENDIX C - PROPOSED DATA COLLECTION

APPENDIX C - OUTLINE DATA REQUIREMENTS

Socio-Economic Data

C.1 For each country, sub divided by administrative unit:

- Population;
- Gross Domestic Product/Gross National Product;
- Gross National Product per capita;
- % Population living urban area.

Trade Data

C.2 For each administrative unit (eg. Oblast) and for each commodity type (eg. cotton, steel, wheat, textiles):

- Annual export (tonnes and value);
- Annual import (tonnes and value);
- Breakdown by destination of exports;
- Breakdown by origin of imports;
- Annual in-flow from other administrative units within the same country;
- Annual out-flow to other administrative units within the same country.

C.3 Seasonal variation in trade flows for each commodity type.

Production/Consumption Data

C.4 For each administrative unit and for each commodity type:

- Annual production (tonnes);
- Annual consumption (tonnes);

C.5 Data on seasonal variation of production and consumption of commodity types.

Road Origin-Destination Data

C.6 For each administrative unit and for each commodity type:

- Origin-Destination freight flows between administrative units.

Rail Origin-Destination Data

C.7 For each commodity type:

- Origin-Destination freight flow between administrative units.

Logistic Point Data

C.8 For major producers/processors (factories, agricultural distribution points, processing plants):

- Total annual production of specified commodity in tonnes;
- Specify destination, transport mode and quantity of production of commodity to administrative units within study area;
- Specify destination, transport mode and quantity of production of commodity to countries outside study area;
- Total annual consumption of specified commodity (tonnes);
- Specify origin, transport mode and quantity of incoming commodity from administrative units within study area;
- Specify origin, transport mode and quantity of incoming commodity from countries outside study area.

C.9 Data on seasonal variation of production and consumption at logistic point.

Road Link Traffic Flow

C.10 Traffic Flow (ADTs) on road links by vehicle type. Specify survey date, data source, survey duration and vehicle categories (eg. >5 tonnes, 2-5 tonnes, private vehicle, but etc.)

Rail Link Flow

C.11 For each link:

- number of train in each direction (freight, passenger);
- freight flow tonnage by commodity.

Waterborne Link Flow

C.12 Flow on water links by vessel type and frequency.

C.13 Freight flow on water links by commodity type. Specify survey date, data source, survey duration, survey methodology and classification units (eg. Tonnes);

Port Handling Data

C.14 For each freight commodity type:

- Total freight volume handled by ports over specified period;
- Origin and destination and volume passing through port (tonne, TEU).

Modal Transhipment (eg. Rail to Road)

C.15 For each freight commodity type:

- Total freight volume handled at interchange (tonnes, TEU);
- Original and Destination, volume and direction of modal change;
- Data on real costs and time associated with interchange.

Border Crossings

C.16 For each freight commodity type:

- Total freight volume and value;
- Origin and Destination, volume, incoming and outgoing modes;

C.17 Vehicle Flow Classification. Specify data period, data source, and vehicle categories (eg. >5 tonnes, 2-5 tonnes, private vehicle, but etc.)

C.18 Locomotive/Wagon Flows

Road Vehicle Specifications

C.19 Data on vehicle types, carrying capacity, laden weight, typical loading, number in operation etc.

Road Operations

- Recorded time taken to travel between major nodes/cities;
- Third Party (public carrier) distribution tariff between major nodes;

Rail Operations

- Specify maximum hauling ability (tonnage) for locomotives in use;
- Minimum operating headway on rail links;
- Current frequency of service;
- Recorded time taken to travel between major nodes/cities;
- Unit cost between major nodes.

Port Operations

- Specify Port maximum goods handling and storage capacity;
- Specify Port maximum vessel capacity and maximum draught;

Waterborne Operations

- Specify vessels in operation; their capacity, frequency, reliability, maximum speed, draught;
- Voyage times between ports;
- Unit costs between ports.

Road Link Physical Characteristics

- Road link lengths and link type (single carriageway etc);
- Road link condition;
- Toll charges on link.

