

Distr.
GENERAL

UNCTAD/SDTE/TIB/4
23 January 2001

Original: ENGLISH

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

**Simplified customer-oriented information technology for
railways in developing countries:
the experience of Tanzania Railways Corporation**

Report by the UNCTAD secretariat

Preface

This report is based on a paper presented by Mr. R. D. Shamte, Chief Commercial Manager, Tanzania Railways Corporation (TRC), at the International Railway Congress Association/Union Internationale des Chemins de Fers (IRCA/UIC) Railway Seminar held in Stockholm, Sweden, from 5 to 7 July 1999. The theme of the seminar was customer-oriented rail information technology systems.

The report has been published in order to disseminate information on the experience of implementing ACIS RailTracker on a public railway in sub-Saharan Africa and to document the benefits that have been achieved.

UNCTAD would like to express its appreciation to the Director General of TRC for having authorized the publication of this report, which was written by his senior staff.

CONTENTS

| | Pages |
|---|-------|
| Introduction | 1 |
| I. What is RailTracker? | 1 |
| II. RailTracker Parameters | 3 |
| III. RailTracker Functions..... | 3 |
| IV. RailTracker Data Input | 5 |
| V. Data Collection and Transmission | 7 |
| VI. Data Integrity Checks and Quality Control | 8 |
| VII. RailTracker Output..... | 8 |
| VIII. Benefits of RailTracker | 10 |
| IX. Future Developments | 13 |
| X. Other Customer Information Systems | 13 |
| XI. Conclusions | 14 |

INTRODUCTION

1. This paper discusses customer-oriented information technology (IT) and systems that are being used by Tanzania Railways Corporation (TRC). TRC is one of the two rail networks in the United Republic of Tanzania covering the central and northern parts of the country. The total rail network is 2,600 kilometres long. In addition to the Tanzanian mainland, it serves Burundi, Rwanda, the eastern part of the Democratic Republic of the Congo and Uganda.

2. The major market segments are domestic traffic and transit traffic as well as passenger services. The domestic market accounts for about 60 per cent of the total freight market. Since 1992, TRC has been undergoing a restructuring programme financed by the World Bank, European Union, Kreditanstalt für Wiederaufbau, Canadian International Development Agency, Overseas Development Agency and the African Development Bank. The programme covers physical and organizational reviews and investments.

3. One of the priority items in the programme is the introduction of IT for improving operations and services to customers. It should be noted that the simplicity of the system derives from the fact that it is not fully computerized, i.e. electronic vehicle identification is not used. However, it is an on-line system with near real-time reporting on the rail network's performance.

1. The software system that has been implemented is part of UNCTAD's Advance Cargo Information System (ACIS). ACIS gives information on cargo, in advance of its arrival, across different modes and interfaces. By making appropriate information available, it allows the effective logistics management of a transport chain. ACIS is designed, developed and installed by UNCTAD. It is composed of a railway system called RailTracker, with PortTracker for ports, and LakeTracker and RoadTracker for lakes and roads respectively. Of the four systems, only RailTracker and PortTracker have been developed and are operational; the other two are still under development. This paper will discuss the RailTracker subsystem only.

I. WHAT IS RAILTRACKER?

5. RailTracker is a computerized wagon, locomotive and train reporting system that tracks cargo and wagons throughout their movement. It thus increases the efficiency of freight operations, enabling railways to plan the movement of wagons much more effectively since they always know where the wagons are and whether they are empty, loaded and fit for running. This improves short-term train planning since it is possible to know when empties will be available, and enables rolling stock and motive power to be maintained on the basis of up-to-date records of equipment use. RailTracker also enables the railways to satisfy customers' requests for information about the whereabouts of their goods at any given time. In addition, it generates statistics and performance indicators for decision-making.

6. The RailTracker system has various modules that perform certain functions. The following is a brief description of those modules.

Traffic operations module

7. This is the main module in the RailTracker system. It is used to record all the operations of rolling stock and consignments such as train movements, traffic operations, operations in respect of consignments and those related to vehicles. The RailTracker databases are updated via this module.

RailStats module

8. This module produces various statistics and performance indicators used by railway management to manage and control the operations of the railway. Policy makers can also use these indicators to formulate both short- and long-term plans for the transport sector.

Customer module

9. This module is used by railway customers to monitor the whereabouts of their consignments by connecting to the RailTracker system from their premises using a modem and telephone line. The information which the customer receives is filtered so that he can see only his own consignments. The module is now available on the Internet for on-line viewing from anywhere in the world.

Wagon turnaround module

10. The wagon turnaround module computes wagon turnaround for available wagons during the reporting period.

Fuel consumption module

11. This module is used to monitor the fuel consumption of each locomotive in the railway system per driver and per issuing depot for a particular period.

Reporting module

12. The reporting module is used to produce predefined reports from the system. The reports can either be viewed on the screen or printed on the printer.

Railway representative module

13. The railway representative module is used to enable foreign railway representatives to trace vehicles pertaining to their railway or a consignment to/from their network while they are on a foreign network.

The read only module

14. As the name implies, the read only module is used only to view information from the system. No system update can be done from this module.

