RESTRUCTURING OF THE AZERBAIJAN RAILWAYS

MIS PLAN

(DRAFT)

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REPORT TITLE

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1   MANAGEMENT INFORMATION SYSTEMS (MIS)

1.1   Introduction

The general situation in relation to computerisation appears to be one of waiting for the availability of funds and the implementation of the TACIS trans-Caucasus fibre-optic communications link. Examples of the hurdles which have to be crossed in the implementation of integrated information technology systems include:

- the virtual absence of communications infrastructure,
- rival propositions for the development of communications infrastructure,
- an apparent tendency to use computers to replicate historical systems,
- the absence of experience in the development and running of integrated computer systems,
- the absence of a co-ordinated approach to coding structure development - for example staff serial numbers are unique to each function / enterprise within the Azerbaijan Railways,
- the duplication of data streams - for example freight tonnage is reported by a number of separate systems,
- the current concentration of data collection in the Baku Central Computer Centre.

This restructuring, which will reflect an enhanced business focus, will result in a new organisational structure with associated management information needs.

1.2   Current MIS

1.2.1   Central Control under Soviet Union

Computerisation in the Azerbaijan region in Soviet times was limited to a few core operational systems based on 1970's computer hardware. The computers and computer systems inherited from Soviet times have been abandoned by Azerbaijan Railways. (ADDY).

1.2.2   MIS Developments in Azerbaijan Railways

Management information systems in the Azerbaijan Railways are almost entirely manual with some being based on hand written reports. Systems emulating the functionality of the abandoned Soviet designed systems have been implemented on PC's which are operated in the Baku Central Computing Centre as if it were a batch mainframe computer centre. Computerisation on the Azerbaijan Railways is at an intermediate stage between the elimination of the computer hardware installed in Soviet times and the implementation of contemporary technologies.

An exception to this general situation is a computerised reservations / ticketing system in Baku passenger station which supports ticket issuing and seat reservations on long-distance trains departing from Baku. The system is based on 26 ticket booth configurations of PC and printer networked over a LAN to a file server in the administrative offices over the central station.

The extension of computing is inhibited by a shortage of finance and the lack of a suitable communications infrastructure. Currently, data communications are limited to 1,200 bps lines between the Baku Central Computing Centre and:

- Beyuk–Kiassik on the border with Georgia,
- Ialama on the border with Russia,
- the Ferry Port on the Caspian Sea,

- the Freight Unit in the ADDY headquarters in Baku,
- the M.P.S. Computer Centre in Moscow.

While the Baku / Moscow link is over a line leased from the Ministry of Communications, the other links are over ADDY private lines. However, data exchanges between this configuration and other sections of the Azerbaijan Railway (including the Baku Central Computing Centre) are based on paper documents. Personal computers (PC's) in the Baku Central Computing Centre were placed on a local area network (LAN), during October, 1998. It is planned that the implementation of this LAN will provide a basis for the automated exchange of data between personal computers in the Central Computing Centre including the wagon information system referred to above.

Other PC's are operated in stand-alone mode with data being exchanged either by diskette or by reports printed on paper which have to be re-entered into the receiving PC.

1.3 Core Systems

1.3.1 Accounting

1.3.1.1 Accounting in Azerbaijan

The issue of moving Azerbaijan accounting standards towards international standards is currently under review with a completion date in 1999 during the first year of the business plan.

However, current indications are that this review will not result in a total conversion to international standards.

1.3.1.2 Accounting in ADDY

Available information indicates that accounting in the ADDY is essentially a manual process. Accounting in the ADDY continues to be in accordance with the Soviet standards and ADDY take the view that whichever accounting standard is approved by the Government will be implemented by the railway.

1.3.1.3 Accounting & Corporate MIS

A corporate management information system needs both physical and financial measures of performance.

The critical point is to ensure that the data produced by those systems is in synchronisation and soundly based. For example, production costs that are based on standard costing rates that are not contemporary are worse than useless, such costs are misleading. Accordingly, it is essential that the systems that compose the corporate management information system are integrated.

Since the accounting systems are at the centre of the management information structure, it is essential that those systems are integrated. The need for integration increases with the level of diversity in an organisation.

The enterprise concept that is present in the ADDY is evidence of the diversity of the activities in a national railway. It is equally important to know that the costs in an engineering works are under control as it is to know that the transport income projections are being achieved. All these issues are elements of the mosaic that comprises the ADDY. That is why accounting systems in the railway need to be integrated with each other and with the physical measures of performance to enable the business plans to be managed effectively.

1.3.1.4 Characteristics of the Integrated Accounting System

An integrated accounting system will:

- be based on data being entered once,
- support integrated financial and management accounting,
- support comparisons with budget and a previous year,
- support the processing of non-financial data,
- support multiple currency accounting,
- support multiple users in client / server mode.
- have the capacity to receive data electronically from other computer systems,
- have the capacity to transmit data electronically to other computer systems,
- accept transaction input over a network,
- accept journal data by file transfer over a network,
- have a user friendly report writer,
- support the exchange of data with desktop tools such as spreadsheets and word processors,
- include a user access control process based on a hierarchy of needs.

It is expected that an integrated accounting system would, in addition to providing improved management information, yield savings in administrative costs through:

* the integration of data entry into the originating workplace,
* avoidance of duplication of data entry,
* the exchange of data with other systems over the computer network,
* abolition of manual analysis of data,
* abolition of manual preparation of reports,
* improved report production,
* improved access to data on file in the database.

1.3.1.5 Custom written Accounting Systems

The development of a custom accounting system either by in-house or contract systems and programming personnel would not be in accord with current thinking. Current thinking is that it is better to acquire a comprehensive parameter driven package system.

The development of custom written computerised accounting systems has a number of inherent hazards including:

- lack of computer system specification experience on the part of those preparing the user specification,

- limited scope, for example central ledger accounting not integrated with management accounting,

The adoption of international accounting standards would increase the possibility of identifying a suitable accounting package system.

The current transitional status of accounting standards requires that selected computerised accounting system should have the capacity to adapt to the evolving situation with minimum program changes. The installation of an integrated accounting system will demand that there is a corporate commitment to making the changes in processes and procedures necessary for its successful implementation.

1.3.2   Human Resources

Personnel records are maintained manually on paper held in each function / enterprise. Over 60% of ADDY employees are paid through manually calculated payrolls.

In year one of the business plan the implementation of a Human Resources policy within the context of an organisational and management restructuring will require that information on personnel numbers, grades, education, skills is readily available both locally and centrally.

It is essential that figures that are used as the basis of management decisions are consistent and accurate. This results in a need to maintain a close relationship between the Human Resources records of employee numbers and the numbers persons being paid through the Payrolls.

The maintenance of such a close relationship is more readily achieved if both the Human Resources records and the calculation of remuneration are computerised. The ideal solution is a combined payroll / human resources computer system which services the needs of both functions from a common database.

