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Vehicle and Route Optimization

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KUMARAGURU COLLEGE OF TECHNOLOGY

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COIMBATORE - 641006

BONAFIDE CERTIFICATE

Certified that this project report titled **"Vehicle and Route Optimization"** is the bonafide work of **"Mr. S.Mohan"** (Register Number: **71206621032**) who carried out the research under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ramco

RS/HR/PJT120 25 June 2009

The Head Of The Department
Kumaraguru College of Techonology
Coimbatore

Dear Sir / Madam,

This is to certify that **Mr Mohan S,** (Regn. No.71206621032) final year MCA student of your college has successfully completed the project titled **"Development of Vehicle and Route Optimization module"** under the guidance of **Ms Dinesh Kumar P, Technology Consultant** from **04th December 2008 to 15th June 2009** in our organization as part of his course curriculum.

Thank you.

for **Ramco Systems Ltd.**

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ABSTRACT

The project **"Vehicle and Route Optimization"** is developed for the TVS Logistics Services Limited. The objective of this project is to optimize the vehicle and route for transferring cargoes from one location to another. It also provides proper utilization of vehicle and proper selection of cargoes.

Vehicle selection involves finding a suitable and right type of vehicle from a list of available vehicles on contract based on available cargoes on a given day for a particular route or trip.

In route selection, the total distance of the routes covered by the vehicles should be optimized and also each consignor should be visited precisely once. TVS Logistics requires route optimization for both milk run and line haul method.

A vehicle and route optimization system has been developed based on combination optimization techniques. The techniques are efficient methods to find a suitable vehicle from a list of available vehicles. Planning vehicle routes for delivery must consider combinations of vehicles, loads, and delivering orders satisfying tight and various conditions.

This project has been developed using C# .Net as front end and SQL Server 2005 as back end.

ACKNOWLEDGEMENT

The satisfaction that accompanies the successful completion of any task would be incomplete without mentioning the names of people who made it possible, whose constant guidance and encouragement crowns all efforts with success.

I convey my earnest thanks to Professor **Mr.R.Annamalai**, Vice Principal, Kumaraguru College of Technology, Coimbatore for the successful completion of the project work.

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I would like to express my sincere thanks and deep sense of gratitude to my Guide and Project Coordinator **Mrs. V. Geetha,** Assistant Professor, Department of MCA as without her best guidance it would not have been possible for me to successfully complete this project.

It is my pleasure to express my profound gratitude to **Ramco Systems Limited**, Chennai for admitting into this project. I am thankful to **Mr. P. Dinesh kumar, Project Manager** of Ramco Systems Limited, for his excellent guidance, timely suggestions and constant support in all my endeavors.

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List of Abbreviations

Acronyms	Expansion
CWB	Cargo Weight Bill
WH	Ware House
UOM	Unit Of Measure
DFD	Data Flow Diagram
ERP	Enterprise Resource Planning
ASP	Active Server Pages
CLR	Common Language Runtime
CTS	Common Type System
MSIL	Microsoft Intermediate Language
SQL	Structured Query Language

CHAPTER 1

INTRODUCTION

1.1. COMPANY PROFILE

Ramco Systems Limited is a software products and services provider for a variety of enterprises. The company was incorporated in India, and has presence world over. Ramco Systems has over 600 global customers running its business-process-web-centric enterprise suite of applications and is the world's largest provider of Aviation Maintenance & Engineering (M&E) and Maintenance Repair & Overhaul (MRO) Software Solutions.

Ramco Systems Limited, together with its subsidiaries, provides enterprise software and services worldwide. The company provides its business application services by using the Business Process Delivery System (BPDS) system. BPDS are a suite of products that help enterprise customers to transform their business applications. It includes the Ramco Business Process Platform that models business processes, creates new business services, and assembles applications; Ramco Business Services that provides approximately 1,000 pre-configured business services for reuse.

Ramco Business Analytics that provides business intelligence through the use of dashboards, key performance indicators, and a balanced scorecard framework. Ramco provides its solutions to banking, insurance, aviation, manufacturing, e-governance, automotive components, food production, chemicals, textiles, real estate & construction, and retail industries.