II. RAILTRACKER PARAMETERS

15. Before the RailTracker system is installed, parameters concerning the railway network and its rolling stock need to be customized. The *railway network* is made up of the tracks connecting the many locations that are called stations. The segment of the track between two stations is called a main line. A railway always has an originating point (station), and any other point on its network can be indicated by its distance in relation to the originating point. When a station is at an interconnecting point between two railways, it is called an interchange point. Most railway activities take place in stations. Some of them are carried out in specialized areas such as workshops, warehouses or customer premises. These areas are called sidings. Elements of a railway network are identified in the RailTracker system through their codes, as follows:

- A two-letter code for the network itself;
- A three-letter code for each station;
- A one-letter code for the type of siding;
- A three-letter code for each siding.

16. As regards the vehicles, *trains* — the equipment used for transportation on a railway — are grouped into two major types:

- Locomotives or engines (code “E”);
- Wagons and coaches (code “W”).

17. The engines and wagons constitute the railway fleet. The main activity of a railway company is to run trains for the transport of persons and/or goods from one place to another. A train comprises at least one locomotive pulling wagons or coaches, empty or loaded. The RailTracker system identifies engines and wagons by their code number. Trains are also identified by their number and the date on which they are made up.

18. Goods given to a railway for transportation are called *consignments*. Customers provide the consignments. The formal agreement between a railway and a customer for transportation of his consignments is formalized in a document called a consignment note. A consignment note implies that goods are under the responsibility of the railway. A consignment note may cover the transport of more than one type of goods. Each type of goods on a consignment note is a consignment item. Customers are given a four-letter customer code. The type of goods is identified with a three-letter code called a commodity code.

III. RAILTRACKER FUNCTIONS

19. Various activities are carried out in order to ensure transport on a railway network. In order to collect and process information produced by railway activities, a breakdown of those activities into elementary activities called *operations* is made. There is a specific operation code to identify each elementary operation in the RailTracker system.

20. **Traffic operations** are operations that change the physical position or traffic status of a vehicle. When a vehicle is available for traffic (= fit), two statuses are possible:

- The vehicle can be attached, i.e. it becomes part of a train; or
- The vehicle is detached, i.e. it is not part of any train.

On a network, a fit vehicle is in one of the following locations (see figure 1):

- In the yard;
- In the customer siding; or
- On a foreign network.

When a vehicle is not available for traffic (= sick and stopped for traffic), it must be moved to the "sickline". Siding operations include placing on the siding (DS) or withdrawing from a siding (RS). The combination of physical positions and traffic status imposes constraints on traffic operations, such that only certain traffic operations are allowed for each location.

21. **Handling operations** are operations that change the status or the position of a consignment (item) with regard to:

- A foreign network;
- A customer siding;
- A yard.

There are four possible consignment statuses:

- Taken in charge: goods are accepted by the railway for transport. This means that a consignment note has been created and goods are under the railway's responsibility;
- Unloaded: the consignment item is not yet in a wagon;
- Loaded: the consignment item is in a wagon and the number is known;
- Provided: the consignment item has been delivered to the customer.

Like traffic operations, the combination of physical positions and traffic status imposes constraints on handling operations, such that only certain handling operations are allowed for each location (see figure 2).

22. There are some **special cases** for the functions covered by the RailTracker system:

- Positioning: for one reason or another, the location of a vehicle or cargo as recorded in the system might not reflect its physical location in the network. In such a situation, a positioning is used so that the recorded position of a vehicle or cargo matches its actual position;
- Milestone: a milestone is not a station or a siding, but any point on a railway main line. Traffic operations and handling operations are authorized at milestones in the case of a breakdown or an accident. For example, a train can be terminated at a milestone, and a wagon can be offloaded or loaded.

IV. RAILTRACKER DATA INPUT

Data collection, transmission and quality control team

23. Data collection, transmission and quality control require a well-composed, organized and coordinated team. The data input team comprises an input supervisor, data controllers and data feeders. Every team member must clearly know his responsibility and areas of operation. The supervisor should continuously coordinate, monitor and evaluate the activities and performance of the team. The RailTracker system architecture is shown in figure 3.

24. The following are some of the factors that were used in selecting the members of the TRC data input team:

- Each member has a thorough understanding of the railway network architecture (i.e. stations, customer sidings, warehouses, workshops, container terminals and interchange points);
- Each member has some idea of the commercial aspects of the railway (i.e. major commodities between locations, major customers, etc.);
- Each member knows the locations of the RailTracker equipment on the network (i.e. file servers, workstations, fax machines, etc.).

The team has been divided into reporting zones:

- Responsibilities are clearly outlined for each individual in the team for each zone, including the type of data he is supposed to collect and transmit and the mode of transmission;
- Adequate training is provided so that all team members are competent enough to undertake the responsibilities assigned to them;
- All the activities of the team members are continuously controlled, monitored and coordinated;
- The performance of the team is continuously reviewed so that weaknesses can be identified early enough and remedial action taken;
- Contingent measures are formulated. For example, what happens if the equipment normally used for data transmission is not available? What happens when one of the workstations on the network used for data entry is not working?