However, the Chief of the Baku Central Computing Centre has advised that the existing computer payroll system, that is used to calculate the salaries of 14,000 personnel, has the capacity to calculate the salaries of personnel in all parts of the ADDY, may be enhanced to exchange data automatically with other computer systems, may be operated securely on PC's in locations remote from the Baku Central Computing Centre, is supported by formal operating instructions in printed form.

1.3.3 Freight Management Systems

Four systems are involved in the freight management process each dealing with freight from a different perspective. These freight systems, that have been developed in place of the abandoned ASOUP system, appear to be in an ongoing process of review and modification with the aspiration of achieving a situation that is superior to that obtaining when the old ASOUP system was in operation.

The continuing close relationship between the railways of the independent States and Russia necessitates the maintenance of these facilities.

1.3.4 Passenger Reservations and Ticketing System

There is a computerised seat reservation and passenger ticketing system in Baku central passenger station.

The system is designed to:

* reserve seats up to five days in advance of the date of travel,
* release unpaid reservations three hours in advance of the time of departure,
* print tickets using numbered pre-printed ticket blanks,
* print sales clerk cash account at end of shift,
* print report on ticket sales per ticket sales clerk per day of issue,
* print report on passenger numbers per destination per day of travel,
* print report on passenger Km per destination per day of travel.

Data on ticket sales is passed on paper to the Baku Central Computing Centre for input into the Passenger Revenue Reporting system. Data on passenger Km is passed on paper to the Statistical Section.

The system is currently limited to main line passenger trains starting from Baku central passenger station. Ticketing computer system configuration consists of:

* 26 ticket booths with a computer and printer,
* a file server and
* a system monitoring computer that displays the level of server activity.

The file server and system monitoring computer are located on the 8th Floor of an office block over the passenger station. The report of ticket sales on a day in September, 1998 showed

that total sales were fewer than 1,100 with one ticket sales clerk accounting for 270 tickets and another having as few as 3. This imbalance raises issues such as:

* the need for such a large number of ticket sales booths,
* the management of work flow to the booths that are operational.

During a visit at about 16.00 hours the monitoring computer indicated a very low number of active ticket machines accompanied by frequent peaks of system demand. This pattern of activity points to the possibility of system performance problems in the event of an increased level of activity arising from:

* a greater number of concurrent users,
* an increased number of passengers,
* an increased number of trains.

The Chief Engineer Passenger has spoken of a desire to extend the computerised reservations system to all stations on the main-line from Baku to Beyuk-Kiassik on the border with Georgia – with an expectation that this project could proceed as soon as the Tacis fibre-optic cable is operational.

This proposition, which is based on an assumption that all these stations could be served by a file server located in Ganja, raises issues such as:

* the necessity for having computerised ticket issuing at every station,
* the communications media linking stations to the Fibre-Optic Cable ,
* the response time at ticket issuing computers that are remote from a file server,
* the implications of having two, or more, file servers for system design – for example which file server will be supreme,
* possibility of sharing computers between activities such as passenger ticket sales and freight cashier at smaller stations,
* seat reservation and ticket issuing arrangements for passenger journeys that start in Georgia.

1.3.5 Materials Management

Materials procurement is centralised in the Materials Manager. However, Permanent Way materials are procured directly by that department. The Materials Management function is based on a Central Warehouse complex at Balinjari supported by subordinate warehouses in Kazi-Magomed, Baku Freight Depot, Alyati, Ganja, Imishly and Nakhchevan.

The Alyati warehouse is dedicated to the storage of strategic State reserves. Warehouse managers are held to be personally responsible for the safe-keeping of the materials in their warehouse. Record keeping is entirely manual except in the Balajari warehouse complex where there is one computer. The consultant has not received any information on the software used in this computer.

Materials procurement is organised by the Materials Manager on the basis of annual estimates of requirements made by the various functional and enterprise managers during the last quarter of the preceding year. Warehouse Materials Accountants make a monthly report of stock movements both volumes and values the Materials Manager's Chief Accountant. Inspectors from the Materials Manager's office visit the warehouses at regular intervals and check the physical stock against the reports that have been submitted.

Units wishing to obtain materials from a warehouse place a requisition with the Materials Manager's Office. This document which describes the materials includes a power of attorney for the person who is to take delivery from the warehouse and a signature of a chief engineer verifying the purpose for which the materials will be used.

Materials issued out of the Materials Manager's Warehouses pass into the responsibility of the recipient and are stored in function or enterprise warehouses pending use as specified.

There is no evidence of a formal system for cross-referencing the stock-holdings by stock item across the wide range of warehouses.

The consultant was unable to obtain details of the numbers of stock items in the various warehouses or of the number of receipts / issues per day, week or month.

1.3.6 Baku Wagon Works

Baku Wagon Works is a representative self-contained enterprise with its own management organisation including director, chief engineer, economist and chief accountant. As such it is representative of the approximately 400 enterprises that comprise the ADDY.

A Profit and Loss Account and Balance Sheet are prepared for the enterprise.

The Baku Wagon Works was one of a small number of Works dedicated to the overhaul and maintenance of tanker wagons in the Soviet Union. This pattern of activity has continued since the establishment of the Republic of Azerbaijan.

During the last quarter of each year the railway, which is the principal customer of the Works, agrees a contract for the number of repairs by type that are to be done during the following year. The price per repair type is based on the cost during the current year adjusted for anticipated inflation and economies during the coming year. This price includes a "profit" component.

Private wagons are repaired under individual contract arrangements using prices that are higher than those agreed with the railway. The money paid by the private companies is paid direct into the bank account of the Wagon Works and in "good" times produces a valuable local cash flow. However, the demand for this work has also declined – in 1998 there are only depot repairs and no general overhauls. The significance of this order pattern is illustrated by the fact that a general overhaul yields three times the income from a depot repair.

Workers are paid, by means of a locally calculated manual payroll, on the basis of the hours that they have worked which are co-related to the numbers of completed repairs. When asked about the use of job costing, the economist stated that it was not feasible to calculate the cost per wagon repair because of the impossibility of allocating overheads such as his salary to individual wagons.

However, direct materials and labour costs are assigned to repair types and overheads are allocated to repair types also. The cost per repair type is divided by the number of completed repairs to arrive at an average cost per repair. This average cost per repair type is compared with the cost used in the annual contract to determine the variation as an indicator of a need for a contract price review.

It was stated that railway contract price reviews usually result in some reduction in the "profit" element in the price.

There is an EBRD proposal for the restructuring of the Baku Wagon Works that calls for a diversification of the engineering activity of the Works to include repairs to all types of wagon. Undertaking repairs on a wider range of wagons would call for a parallel increase in the range of stock items held in Works materials warehouse.

