Restructuring of Georgian Railways
(MIS Plan - Draft 9.11.98)

CONTENTS

1 MANAGEMENT INFORMATION SYSTEM

1.1 Introduction

Georgia is an independent state that was formerly part of the Soviet Union.

The Georgian Railway with its 1569 Km of track, employs 26,480 staff, carries 3.3 million passengers and 4.8. million tonnes of freight each year.

The Management of the railway is being restructured in line with Government policies and the objectives of the Traceca project.

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

Railways in the Soviet Union were administered as an entity with all significant decisions being made in Moscow with Russian as the "railway" language and all activities being carried out by a universal code of practice.

This uniformity applied to computer systems in the same manner as it applied to railway operations and manifest itself in the form of large computer systems that were operated in a consistent manner throughout the Soviet Union.

1.2 Current Management Information Systems (MIS)

1.2.1 Central Control under Soviet Union

The management information systems, like the railway operations in the Soviet Union were highly integrated and controlled by the Ministry of Railways (MPS) in Moscow.

Included in these arrangements was a Soviet Union wide computer network based on a central computer centre (MCC) in the MPS in Moscow and a large number of regional computer centres (RCC's) strategically located throughout the Soviet Union.

Two major computer applications systems, ASOUP and EXPRESS, were the primary users of this Soviet-wide network. ASOUP is a wagon information system and EXPRESS is a passenger ticketting and revenue accounting system.

Computer systems development began on the Georgian Railways in the 1970's.

Developments were based on railway computer centres, that were equipped with large mainframe computers. Machines such as teletypes and microprocessors were used to input data over telegraph and telephone lines.

These developments reflected the philosophies then obtaining in the Soviet Union.

Systems developed were:
Statistical Accounting for both Freight and to a lesser degree Passenger traffics,
Production of Freight Train and Wagon model,
Reporting on operations during the previous 24 hours.

1.2.2 MIS Developments under the Georgian Railways

The Georgian Railways telecommunications network was undermined by the larceny of copper wire and peripheral equipment during the years 1990 to 1995 resulting in a reduction in the range of data processing systems on the mainframe computers.

Statistical Accounting was the only system to survive that period and it is now being transferred to personal computers in preparation for the imminent abandonment of the 1970's mainframe computers.

The Georgian Railways decided in 1995 that the personal computer represented the way of the future and adopted a computing strategy based on the use of networked personal computers.

This strategy was a reflection of the growing power of personal computers, developments in communications technology and the opportunity for a phased implementation strategy compatible with the financial capacity of the Georgian Railways.

The high level of commercial exchanges between the States that gained independence from the Soviet Union has resulted in a continuance of the integrated working that was a feature of the railways on during the days of the Soviet Union.

The implementation in 1996 by the railway transport council of the former Soviet republics of a system for the mutual settlement of payments for the use of other railways freight wagons necessitated the development of a computer system that monitors wagon movements into and out of Georgia.

The data so collected forms the basis of charges for the use of Georgian wagons by other railways and assists in the verification of charges from other railways for the use of their wagons by the Georgian Railways.

The Georgian Railways is using the data to control the duration of the stay of other railways wagons in Georgia so as to reduce the level of charge from other railways for wagon use.

1.2.3 Projected MIS Developments

The Head of Computing –Calculating summarised the computing tasks for the future as follows:
Automation of technological processes on linear level,
Optimisation of train movement management,
Automation of all kinds of accounting and financial issues,
Support for the economic evaluation of decisions.

1.3 Core Systems

1.3.1 Accounting

While there is a statistical accounting computer system for freight and passenger traffic, accounting in the Georgian Railways continues to be an essentially a manual process.

1.3.1.1 Accounting in Georgia

Accounting in Georgia is done in accordance with Soviet standards. However, discussions on the benefit / feasibility of moving towards international standards are in progress.

The continued dominance of commercial and transport interaction with Russia and the States that gained independence from the former Soviet Union Russia will be a significant factor in determining the pace of evolution from Soviet standards towards international standards.

Steps are in progress to organise the accounting profession on the basis of an independent self-regulating body as is the case in Western countries. It is anticipated that this development will contribute to the modernisation of accounting practice and standards in Georgia.