Ramco Technology

Ramco Virtual Works is a new breed of enterprise software that facilitates Flexible and Robust Business Process and Focused Analytics. Ramco Virtual Works provides complete and continuous alignment of business processes and applications. Virtual Works is constituted by a Model driven development Environment, SOA based Enterprise Solution Architecture , a Business Services Repository, Implementation and Configuration tools,

Enterprise Information Management platform and An Enterprise Event Bus. Coupled with Ramco model-driven platform, the Enterprise Information Management platform can provide business intelligence through the use of dashboards, indicators, and a balanced scorecard framework.

The Enterprise Information Management Platform provides Data Consolidation Services, Business Activity Monitoring, Performance Management, Enterprise Decision Management and Conformance Management. Leveraging pre-built business services assets used in application assembly, Ramco Virtual Works provides a ready-made reporting and analytics capability for business applications. The platform can help the organization deliver the responsiveness it needs to stay ahead of the competition.

1.2. OUTLINE OF PROJECT

TVS Logistics requires the optimization of following areas

- Vehicle optimization
- Route Selection

1.2.1 Vehicle Optimization

TVS Logistics currently employs vehicles from service providers and engages innumerous services (contract) between various locations on any day either as point to point or with multiple points. Vehicle pool of TVS Logistics is entirely contracted and is highly dynamic in its availability with almost all types of vehicles included in the pool.

Vehicle selection involves finding a suitable and right type of vehicle from a list of available vehicles on contract based on available consignment on a given day for a particular route or trip.

1.2.2 Route Selection

Route for the vehicles must be constructed in such a way that

- Total distance of the routes should be optimized, the number of vehicles to be used shall be chosen freely.
- Each consignor should be visited precisely once.
- Number of vehicles needed for servicing the consignors shall be minimized, by breaking ties and by choosing the solution with lowest total travel cost.
- Vehicles must be assigned in such way that the capacity of the vehicles is utilized for 100% weight and 95% volume.

CHAPTER 2

SYSTEM ANALYSIS

System analysis involves the process of diagnosing, interpreting and helps us to propose a new system. This chapter describes existing and proposed system.

2.1. EXISTING SYSTEM

The existing system is not a systematic. The vehicles and route were selected manually, so there is a less chance to select the best vehicle and route for transferring cargoes from one location to another. There is no proper utilization of weight and volume for selected vehicles. The cargoes also were selected manually, which may result in ignoring some cargoes completely so that they have to send using another vehicle which involves unnecessary cost.

2.2. PROPOSED SYSTEM

The main objective of proposed system is vehicles must be assigned in such way that the capacity of the vehicles is utilized for 100% weight and 95% volume. In route selection, the total distance of the routes covered by the vehicles should be optimized and also each consignor should be visited precisely once, by breaking ties and by choosing the solution with lowest total travel cost.

2.2.1. Route Selection Scenario

The proposed system requires route optimization for both milk run and line haul method.

2.2.1.1. Milk Run Scenario

Cargo weigh bill for that particular day for milk run and redelivery are the basic input of milk run route optimization. Rejection material and returnable material will be additional inputs to the problem. Milk run routes established by TVS Logistics shall be considered in this case. However this can be deviated under two conditions.

- When the vehicle capacity in terms of weight and volume is greater than the load availability in terms of weight and volume for the established milk run route, then the locations near such routes also shall be considered and a new route shall be formed so that volume and weight requirements are met.
- When the vehicle capacity in terms of weight and volume is less than the load availability in terms of weight and volume for the established milk run route, then the solution shall provide the following options like sub routes within established milk run route so that volume and weight requirements are met.

2.2.1.2. Line Haul Scenario

In the case of Line Haul route optimization, while considering load availability in terms of weight and volume to be transported between two points say A and B, all the enroute locations between points "**A**" and "**B**" (say "**C**", "**D**") shall also be considered such that if any consignment need to be picked up or delivered to such enroute points "**C**" or "**D**" shall be honored during the trips.