The wider range of activity would call for the introduction of new processes into the production chain in the workshops. While it is unlikely that any job would use all the facilities of the newly diversified workshops it is probable that all jobs would use particular production resources. This divergence in the use of workshop facilities would introduce increased complexity into the scheduling of the workflow through the workshops.

Scheduling would involve balancing competing demands for the most intensively used resources so as to achieve the maximum throughput compatible with the best use of all resources including manpower. In a situation where there was a wider range of wagon types and a wider range of repair types there would be a need to move forward from the historical average cost per wagon repair type into a job costing approach.

A job could be an individual wagon or a batch of wagons. However, experience elsewhere would indicate that having converted to a job approach the tendency is to move on to also having jobs for collective tasks such as the manufacture of wagon door hinges for stock.

Job costing would result in each individual job attracting the costs of direct materials and direct operative hours together with provisions for workshop overheads and administrative overheads.

The need to associate direct materials with individual wagon repairs would require that materials were issued from the materials warehouse on the basis of requisitions that charged the materials to individual wagon repair jobs in parallel with the updating of the records of materials stock-holdings. Similarly, a job costing approach would call for a direct link between the payroll system, that calculated the operatives remuneration, and the job costing system to ensure that sum of the labour costs recovered through the job costing system equalled the total of the wages bill.

The Director of Baku Wagon Works was not receptive to the possibility of introducing computers in the context of his current cash flow situation.

1.3.7 Locomotive Drivers System

Locomotive Drivers daily journals are brought to the Baku Central Computing Centre for entry into a PC based computer system.

The data entered includes:

- locomotive details,
- train crew details,
- laden wagon,
- empty wagons,
- gross train weight,
- hauled weight,
- weight of freight,
- matching tonne Km figures,
- train running times technical (between stations),
- train running times total (including times at stations).

The tonnage figures used in this system are calculated by averages for each type of wagon / traffic combination. Statistics produced by the system are used to assess locomotive operating performance.

1.4 Computer Infrastructure

1.4.1 Baku Central Computing Centre

In Soviet times, railway computerisation in the Azerbaijan region was controlled from Moscow.

Computerisation was focused on operational efficiency systems such as:
ASOUP for wagon control, and

EXPRSS1 for passenger bookings.

These systems continued to be run on 1970's vintage batch computers in central computing centres up to the early 1990's when states such as Azerbaijan became independent. The Azerbaijan Railways (ADDY), recognising that there was no future in those old computers, decided to start anew with contemporary technology and scrapped the old systems.

The continued close operational relationship between the railways of the independent States and with Russia resulted in a need to develop personal computer (PC) based systems that replicated essential parts of the scrapped old systems.

These systems have until now been operated as if there was a mainframe computer in the Baku Central Computing Centre. The central computing centre continues to provide the type of service which was necessary in the days of large batch computers that required special environmental arrangements. That is a centralised data collection and clerical support group which entered data, checked and corrected error listings and distributed printed outputs.

The development of the personal computer and the improvement in communications facilities have facilitated the transfer of these activities out to the functions / locations where the events take place. The Baku Central Computing Centre has commenced this process within the constraints of the availability of computers and communications facilities.

The current and projected portfolio of computer systems continues to reflect the preoccupation with transport operational computer systems to the exclusion of accounting and general management orientated systems.

1.4.2 Computer Hardware

Available information indicates that the current investment in computers is distributed as follows:

- Baku Central Computing Centre has 28 personal computers
- Baku Passenger Reservation & Ticket system has 28 personal computers, there are five personal computers shared between the two land frontier stations and Baku Ferry Port, and there are up to possibly 20 "stand alone" personal computers in various offices throughout the ADDY.

1.4.3 Computer Software

Central Computing Center personnel develop systems using:
SUBD Foxpro, Clipper, C++, Delphi3 programming languages
SYSBASE, InterBase, Oracle database systems,
NetBeUI, TCP/IP, WindowsNT communications facilities.

However, the Passenger Reservations and Ticketing system was developed by a software contractor outside the control of the Central Computer Centre management.

1.4.4 Data Communications

1.4.4.1 Current Data Communications

The ADDY has a very limited data communications network at this time.

The absence of suitable data communications facilities and a shortage of funds is impeding the development of computer systems.

Long distance data communications are currently limited to 1,200 bps lines between:
Baku Central Computing Centre and Beyuk–Kiassik on the border with Georgia,
Baku Central Computing Centre and Ialama on the border with Russia,

Baku Central Computing Centre and the Baku Ferry Port on the Caspian Sea,
Baku Central Computing Centre and Moscow.

These communications links are used for the collection of data on wagon and container movements into and out of Azerbaijan for transmission to Moscow.

The wagon data collection system uses:

one personal computer in Baku Ferry Port,
one personal computer at Ialama on the border with Russia,
two personal computers at Beyuk-Kiassik the border with Georgia,
two personal computers in the Baku Central Computing Centre.

In addition, the **INTERNET** is used to retrieve data on inter-railway wagon settlements by e.mail from the M.P.S. computer centre in Moscow.

As recently as September, 1998, the data transfers involved operators using a personal computer in the Baku Central Computing Centre to collect data from the Ferry Port and border point personal computers twice daily in accordance with a fixed schedule.

The collected data was then transferred by diskette to another personal computer for transmission to Moscow. The data was transferred to another personal computer in the Baku Central Computing Centre for local analysis.

This operator intensive procedure was replaced by a local area network (LAN) in October 1998. The LAN provides a basis for the automatic exchange of data between personal computers in the Baku Central Computing Centre and is indicative of the future direction of computing development in the ADDY. The installation of this LAN should increase the usefulness of the Baku Central Computing Centre personal computers (PC's) which were previously operated in stand-alone mode.

Networking PC's will:

* remove the need for duplicate data entry,
* reduce the hazard of data-entry errors,
* improve data exchange between PC's on the LAN,
* reduce the labour content in the data processing activity,
* give ready access to the databases on the network,
* increase the availability of the PC's for data processing.

While the Baku / Moscow link is over a line leased from the Ministry of Communications, the other links are over ADDY private lines.

There is also a 1,200 bps link between the Baku Central Computing Centre and the Freight Unit in ADDY Headquarters.

1.4.4.2 Projected Data Communications

It is generally accepted that the proposed Caucasus Fibre-Optic Cable from the Black Sea to the Caspian will be a major contribution to meeting the data communications needs of the ADDY. There is a shortage of data on how it is proposed to link data communications to the TACIS Fibre-Optic Cable when it becomes available. That is the service to be provided by the fibre-optic cable service has yet to be announced. The need to implement a communications system to connect the major installations, including the administrative headquarters of the ADDY, in the Greater Baku area to the Fibre-Optic cable has been identified and preliminary planning of a micro-wave network has been undertaken.