1.3.1.2 Accounting in Georgian Railways

Accounting in the Georgian Railways continues to be in accordance with the Soviet standards.

The Georgian Railways take the view that whichever accounting standard is approved by the Government will be implemented by the railway. However, there is no timetable for such a decision by the Government.

A parallel hurdle for the implementation of an accounting system in the Georgian Railways is the fact that organisational re-structuring is an intermediate stage. While one segment of the railway continues to be managed on the basis of the system inherited from Soviet times, the other has been converted to a functional organisation with fewer layers of management.

This means that if a computerised accounting system were implemented at this time it would need to have the capacity to service the information requirements of both organisational structures just as if there were two different organisations working side by side.

1.3.1.3 Accounting & Corporate MIS

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

For example, there is no value in a production manager increasing the volume of production if what he produces remains unsold in a distribution warehouse or if the increased output has had to be sold at a price that is lower than the cost of production.

This simple example illustrates that a corporate management information system has draw data from all the business processes in the organisation to produce information that shows how the organisation is performing in all its facets.

Issues that could arise in such a scenario would include:
had the market for the production been properly assessed?
was there an increase in competition?
were the production costs competitive?
were the marginal costs greater than projected?
was the pricing policy soundly based?
what action should be taken to redress the situation?

The answers to such questions would be drawn from data generated by a range of systems.

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 Georgian Railways is evidence of the diversity of the activities in a national railway.

It is as 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 Georgian Railway. That is why accounting systems in a railway need to be integrated with each other and with the physical measures of performance.

1.3.1.4 Characteristics of an 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 Statistical and Accounting Department has advised the Head of Computing and Calculating that there is no accounting software package that is suitable to the accounting needs of the Georgian Railways and has asked that a custom written system be developed in-house to its specification.

It is understood that the scope of the proposed custom written development does not extend to accounting in major railway activities such as engineering workshops and the permanent way function nor to central ledger accounting.

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,
a tendency to replicate historical manual procedures – without recognition of the role of vested experience in ensuring that manual systems work,
an assumption that individual personal experience constitutes the full range of events rather than undertaking a comprehensive analysis of the accounting process,
limiting data validation with the fallacious objective of speedy data-entry,
an expectation that since the system is being custom written there will be an opportunity to modify the specification both during the development period and subsequently with the experience of operation.

While the former assumption leads to a slippage on the delivery schedule for the new system the latter assumption is a recipe for an unstable system with very high on-going support costs.

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

The current transitional status of accounting standards coupled with the transitional status of the Georgian Railway organisational structure 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

The human resources function in the Georgian Railways is distributed throughout the various constituent departments, functions and locations.

Record keeping in this wide array of human resources offices is based on manually maintained paper records.

The Human Resources Department in Railway Headquarters in Tbilisi has recently taken delivery of three personal computers and a computerised human resources system.

The system is designed to support:
Staff Application Data,
Appointment of staff,
Staff transfers,
Staff vacation arrangements,
Staff rosters,
Staff grading with wages rates,
Staff work history,
Record of referees,
Attestation documentation,
Staff statistics,
Archives,
Vacation diagrams,

Having implemented the system in the Human Resources Department, the Head of the Human Resources plans to extend the use of the system throughout the Departmental apparatus and throughout the various human resources offices in the various functions and enterprises that comprise the Georgian Railways.

The progress on this task will be largely determined by the availability of finance to purchase the necessary computers.

The Head of the Human Resources Department estimated that approximately 150 personal computers would be required.

1.3.3 Materials Management

While the Materials Manager is responsible for all materials procurement, the system permits unit managers to make direct purchases.

It is understood that this option is exercised by most unit managers.

Materials under the direct control of the Materials Manager are held in warehouses in Tbilisi, Shindisi, Khasuri and Samtredia.

While each warehouse has its own manually maintained stock card records accounting is controlled by warehouse accountants in Tbilisi and Samtradia.

The pattern of materials procurement is determined by the availability of cash.

The shortage of cash has resulted in surplus locomotives and wagons being de-constructed so that the components may be used to repair operational stock.

Materials are transferred in bulk to function / enterprise warehouses which are inspected by representatives of the Materials Manager at regular intervals. These inspections are supported by an annual stock-taking which is made in all warehouses on the dame date.