Data required by the RailTracker system

25. In order to function correctly, the RailTracker system has to be fed with all information affecting the status of any vehicle, its location and serviceability. The names of the operations and the forms used for reporting them are as follows:

- | | |
|----------------------|-------|
| - Loading a wagon | 01/05 |
| - Offloading a wagon | 01/05 |
| - Input border | 02 |
| - Exit border | 04 |

| | | |
|---|---|-------|
| - | Placing a wagon at the disposal of a customer on his siding | 550 |
| - | Restoring a wagon from a customer's siding | 550 |
| - | Shunting movement | 550 |
| - | Formation of a train | 02 |
| - | Operations en route (attaching/detaching a vehicle) | 03 |
| - | Termination of a train | 04 |
| - | Report vehicle sick or repaired | 06/07 |
| - | Report locomotive fuel issue | |
| - | Simple note | |

Some forms are used in a number of different operations because the information required is the same for those operations. For example, for form 01/05, the operation is either LO (loading a wagon) or OF (offloading a wagon).

26. The **train formation** report is prepared by the station where the train originates. It gives details of the train (i.e. train number, estimated time of departure, originating station, destination, etc.) and its composition.

27. The **train operations “en route”** report is prepared and sent by the stations between the originating and ending station of the train. It gives details of the attachments and detachments “en

28. The **train termination** report gives the composition of the train as at the time the train reaches the final destination.

29. In the RailTracker system a loading operation creates a consignment note. The **loading** information is collected and transmitted before the wagon involved in this operation is attached to the train.

30. **Offloading** can be done on the station or siding. The offloading operation breaks the link between the wagon and the consignment. A consignment note will remain active (i.e. in progress) until the offloading/provide operation is carried out.

31. **Restitutions/Withdraws** refers to the act of returning a vehicle from a private siding or warehouse. If the wagon is loaded, the RailTracker system will create a consignment note and load the wagon in the same operation. For loaded wagons, the consignment note is therefore transmitted before a withdrawal operation is carried out.

32. The **disposal/placement** operation is the reverse of the restitution/withdraw operation. The wagon is taken into the private siding or warehouse. If it is loaded, it is automatically offloaded.

33. The **take charge** operation creates a consignment note. However, unlike the loading operation, this operation does not link the consignment to a wagon. Taking charge implies that the railway has accepted the goods from the customer and therefore takes responsibility for them. The consignment note created can later be linked to the wagon using the loading operation.

34. The **provide** operation is the reverse of the take-charge operation. It delivers the goods that were initially offloaded in the yard to the customer. It does not involve any wagon.
35. A **shunting movement** moves a vehicle from/to a yard to/from the following sidings:
- Interchange point (I);
 - Workshop (W);
 - Container terminal (T).
36. The **input border** operation records the entry of a vehicle from a foreign network (the vehicle may be a foreign vehicle or a railway's vehicle coming back from a foreign network). If the vehicle is not yet created in the system, this operation will also entail creation of the vehicle. If the vehicle is loaded, this operation will also create a consignment note in the system.
37. The **exit border** operation records the exit of a vehicle from the railway's network to a foreign network (the vehicle may be foreign or the railway's own vehicle).
38. Through the **sick/fit** report the RailTracker system keeps a record of sick vehicles and their sickness codes. When a vehicle is sick, it is important that this information be transmitted so that the status of the vehicle can be updated. Similarly, when a vehicle is repaired, that information should be transmitted. Sick/fit data are the basis of accurate information on the availability of vehicles in the railway.

V. DATA COLLECTION AND TRANSMISSION

39. The data collector is supposed to collect data using the above forms immediately, i.e. when the operation takes place. Every area of operation has a staff member responsible for collecting data that must be transmitted within half an hour from the time of operation.
40. Before transmission to an input terminal, the data controller must check the documents to make sure that they are complete and accurate. He uses his operational experience and, of course, common sense to ascertain the correctness of the data. Some simple logical checks are used — for example, coal cannot be carried in a container; a certain commodity code may not be transported between certain locations; a certain type of vehicle cannot be in a certain part of the network, and so forth.
41. **Where to send the data?** Data are normally sent to the nearest workstation for data entry. However, depending on the equipment installed on the network and the way the team is organized, data may be transmitted to any other location (i.e. not necessarily the nearest workstation) on the network. These locations are defined in RailTracker reporting links (see figure 4).
42. **How to send the data?** The means of transmission should be available and accessible to the data controller. The mode of data transmission should always be the quickest possible one between the two locations. In the event of a breakdown in the links, every possible alternative reporting link is used. As a last resort, when all communication is down, information is sent by the train guard, the most

important thing being that it be sent as soon as possible. Alternative reporting links are, in order of preference:

- Telefax (where available);
- Teleprinter (where available);
- Telephone;
- Train guard.

VI. DATA INTEGRITY CHECKS AND QUALITY CONTROL

43. "Data integrity" means that the information input in the computer system has to conform to certain rules. The RailTracker system is programmed to perform as many logical checks on the input data as possible, using the fixed data it has in its files plus previously recorded data on the same subject. Rejection messages will be issued if the data keyed in are incorrect. These messages are self-explanatory and clearly understood. Errors have to be checked with the source of information and corrected. Since this checking and correction can take quite a long time, emphasis is always placed on achieving accuracy at the first attempt by writing clearly and taking care when collecting the information.

44. Data quality control is an important task in the RailTracker system as it is one of the activities aimed at ensuring the provision of reliable, timely, accurate and complete information. The input supervisor uses the RailTracker modules, particularly the traffic module, to check the reliability, accuracy, timeliness and completeness of the data in the system. In performing this task, he applies his experience in railway operations as well as logical judgement.