A least cost design for the projected micro-wave network would be to base the micro-wave network design on a Star layout around a central Hub. This lesser cost design is vulnerable to locations being isolated by the failure of one link. The failure of the central Hub of the network would result in a "worst case scenario" where all locations were isolated. The budgetary cost of this design was said to be in the range of US$130,000 to US$150,000.

The lack of resilience in the "STAR" design could be avoided by the implementation of "Ring Circuit" micro-wave network. The achievement of a "Ring Circuit" network usually requires the introduction of additional communications nodes. That is the additional micro-wave base stations which are introduced when there is not "line of sight" between two user base stations.

This alternative network design would through the introduction of two additional communications nodes and four additional micro-wave links give a higher degree of resilience than the lesser cost "Star" design. The work done in the preparation of the budgetary estimates would have to be supplemented by field trials to verify that a line of sight is available between each pair of base stations prior to a final decision. The ADDY Computer Centre has responded to this suggestion with a revised proposal for communications in Baku and the Absheron region based on a combination of radio and land line media. The proposed configuration is shown in the schematic included below.
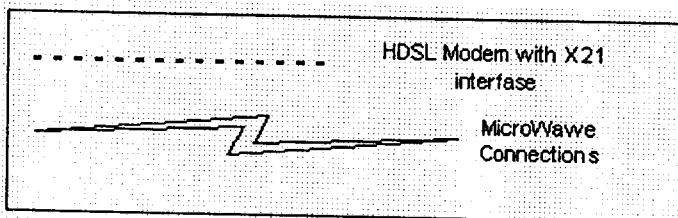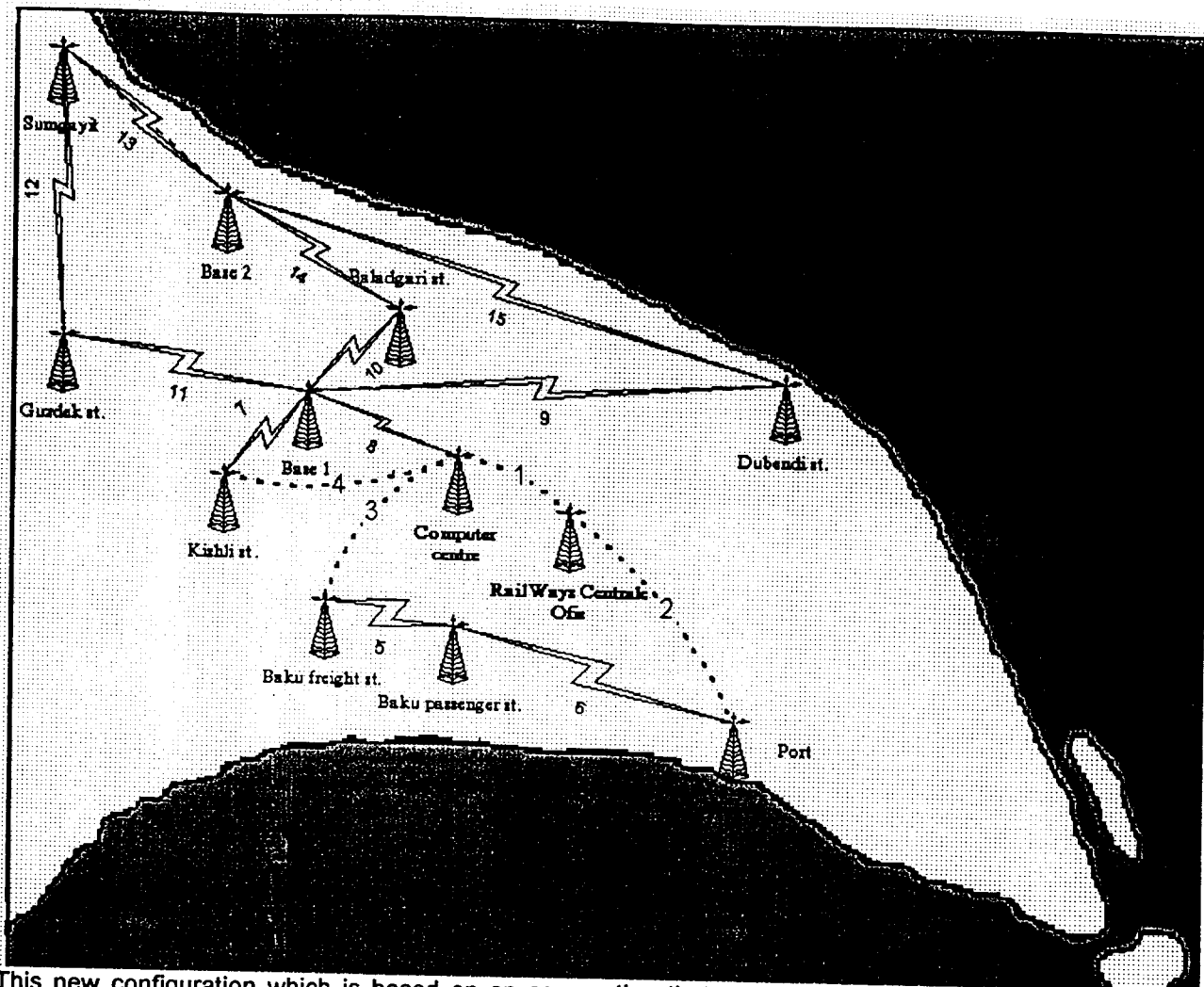
This new configuration which is based on an assumption that copper cable of appropriate quality is available in the areas indicated has two points of potential critical failure.

A failure at the computer centre would cut off all locations to the North as would a failure at Base 1. It is understood that these cost estimates do not include any provision for technology designed to protect against the adverse impact of extremely impenetrable rainfall. It is projected that this revised configuration will cost approximately US$520,000 which raises a serious question regarding the validity of the projected cost of US$180,000 to US$200,000 given for the original proposal.

The number of locations served by the proposed micro-wave network will ultimately depend on the route and architecture of the TACIS Fibre-Optic Cable. Another suggestion was that data communications needs for the remainder of the ADDY outside the area of the Fibre-Optic Cable should be met by the installation of micro-wave networks. The observations regarding reliability and resilience made above would be equally applicable to this proposition. The micro-wave proposals, which came from the Central Computing Centre, were not supported by the Chief of Signalling and Communications in discussions with the consultant.

There was an inconsistency in the messages being received from the Signalling and Communications Department regarding the manner in which the services would be linked to the proposed Tacis Fibre-Optic link.

There was an emphasis on the provision of voice communications with data communications in a secondary position and no indication of the Fibre-Optic cable being used to support track-side signalling. Neither was there any evidence of a formal assessment of data volumes.

It is usual for organisations that are installing a modern PABX to adopt a "one phone per desk" strategy resulting in a significant reduction in the number of PABX lines and the number of telephone handsets. The very large numbers of lines per PABX mentioned during discussions would indicate that there is scope for such a rationalisation during the planning of new PABX telephone systems based on the TACIS Fibre-Optic Cable.