While communication between these warehouses and the Materials Manager's department is based on the FAX, co-ordination of stock levels in various warehouses depends on telephone enquiries.

The materials management philosophy does not include the concept of treating materials stock-holdings as a capital asset with stocks on hands at year-end being shown on the Balance Sheet.

The view is that as there is never enough money for materials procurement the possibility of having materials on hands at year-end does not arise.

However, the Materials Manager does look forward to the computerisation of the control and accounting processes in the warehouses under his direct control.

1.4 Computing Infrastructure

1.4.1 Structure of the Computer Calculating Centre

The Chief of the Computing-Calculating Centre leads a management team of 16 persons.

The work of the centre is distributed over six departments as follows:

System Development with a staff 21 is responsible for:
Development of new computer systems,
testing new computer systems,
personnel training.

Information Area with a staff of 6 is responsible for:

database creation,
supervision of database use,
implementation of standards,
management of technical library.

Computer Network Administration with a staff of 18 is responsible for:
data communications network administration,
systems support to linear subdivisions,
collecting and processing of wagon information,
information analysis,
information distribution.

Statistical Section with a staff of 32 is responsible for:
- the Statistical Accounting for freight and passenger system including;
document coding,
data entry,
data processing.

Technical Provision with a staff of 14 is responsible for:
the running maintenance of all technical equipment including;
computers,
large machines,
energy supply,
air conditioning etc.
Capital repairs are contracted out on a job by job basis.

Building Services with a staff of 9 is responsible for:
the care of the building and its repair.

1.4.2 Computer Hardware

The computer hardware inventory of the Georgian Railways will, with the abandonment of the obsolete 1970's vintage mainframe computers, consist of personal computers (PC's).

The inventory consists of 59 PC's, that are distributed as follows:

Computer-Calculating Centre	36	
Carriage Service		3
Wagon Service		1
Statistical Accounting	2	
Personnel		3
Consignment Note Processing	4	
Garabani station		1
Sadakhlo station		1
Poti station	1	
Batumi station	1	
Batumi wagon depot	1	
Samtredi wagon depot	1	
Samtredi Territorial department		2
Khashuri wagon depot	1	
Tbilisi marshalling yard	1	

All but five of the 59 PC's are linked in a network as either servers or clients.

The five stand alone PC's are employed in the Computer-Calculating Centre for statistical data entry.

1.4.3 Computer Software

Systems developed for use with the DOS computer operating systems were written in FoxPro-2.0 and FoxPro-2.6.

Systems developed for use with Windows were written in FoxPro for Windows-2.6.
Work is in progress on the conversion of these systems to Visual FoxPro-5.0.

The Local Area Network (LAN) is run under Windows NT.

It is planned, subject to the availability of financial resources, to upgrade file management by the implementation of the Oracle Relational Database management system.

1.4.4 Data Communications Network

The Georgian Railways have made significant progress in the development of a data communications network within the limits of existing data communications infrastructure and available finance.

The diagram shown below illustrates the extent of those developments.

The difficulties under which the Georgian Railways operate are demonstrated by the fact that while the nominal speed of installed modems is in the range 1200 bps to 33600 bps the real transmission speeds being achieved are in the range 200 bps to 9600 bps.

The Georgian Railways have recognised the benefits that accrue from networking personal computers (PC's) resulting in all but five being networked through this combination of local area network in Tbilisi and long distance communications to a number of centres including Moscow.

The binary synchronous links with Moscow and two of the stations are interfaced to the LAN through a combination of two IBM486 PC's and a data concentrator.

The networking of PC's will:
enable the distribution of data collection to the responsible department,
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.

The absence of good data communications is seen to be a major obstacle to the introduction of modern management techniques and operational controls.

The proposed TACIS Fibre-Optic cable from the Black Sea to the Caspian is seen to have the potential to make a major contribution to meeting the data communications needs of the Georgian Railways.

However, there is a lack of information on the boundaries of the proposed service particularly on issues such as the number of intermediate interface points and the provision in the planned configuration for data transmission connections.

Recognising the need to improve communications in the near-term, the Georgian Railways have initiated tests in the use of satellite communications as an interim measure and plan to install satellite communications at a number of stations starting in November, 1998.

The Georgian Railways perceive this to be an expensive but necessary strategy.