Parameters that play a crucial role in vehicle selection are

- Valid contract availability for the vehicle for the given route from the company
- The vehicle capacity and its fit to run condition
- The validity of permit
- The transit time
- The service provider's performance level

- Nature and type of consignment such as stackabiltiy
- Quantity of the consignment– available for dispatch, pickable as scheduled, returnable and faulty material.
- The readiness for the dispatch of the consignment

CHAPTER 3

DEVELOPMENT ENVIRONMENT

This chapter describes the hardware and software requirements for the application.

3.1. HARDWARE REQUIREMENTS

The hardware support required for deploying the application are:

Processor	:	Inter Pentium IV 2.4 GHz
RAM	:	256 MB
Hard Disk	:	40 GB hard disk

3.2. SOFTWARE REQUIREMENTS

The software support required for deployment are:

Operating System	:	Windows XP
Front End	:	C# .Net
Back End	:	SQL Server 2005

3.3. PROGRAMMING ENVIRONMENT

3.3.1. Microsoft .NET Framework

The .NET Framework is an integral Windows component that supports building and running the next generation of applications and XML Web services. The .NET Framework is a large set of class libraries that can be used for many programming languages, like Microsoft's C#, Visual Basic, Managed C++ and more. So the first thing we notice here is that the .NET Framework class libraries can be used for more than one programming language.

Besides the Class Libraries, the Framework provides a Common Language Runtime (CLR) that manages the execution of any .NET application written in it using a .NET programming language. Simply put, the .NET Framework consists of Class Library that provides the common system services and functions that you will use and extend in your applications, and an Execution Environment that manages .NET Applications. The functionality provided by the Class Library will help you to develop Windows applications, Web applications, distributed applications and even let you integrate XML and XML Web services into your applications.

C# .NET

C# .Net is a new programming language from Microsoft designed specifically to target the .NET Framework. Microsoft's .NET Framework is a runtime environment and class library that dramatically simplifies the development and deployment of modern, component-based applications.

C# supports concepts such as inheritance, encapsulation, polymorphism, and interface-based programming. C# supports common C, C++, and Java language constructs such as classes, structures, interfaces, and enums, as well as more novel constructs such as delegates, which provide a type-safe equivalent to C/C++ function pointers, and custom attributes, which allow annotation of code elements with additional information.

In addition, C# incorporates features from C++ such as operator overloading, user-defined conversions, true rectangular arrays, and pass-by-reference semantics that are currently missing from Java.

Unlike most programming languages, C# has no runtime library of its own. Instead, C# relies on the vast class library in the .NET Framework for all its needs, including console I/O, network and file handling, collection data structures, and many other facilities.

Compilation of C#

When we write an Application in C# the compiler doesn't generate a binary file (like traditional compilers) but rather it generates a file (for now you can call this file a .NET Module) that contains Microsoft Intermediate Language (MSIL) code.

The Common Language Runtime (which is the execution environment for the .NET Framework Applications) has a compiler called Just-In-Time, or the JIT Compiler, which will compile the MSIL Instructions into native CPU Instructions upon the first execution of your application methods on a one-by-one basis. I think this needs a little more explanation.

Assemblies

Every time you compile C# code the file produced (.dll file or .exe file) is called an Assembly. The Assembly is a self-describing component; when you compile the source code files the compiler emits information about the types contained in the application, along with other information that is needed by the runtime (such as what files are needed to run the application).

3.3.2. SQL Server 2005

Database

A database is a structured collection of data. Data refers to the characteristics of people, things and events. SQL Server stores each data item in its own fields. In SQL Server, the fields relating to a particular person, thing or event are bundled together to form a single complete unit of data, called a record (it can also be referred to as raw or an occurrence). Each record is made up of a number of fields. No two fields in a record can have the same field name.

During an SQL Server Database design project, the analysis of your business needs identifies all the fields or attributes of interest. If your business needs change over time, you define any additional fields or change the definition of existing fields.

SQL Server Tables

SQL Server stores records relating to each other in a table. Different tables are created for the various groups of information. Related tables are grouped together to form a database.