1.4.5   Central Computing Centre Staff

The personnel structure of the Central Computing Centre reflects its origins as a mainframe batch computing installation of the 1970's.

Despite the change over to personal computers, the Centre continues to provide the data collection, data validation and output distribution services which were a feature of computing back in the 1960's and early 1970's. This emphasis on support functions coupled with an inability to re-locate surplus personnel results in a staff of only 7 computer programmers in an establishment of 150 persons.

None of the personnel were described as systems analysts nor designers. The small number of computer professionals represents yet another limitation on the capacity of the ADDY to develop and implement systems. There is no existing programme for the retraining of suitable surplus personnel to meet the personnel needs of the future.

1.5   Computing Techniques

1.5.1   Data Coding

Limited computerisation in the ADDY has resulted in very little use of codes to represent locations, activities or events. Coding structures are the foundation of computerised systems. This is particularly so when the computerised systems are integrated management information systems. Integrated computerised systems are achieved through the exchange of data between systems by electronic means without any need for manual intervention.

The successful exchange of data depends on a coherent approach to coding. Integrated systems need integrated coding structures. A coding system must condense information, ensure uniformity of presentation, eliminate ambiguities, and facilitate sorting and filing.

The coding system must enable each item in the list to which it refers to be identified in a single, reliable and easy manner.

The code chosen then makes it possible to achieve the necessary one-to-one relationship between an item and the symbol representing it. It should also enable items in the list to be described.

A coding structure must therefore essentially meet the following requirements:

Permanence:	the code allocated must remain unchanged for as long as possible,
Simplicity:	the code must take account of the conditions under which it is to be used and the personnel using it,
Accuracy:	there must be no ambiguity in allocating a code to an item or in recognising an item from a code,
Conciseness:	codes should use the minimum number of symbols, taking into account the requirements expressed by the users, and if at all possible have a constant length,
Enhancement:	it must be possible to update the code in the event of the number of items in the list being increased,

Numeric: so that difficulties associated with the use of different scripts are
avoided.

It is important that a coding structure should have sufficient provision for expansion so as to
avoid the problems/cost of upgrading computer applications and/or having to undertake tasks
such as the re-marking of railway rolling stock. The efficient operation of a coding structure
depends on code allocation being vested in a single authority. Since the ready integration of
systems depends on codes having a consistent meaning across an organisation, it is
necessary that the development of coding structures should be addressed on an organisation
wide basis.

Not alone should a code have a consistent meaning across an organisation but so also should
an item have but one code across the organisation. Where a coding structure is used by two,
or more, sections of an organisation there is a need for agreement between the parties as to
which should be the code allocation authority or as to whether code allocation should be
vested in a committee representative of the participating sections.

1.5.2   Information Quality

The introduction of a new management organisation with a competitive business focus will
generate a demand for information to be available as required.   The servicing of this demand
will call for the availability of an appropriately organised database with online enquiry tools
enabling the end user to access the database and formulate enquiries with a minimum of
effort. It will be essential to ensure that there is consistency in information produced whether
in scheduled reports or in response to ad-hoc enquiries.

The foundation of consistent information is good systems design and accurate data. If invalid
data is accepted by a computer system, the information provided by the computer system will
also be invalid.   A failure to recognise such inaccuracies can result in disproportionate
damage to an organisation because of the impact of decisions based on the erroneous
information.

Evidence of such inaccuracies will result in a lack of confidence in information provided by
the system It will lead to the development of manual checking processes with an associated
waste of resources.

The wasteful consumption of resources can also arise where data is collected in parallel by
two, or more, application systems. The information produced by such systems will inevitably
be cross checked and apparent incompatibilities identified.

An example of parallel data streams relates to freight tonnage:
freight tonnage is entered into a computer system from Locomotive Drivers daily journals,
freight tonnage is input from freight revenue documents,
freight tonnage is input from reports of consignments loaded and unloaded at stations,
resulting in a cross-checking process in the Baku Central Computing Centre.

While some incompatibilities may be due to valid differences in presentation, others will arise
from data-collection errors in one, or more, of the applications system.

* Data collection errors, during the document trail from an event to the time and place of
  data-entry, can arise in a number of ways including:
* original data recording errors,
* data transcription errors,
* data summarisation errors,
* data transmission by telephone errors,
* data entry errors due to inadequate validation at time of entry.

Having parallel data collection processes increases the opportunities for such errors with the
associated implications.

The reduction / avoidance of these situations can best be achieved through:

- data being entered once at source, ideally by the person involved in the event,
- online data validated at time of entry,
- data, once entered, being available to all application systems,
- the exchange of processed data between application systems,
- the development of a corporate database available to all users / systems in accordance with a formal hierarchy of access needs.

These processes can be facilitated by having personal computers located in the work-place where the person doing the work will have the knowledge to correct errors, identified by the validation process, in real-time. The arrival of the personal computer with its graphic colour screen has provided the basis for a dramatic change in the data-entry process. The use of named boxes supported by item description selection from a drop-down menu has reduced the need for the entry of the codes on which computer systems rely so heavily and as a consequence reduce the opportunity for data-entry errors.

The drop down menus can be customised to reflect the frequency with which items in a list occur in a particular location thereby speeding up the item selection process and data-entry generally.

1.5.3 Database

1.5.3.1 Computer Systems Integration

The initial approach to computerisation was to develop systems in isolation.

It was soon realised that there was an opportunity / need to exchange data between systems. The exchange of data between systems brought advantages such as:

- the avoidance of duplicate data-entry, which in the early days of punch cards when each item of data had to pass through two keyboard processes of punching and verification prior to being loaded into a computer, was very costly,
- consistency in the data being used by associated systems,
- faster production of reports.

In time it was not unusual for many systems to be linked together in series to produce a final product such as management accounting reports. The diagram below is a simplified example of the relationship between a payroll, inventory control and job costing systems. It shows how the validation of the timesheet, job card and materials requisitions were carried out in isolation from each other thereby creating opportunities for incompatibilities as the systems converge to produce the job costs.

Incompatibilities at each point of convergence generate additional human involvement, lengthen the duration of the processing cycle and delay the production of management reports. The integration of such systems also calls for the synchronisation of the running of the various systems so that files have the appropriate status when used. Synchronisation calls for the intervention of a human scheduler. As the number of inter system relationships increases, the opportunity for incompatibilities and the complexity of the scheduling task increase exponentially leading to failures and disruption.

1.5.3.2 Database Management

Database management systems were developed in response to a growing demand for the integration of computer systems.

Relational databases such as Oracle have become the accepted database technology. Relational database design is built around having a series of Tables each dealing with a separate facet of the real world which the database portrays. Forms, which are associated

with Tables as appropriate, are the means through which data is input and processing is initiated.