VII. RAILTRACKER OUTPUT

45. This section concentrates on the standard outputs a user can access from within the different RailTracker modules. The main modules that include reporting facilities are listed below:

- Traffic operations: for traffic operators;
- Consultation: for traffic and commercial users;
- Foreign railway consultation: for foreign railway management (resident representative);
- Customer: for commercial users;
- Reporting: for management and operations staff;
- Automatic RR4 reports; management and other staff.

Traffic operations module

46. There are three main sub-menus dedicated to reporting and output facilities in this traffic operations module, which is the main application for the data entry operators and supervisors:

- Find (a vehicle, consignment, train, container, goods reference);
- List (vehicles in station, critical vehicles, train composition, etc.);

- Vehicles to manage (foreign vehicles in the network, our vehicles out, operations at a location, etc.)

These are real-time reports, which are used at the operational level.

Consultation module

47. The consultation “read-only” module has exactly the same facilities as the transport operations module in terms of output reporting except for reports focusing on operations (List Train Operations, Manage Vehicles Operations at a Location, Manage Goods Operations at a Location, etc.).

Foreign railway consultation module

48. This special consultation “read-only” module has been designed for foreign railway managers. It is exactly the same as the consultation module except that its main feature is a filter operating on foreign objects". A foreign railway manager can access only the following types of information:

- All his wagons;
- Local wagons with cargo consigned to his network;
- Local wagons with cargo originating from his network.

His wagons carrying local traffic are shown, although their contents are hidden for obvious reasons of confidentiality.

Reporting module

49. The reporting module features two types of reports: reports that can only be printed (no screen display) and reports that can both be printed and displayed (run menu). The run menu has two sub-menus: situation report and control report. Control reports are specifically used by the system supervisor for checking data consistency or coherence. All run reports are based on the notion of a “pipeline”: in the pipeline or out of the pipeline. A vehicle is in the pipeline when it has a scheduled destination:

- A vehicle attached to a train has a destination — its own or by default the destination of the train;
- A loaded vehicle has by default the destination of the goods it is carrying;
- An empty vehicle which is booked or which has a transport order (next step after an ASAP Instruction).

A vehicle is out of the pipeline when it is available for immediate use by Traffic, not loading, not attached and has no scheduled destination.

Customer module

50. The customer module is extremely important for the Commercial Department. Briefly, an internal user of the railway (there is a special flag to define his access) can access all customers, one at the time

of course. To obtain access to the Customer Information System, the internal user selects, from the customer module main menu, the code of the customer he wants to analyse by moving the cursor down the list (a search argument can be selected through Shift + >). Once this code has been selected, it operates as a filter and what basically is seen is what this selected customer would see if he were connected to the system.

Automatic RR4 reports

51. These are sets of customized reports produced every morning at 0700 hours and distributed to all TRC senior and upper management for use in their strategic and operational planning. The reports give different exception scenarios of the rolling stock and loading performance of the previous day. These include backlog for clearance, daily loadings including revenue collected, stranded loads, container carriers' positions, inward wagons awaiting offloading, fleet disposition, loading by customers and foreign wagons in the system. The module has great flexibility to create a wide range of reports covering many areas of operations for any required period. This has allowed TRC to develop a Management Information System as outlined below.

VIII. BENEFITS OF RAILTRACKER

52. There is no doubt that the major purpose of the RailTracker system is the generation of advance customer information. Complemented by minor manual operations, the system has achieved its objective within TRC. Once the Automatic Vehicle Identification System and electronic data interchange (EDI) system have been introduced, further accuracy will be achieved.

53. Improvement in telecommunication facilities is also required in order to reduce reporting delays and the costs of operating the system. Current performance supplies data that is two hours behind real time. For TRC, however, it is a great improvement that has provided significant benefits to TRC, both qualitative and quantitative.

54. While it has provided customers with current information on the location of their consignments, the system has been more beneficial to TRC management, providing them with useful information that has enabled TRC to serve its customers better. Achievements for both groups are explained below.

TRC management benefits

55. The successful installation and implementation of the RailTracker computer system has had significant benefits for TRC at both strategic and tactical management levels. Graph 1 illustrates the improvement in performance achieved from 1997 to 1999.

56. The Automatic RR4 reports have enabled senior and upper management to be well informed of operations, with the aim of satisfying customers and improving performance.

57. The major achievements of the information systems have been as follows:

(a) Reduction of:

- (i) Wagon turnaround time from an average of 18 days at start in 1994 to 13 days;
- (ii) Wagon detention at terminals from 8 days to an average of 4 days;
- (iii) Average daily interchange balance from 203 to 108 wagons;
- (iv) Average dwell time of foreign wagons from an average of 28 days to 12 days;
- (v) Locomotive detention at terminal and in transit yards;
- (vi) Transit times from 15 days to an average of 3 days.

(b) Increase in:

- (i) Locomotive and wagon utilization from 280 kilometres per day in use to 380 kilometres for locomotives and from 73 to 120 kilometres per wagon day;
- (ii) Wagon productivity from an average of 20 loadings to 28 loadings per annum.

(c) The production of on-time performance statistics plays a greater role in the development of strategies for improvement of the business and organization in general.