Primary Key

Every table in SQL Server has a field or a combination of fields that uniquely identifies each record in the table. The Unique identifier is called the Primary Key, or simply the Key. The primary key provides the means to distinguish one record from all other in a table. It allows the user and the database system to identify, locate and refer to one particular record in the database.

Relational Database

Sometimes all the information of interest to a business operation can be stored in one table. SQL Server makes it very easy to link the data in multiple tables. Matching an employee to the department in which they work is one example. This is what makes SQL Server a relational database management system, or RDBMS. It stores data in two or more tables and enables you to define relationships between the tables and enables you to define relationships between the tables.

Foreign Key

When a field is one table matches the primary key of another field is referred to as a foreign key. A foreign key is a field or a group of fields in one table whose values match those of the primary key of another table.

Referential Integrity

Not only does SQL Server allow you to link multiple tables, it also maintains consistency between them. Ensuring that the data among related tables is correctly matched is referred to as maintaining referential integrity.

CHAPTER 4

SYSTEM DESIGN

The activity of proceeding from an identified set of requirements for a system to a design that meets those requirements. This chapter describes the data model and process model of the application.

4.1. DATA MODEL

This section describes various data model used in the application.

4.1.1. Table Structure

The tables for the application structures are shown in Tables 4.1.1.1 to 4.1.1.9

Table Name: Warehouse_master

Description : This table stores all the information about warehouses.

RAMCOBL138.t...house_master

Column Name	Data Type	Allow Nulls
	varchar(30)	☑
City_Name	varchar(30)	☑
WH_Name	varchar(30)	☑
WH_Code	varchar(30)	☐
WH_Type	varchar(30)	☑

Table 4.1.1.1 Warehouse_master

Table Name: Route_Code_Master

Description : This table contains the information about the vehicle routes.

RAMCOBL138.t...e_Code_Master

Column Name	Data Type	Allow Nulls
	varchar(30)	☐
Nature_of_Movement	varchar(30)	☑
Controlling_Location	varchar(30)	☑
Effective_From_Date	datetime	☑
Transit_Time	numeric(18, 0)	☑
Time_UOM	varchar(30)	☑
Distance	numeric(18, 0)	☑
Distance_UOM	varchar(30)	☑
Route_type	varchar(30)	☑
Warehouse_Code	varchar(30)	☐
Mode_of_Transport	varchar(30)	☑
Cumilative_Distance	numeric(18, 0)	☑
Cumilative_Transit_Time	numeric(18, 0)	☑

Table 4.1.1.2 Route_Code_Master

Table Name: Location

Description : This table stores all the information about hubs.

RAMCOBL138.te... dbo.Location

Column Name	Data Type	Allow Nulls
	varchar(30)	☐
Location_Type	varchar(30)	☑
Location_Name	varchar(30)	☑
		☐

Table 4.1.1.3 Location

Table Name: Available_Vehicle_Master

Description : This table contains the information about the available vehicles.

RAMCOBL138.te...ehicle_Master

Column Name	Data Type	Allow Nulls
	varchar(30)	☑
Reg_No	varchar(30)	☐
Transport_Medium	varchar(30)	☑
Status	varchar(30)	☑
Vehicle_type	varchar(30)	☑
From_Date	datetime	☑
To_Date	datetime	☑
Ref_Location	varchar(30)	☑
Cost_Driver	numeric(18, 0)	☑
Unit_Cost	numeric(18, 0)	☑
Mileage	numeric(18, 0)	☑
guid	varchar(30)	☑
		☐

Table 4.1.1.4 Available_Vehicle_Master

Table Name: Vehicle_Capacity

Description : This table stores all the information about vehicle capacity.

RAMCOBL138.te...icle_Capacity

Column Name	Data Type	Allow Nulls
	numeric(18, 0)	☑
Width	numeric(18, 0)	☑
Height	numeric(18, 0)	☑
LWH_UOM	varchar(30)	☑
Volume	numeric(18, 0)	☑
Volume_UOM	varchar(30)	☑
Capacity	numeric(18, 0)	☑
Capacity_UOM	varchar(30)	☑
Reg_No	varchar(30)	☑

Table 4.1.1.5 Vehicle_Capacity

Table Name: Vehicle_permit

Description : This table contains the information about the available vehicle permit.