Data is output from a database by means of Reports and Queries each of which are associated with Tables as appropriate. The Reports facility is employed when producing reports printed on paper in accordance with a schedule. The Query facility is employed to make on-line enquiries where the response may be displayed on a computer screen or printed as appropriate. The guiding principle in database design is that each item data is held only once and is made available to users in accordance with a defined hierarchy of access rights.

This ensures that data is entered once thereby avoiding the increased exposure to errors in multiple entry scenarios and the associated problems of reconciliation.

A database management system:

- controls access to data,
- ensures that synchronisation issues do not arise,
- provides data recovery procedures in the event of system failure.

1.5.4 Management of MIS Development

There is a need to ensure that investment in MIS supports the new management organisation in the achievement of the business objectives of the ADDY.

The corporate approach to MIS development needs to ensure that:

- business focused applications systems which yield improved services to the customers in a cost effective manner are implemented,
- the business unit management have a sense of system ownership with an associated sense of responsibility for the successful implementation and operation of new systems,
- the development of computerised systems is undertaken in the coherent and complementary manner which is necessary to the achievement of integrated management information systems,
- the steps being taken to focus computer expenditure are reinforced and that computer related investment decisions are made on the basis of the contribution to the improvement of the overall profitability of the ADDY rather than on the accident of the function / unit / enterprise which may have a current cash surplus.

1.6 Recommendations

1.6.1 Accounting

It is recommended that the accounting needs of the restructured ADDY should, if at all possible, be met by the acquisition of an established accounting package.

The selected accounting package should:
- be an industry recognised package,
- be hardware independent,
- have vendor/agent support in Baku,
- support integrated financial and management accounting,
- support multiple currency accounting,
- support the processing of non-financial data,
- support multiple users,
- provide interfaces for the exchange of data with other computer systems,
- accept transaction input over a network,
- accept journal data by file transfer over a network,

- have a user friendly report writer,
- support data exchange with desktop tools such as spreadsheets and word processors,
- include a user access control process.

The multiple enterprise structure of the ADDY will have significant implications for the cost of software package solutions. Software package providers expect to conclude individual licence agreements with each legal entity.

It is not possible on the basis of available information to make an estimate of the cost of the software required for the implementation of an integrated accounting package system. The multiplicity of legal entities is also an issue when placing contracts for the custom development of computer software. It is necessary when placing orders for computer software development to ensure that full title to all the rights relating to the use, modification and resale of the software pass to the ADDY.

1.6.2 Human Resources

It is recommended that a strategy should be developed for the early implementation of the payroll system in all the ADDY enterprises and functions based on local personal computers in anticipation of the availability of wide area data communications.

Steps should be taken to secure a Human Resources software package. A suitable system would:

- have a comprehensive employee master record,
- support data collection by computer file over a network,
- support data collection by scanner,
- support employee history,
- maintain records of employee attendance, pay rates etc.,
- run in client/server mode on a Windows computer platform,
- support control of user access in accordance with a hierarchy of need.

1.6.3 Freight Management

The ongoing upgrading of the freight operating systems should be suspended and be replaced by a project with the objective integrating the functionality of these systems around a common database or, if necessary, databases. Consideration should be given to the inclusion of the locomotive performance reporting activity, which includes details of tonnage and tonne Km hauled, in the project.

The adoption of database techniques would:

- reduce the volume of data-entry,
- avoid the cross-checking process that is a feature of the current situation,
- improve the quality of data held on file,
- increase the usability of the data,
- lead to better management information.

This investment in the freight operating systems should be paralleled by the development of a system that should implement all truly commercial functions:

- customers files,
- information to clients,
- real time computation of costs,
- pricing and invoicing,
- delivering statistics on sources of revenue.

It is important to implement this commercial system first in a single "information centre" in Baku, it could be decentralised to a number of key locations as data transmission facilities and resources permitted. It is recommended that these developments should be based on the Oracle Database Management System with which some of the personnel in the Central Computing Centre are already familiar. Central Computer Centre personnel should be given formal training in a recognised Oracle Training School in the design, development and implementation of relational databases using the Oracle system.

1.6.4 Passenger Reservations and Ticketing

It is recommended that:

- responsibility for the security, maintenance and extension of the Passenger System software should be passed to the Central Computing Centre immediately,
- interfaces between the computerised passenger ticketing system and other computerised systems such as passenger revenue accounting should be developed as a matter of priority; these interfaces could be based on a diskette transfer pending the establishment of data communications between Baku Passenger station and the Baku Central Computing Centre,
- the need for 26 computerised ticket booths in Baku should be examined; the volume of sales on the sample day seen during the visit does not warrant such a large number of booths – 50% would probably be a generous allocation,
- stations outside Baku should be selected for computerisation on the basis of the volume of long-distance passenger traffic. In the absence of access to passenger booking statistics, the consultant would expect that a very high percentage of passengers originate at a small number of stations.
- ticket booth computer configurations surplus to the traffic needs of Baku station should be relocated to those stations as data communications facilities become available.

It is recommended that the design of the Passenger System should be reviewed prior to any extension of the system. The review should include:

- an assessment of the database management facilities versus the facilities that would be available in a proprietary database management system,
- an assessment of the throughput capability of the current file server,
- an examination of the division of application activity between the client (ticket office) computers and the file server,
- an assessment of the throughput capability of the Ethernet in Baku Passenger Station,
- an assessment of file security copying and storage procedures,
- an assessment of failure recovery procedures by type of failure, for example what is the ticket sales procedure in the event of a computer system failure?
- an assessment of access control procedures.

1.6.5 Train Despatching

It is recommended that consideration should be given to the development of a Train Circulation Monitoring system as an automated support to the Train Despatching function. The main objectives of the Train Circulation Monitoring system would be to provide timely and reliable information across the company, concerning the train circulation services to be offered for freight and passenger operators.

The application should provide information covering circulation requirements, circulation timetables and planning, circulation statistics, analysis and forecasts. The system would also collect data on the movement trains in support of the train despatch function and as a basis of information for both management and customers. This system should be designed in accordance with database management principles within the Freight Management database structure.

1.6.6 Materials Management

The scale of the investment in materials stock holdings is a critical item in the financial viability of an organisation. Good financial management requires that stock holdings are kept to a minimum through the integration of the records of all warehouses and the adoption of "just in time" (JIT) techniques.

It is recommended that:

* the materials control function should be computerised by the installation of computing facilities in all locations where there are significant stock-holdings,
* the computers in the various warehouse should be linked to a computer in the Materials Manager's department,
* the ADDY should seek to obtain a software package for this materials management function,
* the selected package should:
* work in client / server mode on a Windows computer platform,
* fulfil all the materials management tasks such as order, receipt, issue and inter-store transfers,
* accept both volume and value data for these transactions,
* maintain records of both the volume and value of stock holdings per material item,
* have the capacity to calculate issue price per item on the basis of the amount of the suppliers invoice details,
* generate journal entries for transfer electronically to accounting and costing systems,
* include access control in accordance with a hierarchy of need.