Rail Link Physical Characteristics

- Rail link lengths and link type (single carriageway etc.);
- Road link conditions;
- Toll charges on link.

Water Link Physical Characteristics

- Water link length and maximum vessel accommodated/draught;
- maximum speed on link;
- Data on frequency on non-navigability of link (through weather)

Commodity Values

- For each commodity type:

  - Value open tonne in major cities (Almaty, Akmola) Black Sea Port, CIS border point, other borders (Uzbekistan, Tajikistan).

APPENDIX D - PLANNING TABLES

TABLE 1 OVERALL PLAN OF OPERATIONS

Project title: Regional Traffic Database and Forecasting Model					Proj no:WW.93.05/05.01/B008					Country: TRACECA States				
Planning period: January 1996 - September 1997					Prepared: April 1996					EU Lead Consultant: WS Atkins International Ltd.				
Project objectives: development and implementation of a traffic database and forecasting model														
NO.	MAIN ACTIVITIES	TIME FRAME									INPUTS			
		1996				1997					PERSONNEL		FLIGHTS		PERDIEM
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		EU Experts (weeks)	Local Experts (weeks)	Long haul (flights)	Local (flights)	(days)
1	Mobilisation/Inception	XXXX									25	0	3	5	50
2	Data Acquisition & Storage	X	XXXX	XX							45	120	6	15	140
3	Scenarios & Database Development			XX	XXXX	X					20	80	4	20	120
4	Synoptic Forecasts/ Investment Options					XXX					15	70	4	20	120
5	Implementation/ Handover					XXX	XXXX				15	50	4	20	120
6	Final Report							XX			6	30	3	10	50
									TOTAL		126	350	24	90	600

TABLE 2 OVERALL OUTPUT PERFORMANCE PLAN

Project title: Regional Traffic Database and Forecasting	Proj no:WW.93.05/05.01/B008	Country: TRACECA States
Planning period: January - March 1996	Prepared: April 1996	EU Lead Consultant: WS Atkins International Ltd.
Output/target dates	Agreed Objective Verifiable Indicators	Constraints and Assumptions
Inception mission and Report (month 3) Data acquisition and storage: Progress Report I (month 8) Development of database/model: Progress Report II (month 13) Synoptic reports, development of investment options: Progress Report III (month 15) Handover of software and support missions: Draft Final Report (month 18) Final Report (month 21)	For all reports: - agreement and support of local partners - completion of tasks For database/model: - ease of use by local partners - quality of output - sustainability	Main constraints: - availability of suitable data - availability of suitable local experts - level of co-operation of local authorities Main assumptions: - sufficient degree of local co-operation - traffic forecasting is feasible in the region

TABLE 3 PLAN OF OPERATIONS FOR THE NEXT PERIOD

Project title: Regional Traffic Database and Forecasting Model				Proj no:WW.93.05/05.01/B008				Country: TRACECA States				
Planning period:April-September 1996				Prepared: April 1996				EU Lead Consultant: WS Atkins International Ltd.				
Project objectives: development and implementation of a traffic database and forecasting model												
NO.	MAIN ACTIVITIES	TIME FRAME						INPUTS				
		1996						PERSONNEL		FLIGHTS		PERDIEM
		APR	MAY	JUNE	JULY	AUG	SEPT	EU Experts (weeks)	Local Experts (weeks)	Long haul (flights)	Local (flights)	(days)
2	DATA ACQUISITION & STORAGE											
2.1	Equipment/s'ware procurement	XX						2				10
2.2	Detailed d'base//model spec.	XXXX						10		1		20
2.3	Definition of data requirements	XX						6				15
2.4	Surveys/data collection		XXXX	XXXX	XXXX	XXXX		12	80	3	10	50
2.5	Data review		XXXX	XXXX				8	10	1		20
2.6	Data entry			XXXX	XXXX	XXXX		5	20			15
2.7	Progress Report						XX	2	10	1	5	10
							Total	45	120	6	15	140