RAMCOBL138.te...ehicle_permit

Column Name	Data Type	Allow Nulls
	varchar(30)	☑
Permitted_State	varchar(30)	☑
permission	varchar(30)	☑
Permit_Valid_Date	datetime	☑
		☐

Table 4.1.1.6 Vehicle_permit

Table Name: Eligible_CWB

Description : This table stores all the information about available cargoes.

RAMCOBL138.te....Eligible_CWB

Column Name	Data Type	Allow Nulls
	varchar(30)	☐
RouteCode	varchar(30)	☑
Plan_Date	datetime	☑
Operating_Location	varchar(30)	☑
CWB_Type	varchar(30)	☑
Planning_Group_Id	varchar(30)	☐
Parent_CWB	varchar(30)	☑
Consignor_Code	varchar(30)	☑
Consignee_Code	varchar(30)	☑
Consignor_Part_Code	varchar(30)	☑
Consignee_Part_Code	varchar(30)	☑
Planned_Quantity	numeric(18, 0)	☑
Actual_Quantity	numeric(18, 0)	☑
Actual_Packing_Type	varchar(30)	☑
Weight	numeric(18, 0)	☑
Weight_UOM	varchar(30)	☑
Pack_Length	numeric(18, 0)	☑
Pack_Width	numeric(18, 0)	☑
Pack_Height	numeric(18, 0)	☑
Pack_UOM	varchar(30)	☑
Child_CWB_No	varchar(30)	☑
Status	varchar(30)	☑

Table 4.1.1.7 Eligible_CWB

Table Name: Time_Distance_Matrix

Description : This table contains the information about the distance and time taken to travel for the routes.

RAMCOBL138.te...stance_Matrix

Column Name	Data Type	Allow Nulls
	varchar(30)	☑
From_Site	varchar(30)	☑
To_Site	varchar(30)	☑
From_Location	varchar(30)	☑
To_Location	varchar(30)	☑
Distance	decimal(8, 2)	☑
Distance_UOM	varchar(30)	☑
time	decimal(6, 2)	☑
Time_UOM	varchar(30)	☑

Table 4.1.1.8 Time_Distance_Matrix

Table Name: Alloted_vehicles_output

Description : This table stores all the information about vehicles for which goods have been allocated.

RAMCOBL138.te...ehicles_output

Column Name	Data Type	Allow Nulls
	varchar(30)	☑
plandate	datetime	☑
RouteCode	varchar(30)	☑
RegNo	varchar(30)	☑
CWB_List	varchar(30)	☑
RouteFramed	varchar(30)	☑
Weight	numeric(18, 0)	☑
Volume	numeric(18, 0)	☑
plan_ou	int	☑
guid	varchar(30)	☑

Table 4.1.1.9 Alloted_vehicles_output

4.1.2. Tables Relationship

Database diagrams graphically show the structure of the database tables. It also describes the relationship between all the tables in database.

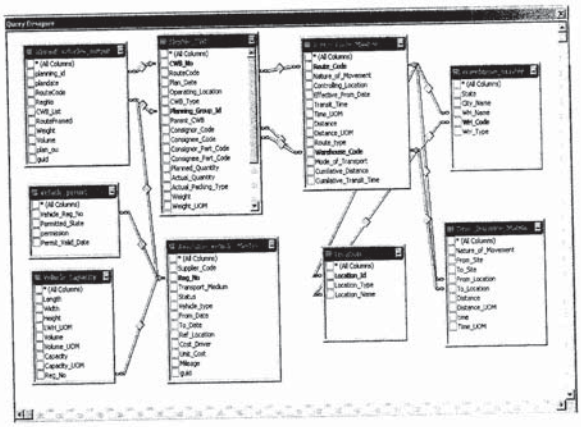

Figure 4.1.2.1 Table Relationship

Figure 4.1.2.1 shows all the tables and their relationship in the database. It also shows the primary key for every table in database.

4.2. PROCESS MODEL

This section describes the sequence diagram and activity diagram for the application.