The focus of the new management structure will, among other items, be on the optimum use of available cash resources. The optimisation of the level of cash tied up in stock-holdings requires that the activities of all stock warehouses are co-ordinated so as to ensure that materials in surplus in one warehouse are not being ordered for another. This objective is best achieved through the development of an integrated stock control system for those warehouses.

The warehouse computers would be linked by communications to achieve the level of integration necessary to achieve the desired integration. The implementation of this project would require that a catalogue of material codes be developed for all materials held in all ADDY materials warehouses. It would be essential the each stock item had the same material code in all materials warehouses.

Having consistent materials codes across all materials warehouse computer systems would support the cross checking necessary to ensure avoidance of the ordering of unnecessary materials.

Consistent materials codes across all warehouses would facilitate the extraction of data on the various aspects of the materials management function such as:

* annual expenditure on particular materials,
* stock-holdings of particular materials,
* incidence of slow moving materials,
* incidence of non-moving materials,
* consumption of materials in a given location compared with some measure of activity in that location.

1.6.7 Baku Wagon Works

It is recommended that, if the EBRD proposals are implemented, the production control, costing, accounting and management activity in the Baku Wagon Works should be computerised. A job costing process based on the existing manual processes would be document and labour intensive. It would be clumsy in operation and vulnerable to error. An

efficient job costing system will be of growing importance as the Baku Wagon Works sought to increase activity through an expansion of work for companies and organisations outside the ADDY.

It is recommended that the ADDY should endeavour to obtain a proven software package rather than seek to develop a custom written system. The Baku Wagon Works computer system should be designed to work in client / server mode on a Windows computer platform. Accounting to Profit & Loss and Balance Sheet should employ the accounting software system adopted as the standard for the ADDY.

The consultant has not, as yet, identified appropriate software in the Baku software marketplace. In the event of the EBRD project not proceeding, it would be still appropriate that the management processes of the Works should be computerised when the capital was available.

The management information needs of the present type of production could be met by a less elaborate approach consisting of the existing ADDY computer payroll and a less elaborate accounting system would probably involve an investment of between US$20,000 and US$30,000 on a stand-alone basis.

1.6.8 Baku Central Computing Centre

The reorganisation of the management structure of the Azerbaijan Railways should be accompanied by a parallel review of the role of the Baku Central Computing Centre. Activity in the centre should be analysed and associated with the new functional structure. The process of transferring data collection out to personal computers in the originating functions / enterprise / locations should be accelerated.

There should be a parallel transfer of local data processing out to these personal computers. Functional management should be given control over and responsibility for the running of their computing facilities - including cost control.

These activities should, in the first instance, be distributed to the head offices of the "enterprises" and the functions. The dispersal of the activities down to the "ground level" where the events take place would depend on the availability of communications facilities and finances. The dispersal of responsibility for the day to day operation of data collection and entry into computer systems would:

- place the responsibility for data collection on the enterprise / functional management,
- give enterprise / functional management authority over the consumption of resources in data collection,
- give enterprise / functional management an incentive to ensure that data collection was done in the most efficient and cost effective way,
- result in the personnel establishment of the Baku Central Computing Centre consisting almost entirely of specialist technical and professional personnel,
- enable the Baku Central Computing Centre management to concentrate on its primary role of system delivery and support.

If the Baku Central Computing Centre is to fulfil its role and make a necessary contribution to the modernisation of the Azerbaijan Railways management information systems, it will have to undertake a number of tasks most notably:

- equip itself as a centre of technical excellence,
- organise itself to work in close co-operation with its customers – the managers of the various functional units / enterprises,
- maintain an inventory of computing resources, both hardware and software, throughout the ADDY – this inventory should be synchronised with asset management in finance and accounting.

The staff of the central computing centre of the future should include personnel with extensive skills and experience in the following:

- computer hardware selection,
- computer software selection,
- telecommunications equipment selection,
- computer systems design,
- telecommunications network design,
- telecommunications network management,
- database design,
- software package procurement,
- software programming,
- system acceptance testing,
- system specification development in close co-operation with the end-user,
- contract specifications,
- tender evaluation criteria,
- contract negotiations,
- development of standards for:
- system operating instructions,
- data security,
- site security,
- failure recovery,
- third party software,
- computer hardware,
- data communications hardware.

The achievement of this level of competence should be brought about through a combination of recruitment of specialists and a formal programme of personnel development.

The personnel development programme should be based on attendance at a combination of internal and external courses. The personnel development programme for the Baku Central Computing Centre should be an integral part of an overall management development plan within the context of the introduction of the new organisation structure and management methods.

It is recommended that the computer personnel and equipment which will form the nucleus of the Computer Centre of the future should be relocated to the Railway Headquarters – the current building is not compatible with the efficient organisation of a modern technology centre. The central computing centre of the future should regard itself as a service enterprise with customers. A service enterprise that, while setting standards and ensuring that those standards are observed, recognises that its purpose is to respond, in accordance with best information technology practice, to the identified needs of the customers in the pursuit of their business objectives.

The relationship between the central computing centre and its customers will be best advanced within a formal context combining opportunities with responsibilities.

1.6.9 Coding Structures

It is recommended that the establishment of a Coding Structure Project Team be given top priority. This project team would consist of a nucleus of foreign experts supported by ADDY personnel representative of the various enterprises and the various disciplines in the ADDY. The development of a coding structure is a prerequisite to the development of integrated management information systems for the ADDY.

The coding structure design will have to encompass all activities in the ADDY so that coding conflicts may be avoided as individual computer applications are developed and integrated in the future. The Project Team will have to undertake an in-depth examination of all activities in each enterprise.

The scale of this task is demonstrated by the fact that there are approximately 400 enterprises in the ADDY and that a number of locations in each enterprise will have to be examined in-depth. The final product of the Coding Structure Project will be a series of Coding Manuals for the ADDY that list Cost-Centre and Nominal Account codes in:

numerical order with short and expanded narrative descriptions,
short description alphabetical order with numerical code and expanded narrative description.
The use of these Coding Manuals in the development of computer systems would ensure that systems developed individually were compatible and available for integration as management information systems developed.

While the duration of this task would be dependent on the scale of the resources employed and the co-operation of the various functions / enterprises, it is anticipated that it would be prudent to plan on an at least two calendar year programme.

1.6.10 Information Quality

It is recommended that:
prime data should, as far as is feasible, be entered by the person undertaking the activity to that the data refers,
the objective should be to have data-entry always be done at the location where the activity occurs,
data should be entered once,
data should be subjected to on-line validation at time of entry,
data should be stored in corporate databases,
data should be available to systems and users in accordance with a hierarchy of access needs,
the ADDY MIS development plan should include provision for the progressive distribution of the data collection function to PC's sited in the locations where the events occur,
data collection programs should be developed around the facilities of the personal computer's graphic user interface using form filling techniques supported by drop down menu options to reduce the need for code selection and entry.