(d) Commercial benefits:

- (i) In a bid to deliver services as agreed with some customers or as targeted by TRC, monitoring of wagon movements after acceptance by TRC is done daily to ensure that cargo is delivered on schedule;
- (ii) One of major impacts of the system is the ability to inform customers of the status and position of their cargo while it is on the TRC network;
- (iii) The ability to trace and control wagons has also meant that wagons can be supplied to customers more reliably;
- (iv) It is possible to detect within a maximum of 12 hours any wagons not paid for, in addition to knowing the revenue earned daily. The latter possibility enables proper control of payments and credits;
- (v) The availability of daily freight loading statistics serves as a good indication regarding the achievement of weekly targets.

Customer information systems

58. In addition to enabling railway staff to obtain customer information, the module enables the customer to view the system directly through:

- The Internet or;
- By direct connection to the system via leased communication lines.

59. The customer module and other modules such as the traffic operations module enable the following information to be available to the customer.

- (i) Daily status of cargo/wagon: Customers can view directly from the system the status of their cargo when it is on the TRC network. When customers are not connected and, upon their request, TRC prints out the information and faxes it to them. This service is available for any customer, but major customers are the main users. For small shippers the information is normally obtained from the Customer Information Centre. The report provides all the details of the consignment and its position at the time of tracking. The status inquiry regarding the consignment/wagon can be in terms of all the customer's consignments in the system or for a specific one.
- (ii) Container tracking: Customers are able to inquire about their containers loaded on TRC wagons and ascertain their status and position on the network. There is no complementary system for tracking containers that are not on TRC wagons. The container is treated as a commodity: once it is offloaded from a wagon it is no longer tracked.
- (iii) Customers are also made aware of the wagons waiting offloading by them. This information is faxed to customers whenever delays in offloading occur in order to help them avoid demurrage charges.
- (iv) As in (iii) above, a printout of wagons placed in customers' sidings is submitted to customers to remind them of the supply and the need for early handling of the wagon.
- (v) Weekly/monthly transaction reports are provided, which include all the details of the consignment note, including freight paid or debited. Customers use such information for preparation of payments and also to countercheck their records and transactions with TRC. This information will be provided through a billing module when it starts operating.
- (vi) There are few customers who operate/own their own wagons in TRC. The railway representative module is configured to customers' particulars to enable them to monitor their wagons.
- (vii) The improvements in information systems, together with other corporate strategies, have now enabled TRC to capture a sustainable demand for services compared with the low demand in the early 1990s. Customer surveys carried out by TRC have indicated that information on the location of cargo ranks second among customer needs.

IX. FUTURE DEVELOPMENTS

60. The flexibility of the RailTracker system has made it easier for the development of some of the above-mentioned modules which were otherwise not available in the original system. Additional functionality and modules have been requested, namely:

- Empty wagon distribution;
- Mechanical maintenance;
- Terminal operations;
- Wagon interchange;
- Demurrage charges;
- Automatic vehicle identification.

Some of these modules have been developed but need to be adapted to TRC's system. Others still need to be developed and will be developed as and when funds are available.

61. The empty wagon distribution, wagon interchange and demurrage charge modules need minor modification to allow for automatic operations since most of the basic information is currently available. Calculation and applications are done manually.

X. OTHER CUSTOMER INFORMATION SYSTEMS

62. TRC has other computerized systems that use RailTracker data for the production of reports and statistics or for operational planning.

63. The *wagon supply module* has two components — a demand planning module that is operated outside RailTracker and the empty wagon distribution module.

64. The *demand planning module*, developed by Coopers & Lybrand during a commercialization study of TRC, stores all the information about customer requests for wagons. The input consists of:

- Customer profile: name, address and nature of business;
- Customer attributes in terms of payment methods, loading and offloading ability, volume of business, type of traffic, e.g. transit or domestic, siding capacity, etc.

65. Information on customers is obtained manually through completion of forms and then the module is updated daily.

66. In the course of the process:

- Automatic weighing of the attributes is carried out to indicate the ranking of customers;
- The system produces a list of customers for loading according to ranking, first in, first out and priority of cargo;
- After the list is prepared, cargo is manually matched with wagons from the RailTracker empty wagon report and allocation of wagons is carried out.

67. When the empty wagon distribution model is completed, data will be fed into the wagon supply module and there will be automatic generation of the allocation of wagons.

68. **SETIM** is a customer billing system that has been installed and will shortly start operations. It is directly connected to RailTracker. It will provide RailTracker with all information regarding loading, i.e. details of the consignment. Once the customer has provided details of his consignment, automatic billing will be done and a copy of the waybill printed. The information will then be fed into RailTracker.

69. It is expected that in future some customers will be connected to the system and will therefore enter their details directly into it. Since all stations will not be connected initially, the invoice will still be billed at the stations and fed into the system through RailTracker.

70. **TROLL** is a module that provides basic operations statistics for use in the costing model OSCAR. This costing model operates outside RailTracker and although it is not accessible to customers, it is important to mention that it is valuable because of its contribution to customer service.

XI. CONCLUSIONS

71. RailTracker has contributed to improving services for TRC customers and utilization of rolling stock. It has lifted TRC from the days of “ask tomorrow” to nearly perfect information on the location of cargo.