4.2.1. Sequence Diagram

Sequence diagram is an easy and intuitive way of describing the behavior of a system by viewing the interaction between the system and environment. A sequence diagram shows an interaction arranged in time sequence.

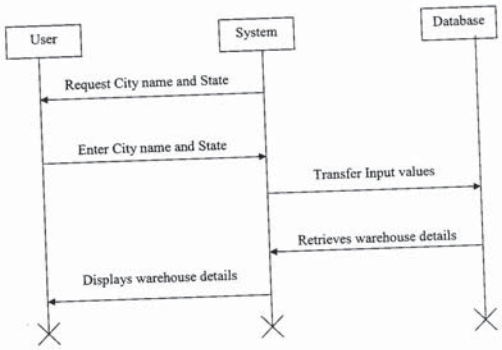

Figure 4.2.1.1 Sequence Diagram for Warehouse Master Details

Figure 4.2.1.1 explains the steps that user followed to get information about the warehouse details. Here user input value will be checked with the database values. If the matching records exist in the database, then the system will display the details of warehouses within that region.

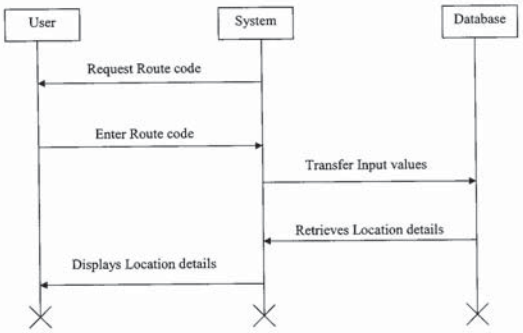

Figure 4.2.1.2 Sequence Diagram for Route Code Details

Figure 4.2.1.2 explains the steps that user followed to get information about the location details. Here user input value will be checked with the database values. If the matching records exist in the database, then the system will display the details of location for given route code.

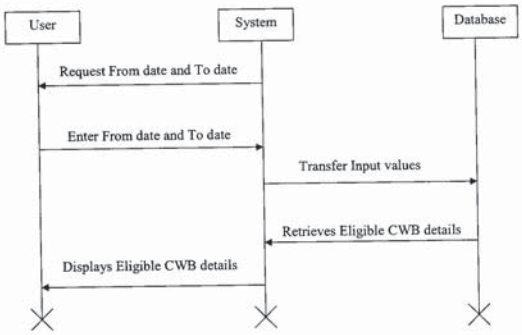

Figure 4.2.1.3 Sequence Diagram for Eligible CWB Details

Figure 4.2.1.3 explains the steps that user followed to get information about the Eligible CWB details. Here user input value will be checked with the database values. If the matching records exist in the database, then the system will display the details of Eligible CWB for the given date.

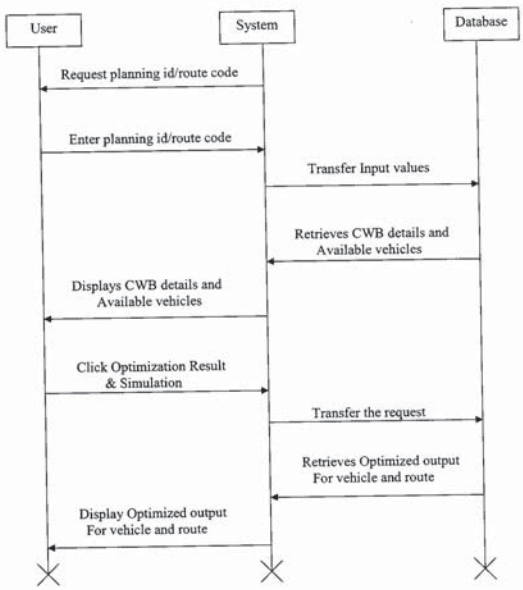

Figure 4.2.1.4 Sequence Diagram for Vehicle and Route Allocation

Figure 4.2.1.4 explains the steps that user followed to get information about the Eligible CWB details. Here user input value will be checked with the database values. If the matching records exist in the database, then the system will display the details of CWB and available vehicle for the given plan id/route code. Finally it will display Optimized output for vehicle and route.