1.6.11 Database

It is recommended that, if at all possible, a database management system such as Oracle should be adopted as the ADDY file management standard. System design personnel should be trained in relational database design concepts so that they may be equipped to ensure that systems design, prior to the acquisition of a database management system, reflects relational database principles.

1.6.12 Management of MIS Development

It is recommended that an MIS Steering Committee be established to:
- determine MIS policy,
- assess proposals,
- set implementation priorities,
- control MIS costs.

This group, which would be led by the Director General of the ADDY, or a Deputy nominated by him, would be guided by its assessment of how proposed projects would contribute to the achievement ADDY business objectives in a competitive environment.

Project proposals would:

- originate in the business units / functions / enterprises,
- be assessed for technical feasibility by the Central Computing Centre, and
- be priced in conjunction with an accounting nominee of the Deputy for Economics.

Project proposals would be presented to the MIS Steering Committee by the proposing Deputy supported by the Head of Computing.

Approved projects would be passed to a business unit Working Party which would be responsible for the development and implementation of the project:

- to specification,
- as scheduled, and
- within the approved cost budget.

Business unit Working Parties would consist of representatives of the business unit and the Central Computing Centre. These Working Parties would be led by a nominee of the proposing Deputy.

The Central Computing Centre or an external contractor would undertake work on a sub-project basis for the Business Unit Working Party. The leader of each Working Party together with the lead Central Computing representative on the Working Party would report to the MIS Steering Committee on progress against specification, cost and schedule at pre-determined intervals such as once every four weeks.

It would be the responsibility of the MIS Steering Committee to initiate project performance audits following a period of live running. The adoption of this approach to MIS development should ensure that:

- business focused cost effective applications systems that yield improved services to the customers in a cost effective manner are implemented,
- the business unit management had a sense of system ownership with an associated sense of responsibility for the successful implementation and operation of new systems,
- the development of computerised systems is undertaken in the coherent and complementary manner which is necessary to the achievement of integrated management information systems,
- the steps being taken to focus computer expenditure are reinforced and that computer related investment decisions are made on the basis of contribution to the improvement of the overall profitability of the KZR rather than on the accident of the function / unit / enterprise that appears to have a current cash surplus.

1.6.13 Data Communications

It is recommended that:

- a multi-disciplinary Working Party be established to:

clarify the scope and boundaries of the proposed TACIS Fibre-optic cable,

develop a comprehensive communications strategy covering voice, data, video and signalling,

progress the proposal for a micro-wave network serving the major locations in the Greater Baku area,

rationalise the number of telephones as new PABX systems are installed,

the computer development strategy should be based on the implementation of local area networks (LAN's) linked by wide area network (WAN) bridges as improved long-distance communications become available,

the design of any micro-wave communications facility should incorporate necessary resilience through the implementation of ring-circuit techniques that would give alternative routing to all locations including the TACIS Fibre-Optic Cable,

information on the pattern of rainfall in Azerbaijan should be reviewed in conjunction with information on the vulnerability of micro-wave communications to heavy rainfall so that the reliability of proposed micro-wave implementations in the Azerbaijan environment may be assessed prior to a decision to proceed with a project.

1.6.14 Training

It is recommended that the design and objectives of the planned management information systems should be an integral part of training programmes developed to introduce middle and lower management to the detailed implications of the new organisational structure.

Management and personnel should be educated in the operation and use of the planned MIS systems as these are being developed and implemented. Technical personnel should be trained in the skills required to design, develop and install these new systems, both computer and communications. Business unit personnel will have to be given training in specification of needs, the testing of systems, the installation of systems and the ongoing management of systems.

User personnel will have to be trained in the tasks involved in the daily running of the systems. These proposals should be incorporated into the overall training programme in support of the introduction and operation of the new business focused management structure.

1.7 Near-term Strategy

The complexity of the ADDY structure, the scale of the education task, the scale of the training task, the evidently large scale of the investment involved all point to a need for a phased implementation of management information systems in the ADDY. In addition, it is inevitable that there will be a waiting period prior to the availability long-distance data communications based on the TACIS Fibre-Optic Cable.

The duration of this period will consist of components such as:

- project approval and funding,
- project design,
- request for tenders,
- review of tenders and supplier selection,
- lead time for delivery and installation of equipment,
- system testing and acceptance,
- service connection, for example time taken to interface LAN's to the TACIS Fibre-Optic Cable between Black Sea and the Caspian.

It is necessary to plan for this situation by identifying tasks which:

should be done prior to the availability of the trunk data communications facilities, tasks which may be done during the waiting period. A soundly based comprehensive coding structure, which is a prerequisite for the commencement of an orderly implementation of an integrated management information system (MIS), is an example of a task which could be addressed during this waiting period. The completion of the coding structure would provide the basis for the development of an overview of the ADDY management information systems identifying the various component modules and defining the data to be exchanged between those modules.

The management information systems overview should be driven by the information needs of the new management structure and style reflecting the manner in which the ADDY plans on adapting to the emerging business environment within which it will have to develop.

The modular composition of the Management Information Systems design would be both functional and geographic giving an opportunity for the adoption of a strategy adapted to the availability of data communications facilities.

One possible strategy would be to first implement the new management information systems in the top layers of the new management structure and to extend the system down through the organisation progressively.

This strategy would have the twin benefits of:

* affording top management an opportunity to adapt to and adopt the new processes before embarking on "selling" new approaches to middle and lower management,
* allowing the selection of geographical modules on the basis of benefit to the ADDY and the availability of data communications facilities.

The project selection process should take into account factors such as the:

* benefit accruing to the ADDY from a possible development,
* availability of computers for the project,
* possibility of installing LAN's where appropriate,
* availability of trunk data communications,
* acceptability of establishing inter-LAN communications over the INTERNET,
* acceptability of data transfers by diskette during the waiting period.

The systems implementation process should be based on a combination of package software for generic situations and custom written software for railway specific needs. The custom written software should be developed using a combination of in-house expertise and software contractors. The employment of contractors would have a number of benefits including:

* a faster development programme,
* avoidance of the hazard of having too many personnel when the initial peak development demand had passed.

It is important to be conscious of the load that computer systems implementation places on the business user within an organisation. Business users need to be educated in the opportunities and requirements of computerisation so that they may be equipped to specify their needs and business processes to computer specialists, key user personnel have to be trained so that they test and accept new systems, user personnel have also got to be trained in the operation of computer systems.

The scale of this work load means that there is a limit to the volume of computerisation which can be absorbed by a business unit either operational or administrative. Accordingly, computerisation development programmes depend not alone on the availability of resources such as finance and data communications infrastructure but also on the capacity of an organisation to service such developments while continuing to perform its day to day tasks.