Satellite equipment at stations served by the TACIS Fibre-Optic cable will be transferred to other locations whenever the cable service becomes available.

The installation at Rustavi was at the planning stage when the above diagram was drawn.

1.5 Computing Techniques

1.5.1 Data Coding

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. That is the coding structures which support integration have also got to be integrated.

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 which represents 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.

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.

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 Georgian Railways.

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 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,
computer related investment decisions are made on the basis of the contribution to the improvement of the overall profitability of the Georgian Railways.

1.6 Recommendations

1.6.1 Accounting

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

The selected accounting package should:
- have a proven record of performance,
- be hardware independent,
- have vendor/agent support in Tbilisi,
- support integrated financial and management accounting,
- support multiple currency accounting,
- support the processing of non-financial data,

support multiple users,
have real-time validation of data at point of entry,
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 user access control in accordance with a hierarchy of needs.

The computerised accounting package system most suited to the needs of the Georgian Railways would most probably be parameter driven and accordingly adaptable to the changing world of evolutionary accounting standards and organisational re-structuring.

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.

It is appropriate that the Georgian Railways should endeavour to ensure that contracts for computer software do not restrict its ability to use the software in any part of the railway or ancillary services.

1.6.2 Human Resources

It is recommended that the installed Human Resources computer system should be extended on a phased basis throughout the railway organisation.

An estimated requirement of 150 PC's for this function made by the Head of Human Resources represents a major investment for a single application.

It is recommended that the estimate should be reviewed under a number of headings including:
the distribution of the human resources function in the reorganised management structure,
the opportunity for sharing of PC's between Human Resources and other functions such as payroll in smaller locations.

The effective use of the Human Resources computer system depends on its integration with the payroll function. Similarly, the introduction of integrated accounting calls for the automation of the payroll function.

It is recommended that the Georgian Railways should computerise its payroll function on the basis of a package software system which would be standard throughout the railway.

The selected system should:
operate in client / server mode,
be computer vendor independent,
produce the standard payroll documentation,
be compatible with the Human Resources computer system,
be compatible with the integrated accounting system,
support online enquiry facilities,
include an access control system based on a hierarchy of need.

1.6.3 Freight Management Systems

The inventory of freight related systems should be reviewed with the objective of developing an integrated approach to the collection and storage of data relating to all aspects of freight operations.

This investment in the freight management systems should also include commercial functions such as:
customer files,
information to clients,
real time computation of costs,
pricing and invoicing,
income statistics by source.

The system would also collect data on train movement in support of the train despatch function and as a basis of information for both management and customers.

Since freight and passenger trains share resources such as operating paths, the train despatching data should not be limited to freight operations.

The train despatching sub-system should provide information covering:
circulation requirements,
circulation timetables
planning,
circulation statistics,
analysis and forecasts.

This type of integrated development is most readily achieved in the context of a database management system such as Oracle.

The adoption of database techniques would:
reduce the volume of data-entry,
avoid the need for cross-checking inherent in situations where the same or similar data is collected through many systems in parallel,
improve the quality of data held on file,
increase the usability of the data,
increase the consistency of the data on which operational and management decisions are based,
lead to better management information.

It is recommended that a "pilot" commercial "information centre" should be established in Tbilisi to assess the benefits and refine the operation of the service to the Georgian Railways customers.

1.6.4 Passenger Reservations and Ticketing

The passenger ticket and reservations activity is manual.

The limited contribution of passenger services to the income of the Georgian Railways does not constitute a basis for an investment in the general computerisation of the reservations and ticketing activity.

However, the computerisation of reservations and ticketing by Azerbaijan Railways may necessitate the introduction of that system into Tbilisi passenger station for international trains to and from Baku.

Accounting details of ticket sales etc., should be submitted through computers installed for train despatch purposes.

1.6.5 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 warehouses should be linked to the Materials Manager's department,

the Georgian Railways should seek to obtain a software package for the 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.

1.6.6 Accounting in Enterprises

The manual accounting systems which are present in all enterprises should be replaced by the computerised accounting system adopted as standard for the Georgian Railways.

The implementation of an accounting system in an enterprise such as an engineering workshop should be based on the client / server model with a number of PC's linked to a server and printers on a LAN.