Figure 1

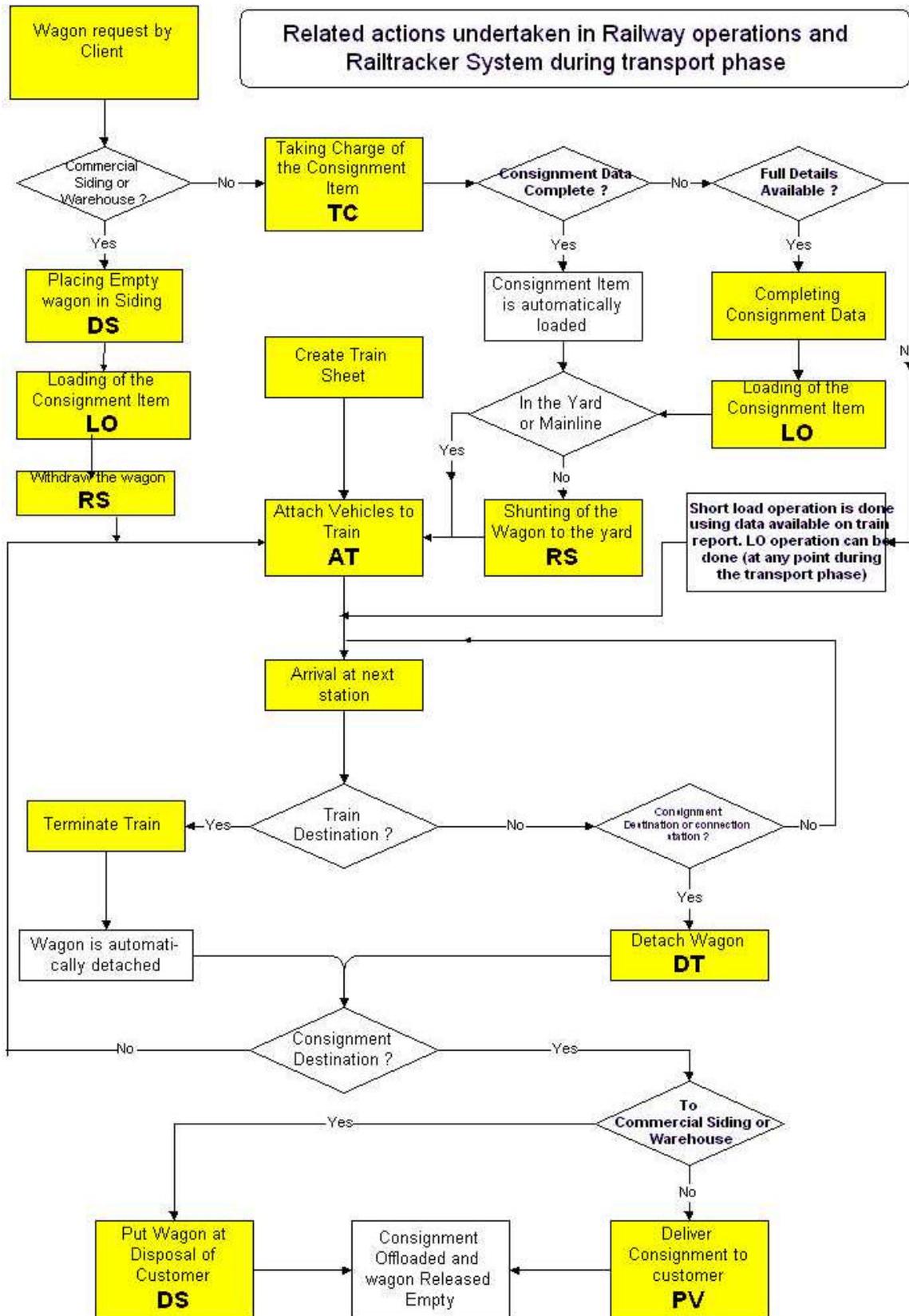
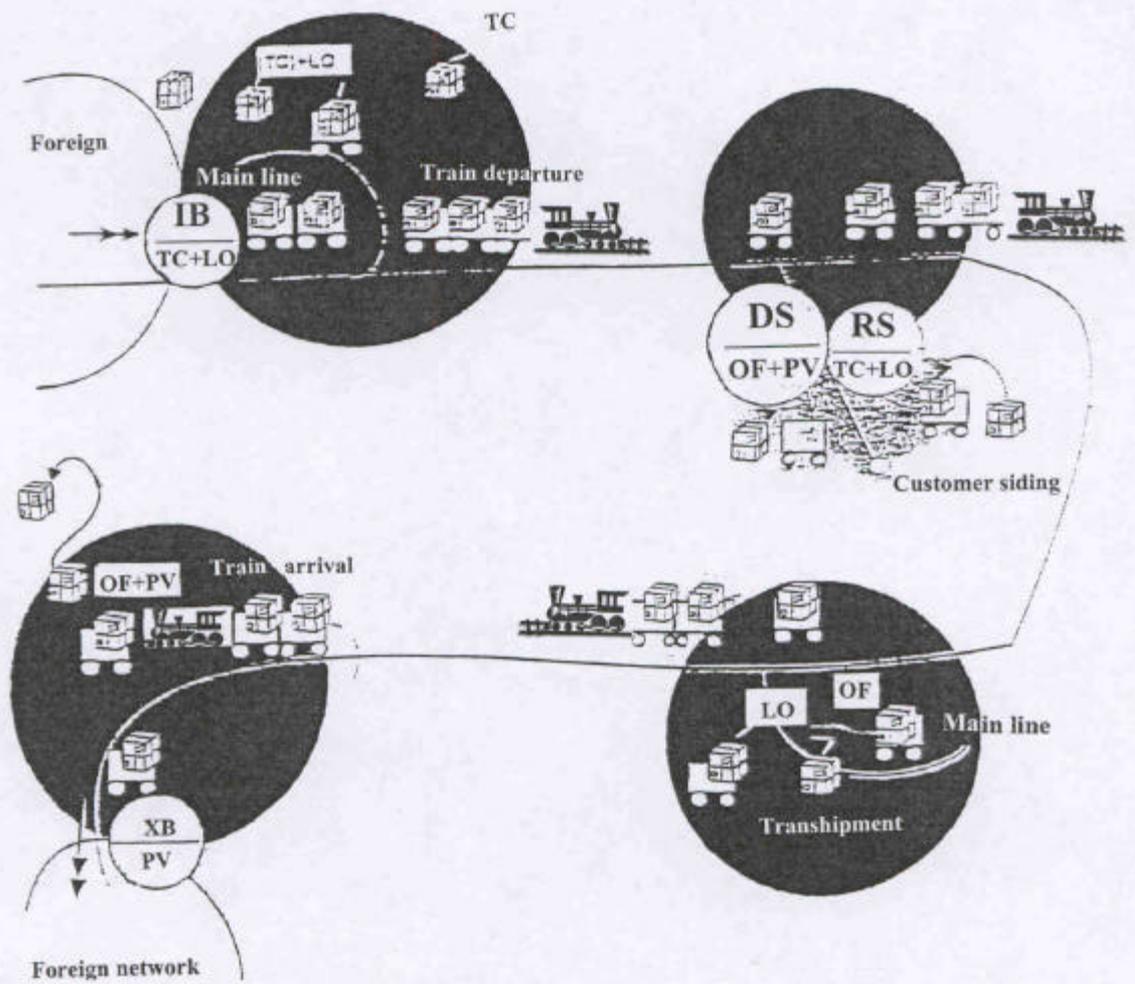