These LAN's would be linked to the Computing-Calculating Centre in Tbilisi as data communications became available.

1.6.7 Computer Calculating Centre

The reorganisation of the management structure of the Georgian Railways should be accompanied by a parallel review of the role of the Computer-Calculating 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 those personal computers.

Functional management should be given control over and responsibility for the running of their local 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 Computer-Calculating Centre consisting almost entirely of specialist technical and professional personnel,
enable the Computer-Calculating Centre management to concentrate on its primary role of system delivery and support.

The Statistical Section which is dedicated to the collection, coding and data entry of statistical data represents an obvious opportunity for the Computer-Calculating Centre to divest itself of activity which would be more appropriately located in the Statistics and Economic Analysis Department.

The work currently undertaken by the Technical Provision Department of 18 persons is normally contracted out to specialist providers of these services. It is recommended that the Computer Calculating Centre should follow this widespread practice.

If the Computer-Calculating Centre is to fulfil its role and make a necessary contribution to the modernisation of the Georgian Railways management information systems, it will have to undertake a number of tasks most notably:
build on its current technical skills base,
establish a supplier / customer relationship with the managers of functional units / enterprises,
maintain an inventory of computing resources, both hardware and software, throughout the Georgian Railways – this inventory should be synchronised with asset management in finance and accounting.

The staff profile of the Computer-Calculating centre should be reviewed to ensure that it includes 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 expertise will involve 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 Computer-Calculating Centre should an integral part of an overall management development plan within the context of the introduction of the new organisation structure and management methods.

The Computer-Calculating 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 Computer-Calculating centre and its customers will be best advanced within a formal context combining opportunities with responsibilities.

1.6.8 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 Georgian Railways personnel representative of the various enterprises and disciplines in the Georgian Railways.

The development of a coding structure is a prerequisite to the development of integrated management information systems for the Georgian Railways.

While the adoption of data collection techniques based on the power of the PC will no doubt reduce the user exposure to coding structures, system designers will still have a need to use such codes within their systems.

The coding structure design will have to encompass all activities in the Georgian Railways so that coding conflicts may be avoided as computer applications developed individually are 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 variety of activity in the Georgian Railways,
the range of enterprises that comprise the Georgian Railways,
the need to undertake an in-depth examination of a number of locations in each enterprise / function / department.

The final product of the Coding Structure Project will be a series of Coding Manuals for the Georgian Railways which 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.

1.6.9 Information Quality

It is recommended that:
the Georgian Railways 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.
prime data should, as far as is feasible, be entered by the person undertaking the activity to which the data refers,
the objective should be to have data-entry always 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,

1.6.10 Database

It is recommended that, if at all possible, a database management system such as Oracle should be adopted as the Georgian Railways 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.

1.6.11 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 Chairman of the Georgian Railways, or a Deputy nominated by him, would be guided by its assessment of how proposed projects would contribute to the achievement Georgian Railways business objectives in a competitive environment.

Project proposals would:
- originate in the business units / functions / enterprises,
- be assessed for technical feasibility by the Computer-Calculating 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 that 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 Computer-Calculating Centre. These Working Parties would be led by a nominee of the proposing Deputy.

The Computer-Calculating 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 Computer-Calculating 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 applications systems which yield improved services to the Georgian Railways 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.

1.6.12 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,
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.

1.6.13 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 an 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 Georgian Railways 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 Georgian Railways.

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.

The development of a coding structure reflecting the newly reorganised management structure and activities in the Georgian Railways should be addressed as a matter of priority in anticipation of the availability of resources both computer and communications.

The completion of the coding structure would provide the basis for the development of an overview of the Georgian Railways management information system 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 Georgian Railway 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 Georgian Railways and the availability of data communications facilities.

The project selection process should take into account factors such as the:
benefit accruing to the Georgian Railways 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 satellite communications strategy adopted by the Georgian Railways pending the arrival of the TACIS Fibre-Optic Cable is representative of the type of initiative which is appropriate in the near-term.

The management of the Computer-Calculating Centre should take the opportunity afforded by this "waiting period" to convert itself to the model for the future by divesting itself of "user tasks".

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 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.

1.8 Acknowledgement

The observations made in this report reflect the data made available during the study period and experience gained elsewhere.