Figure 2

Various traffic and handling operations in RailTracker



Symbols:

| | | | | | | | | |
|---|---|---|------------------|----------------|----------------------------------|--|---|---|
|  |  |  | RS | LO | $\frac{IB}{TC+LO}$ |  |  |  |
| Engine | Wagon | Consignment | Oper. on vehicle | Oper. on goods | Combined oper. on goods vehicles | Station | Railway siding | Customer siding |

Figure 3

Tanzania Railways Corporation - ACIS Railtracker Architecture

August 1998

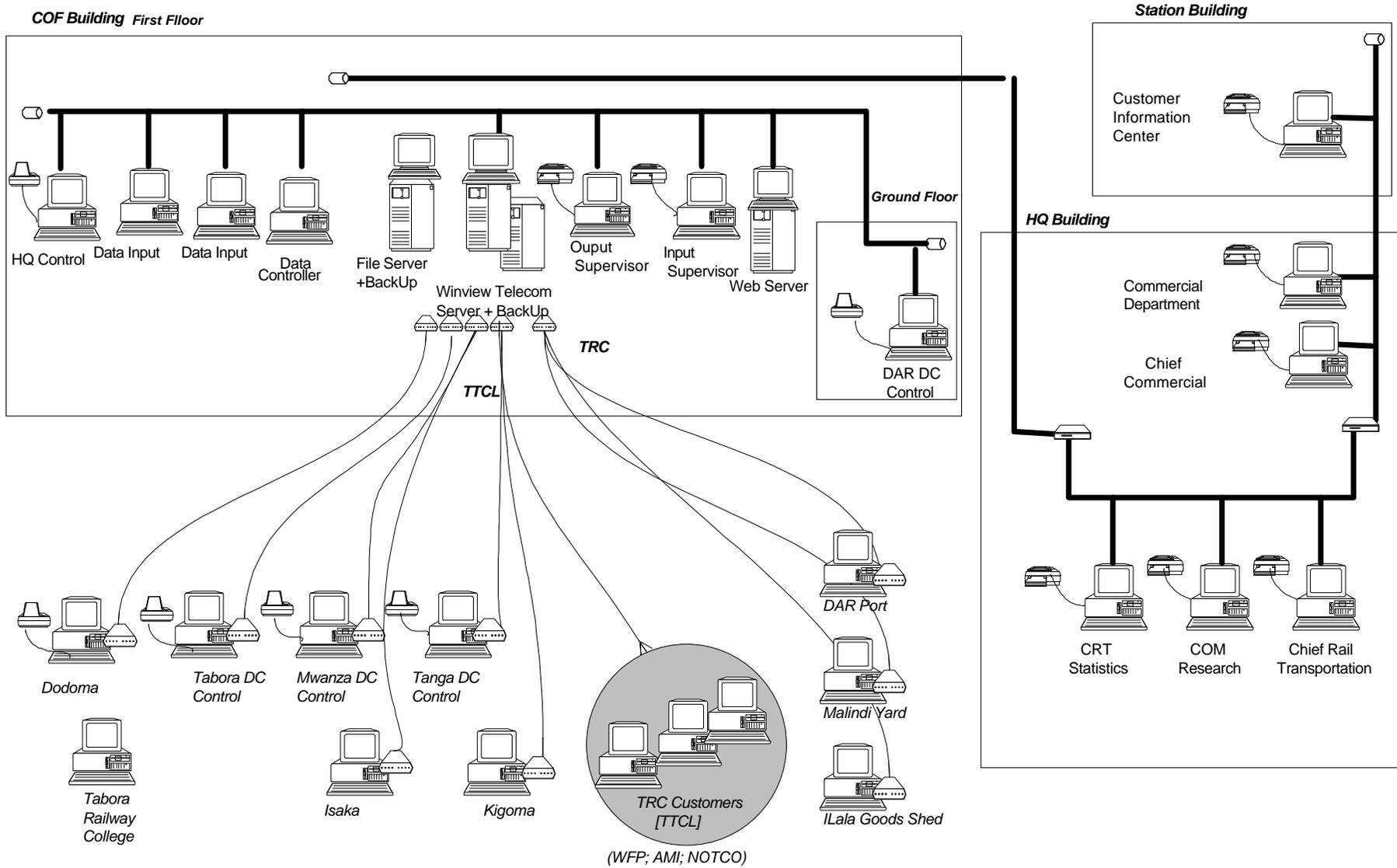
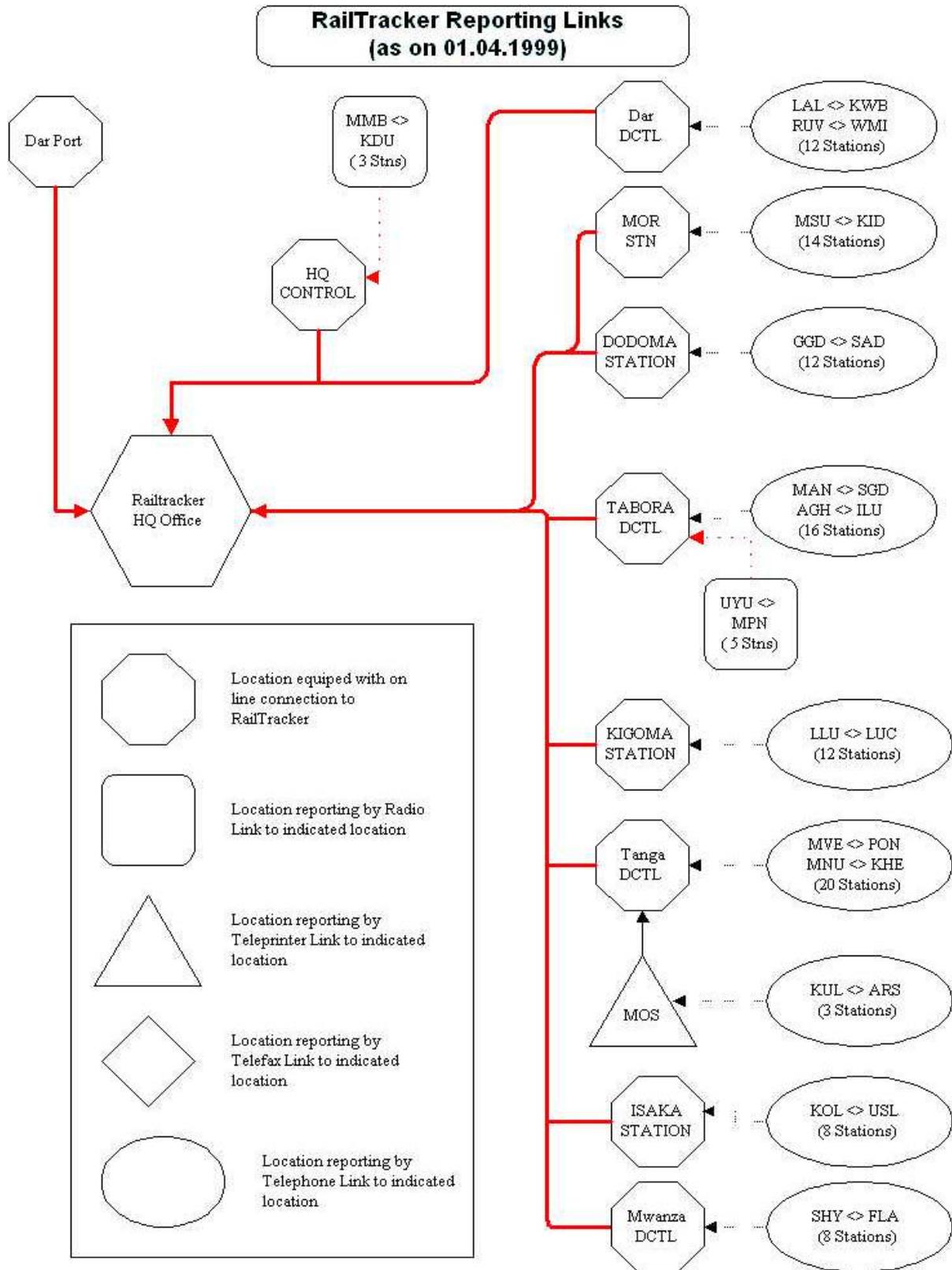


Figure 4



Graph 1 TRC Performance Indicators Comparison 1997/1999