4.2.2. Activity Diagram

Activity diagram is used to show the internal state of an object but the external events may appear in the diagram. In this diagram, activities represent the performance of the operations and transitions are triggered by the completion of the operations.

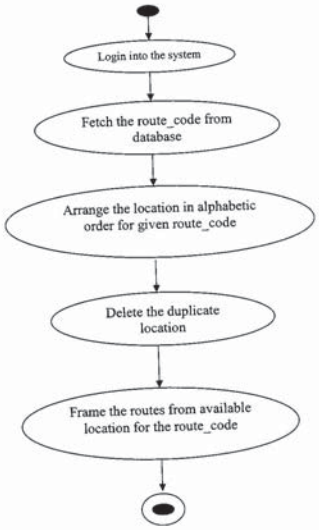

Figure 4.2.2.1 Activity diagram for route selection

Figure 4.2.2.1 explains the operations that are carried in the route selection. In route selection the user can select route_code and CWB for deliver then it will generate the locations for vehicle route.

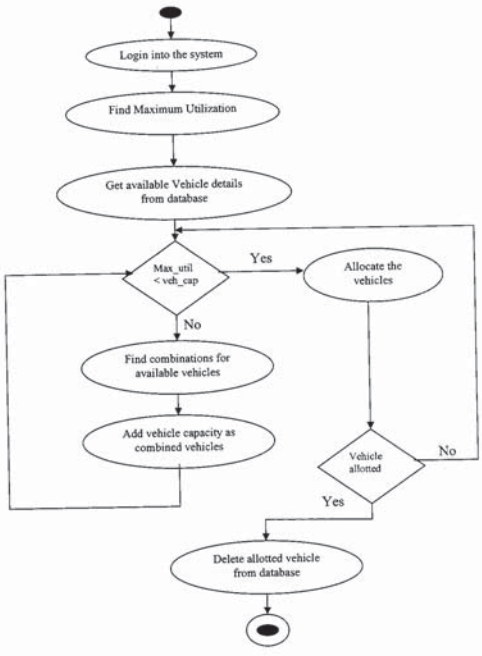

Figure 4.2.2.2 Activity diagram for vehicle allocation

Figure 4.2.2.2 explains the operations that are carried in vehicle allocation. Here user can allocate single or combinations of vehicle for transferring cargoes.

CHAPTER 5

SYSTEM DEVELOPMENT

System development is a series of operations performed to manipulate data to produce output from computer system. This aim at translating the design of the system produced during the design phase into code in user programming language. A modular approach is used for the development of the software.

The development phase for the project was created from the specifications created during the design phase. A principal activity of the development phase is coding and testing the computer program that make up the computer program component of the overall system. Other important activities include implementation, planning, equipment acquisition and system testing. The development phase concludes with the report and review.

5.1. MODULE DESCRIPTION

The following are the modules in the system

- Warehouse Master
- Route Master
- Vehicle Master
- CWB Details
- Time Distance Matrix
- Vehicle Planning

5.1.1. Warehouse Master

The Warehouse details are already in the database, so when the city name is entered, it will display the warehouse detail for that city i.e. the warehouse code, warehouse name, warehouse type, city and state of the respective city. Warehouse master also allows the user to add or edit the warehouse details.

5.1.2. Route Master

In this module, if the users select any of the route code from database, it will display all the details of route code master i.e. Nature of movement, Warehouse code, Location name, Location type of the respective route code. Route master also allow user to add or edit the route details.

5.1.3. Vehicle Master

The vehicle details are already stored in the database. It will display all the details about the vehicles i.e. Vehicle number, Service provide, Capacity, Width, Length, Volume of all the vehicles in the database.

5.1.4. CWB Details

In this module if the user gives From date and To date, it will display all the details of available CWB's in database i.e.cwb_no, RouteCode, Plan_Date, Consignor_Code, Consignee_Code, Planned_Quantity, Actual_Quantity and etc.

5.1.5. Time Distance Matrix

Time distance matrix first screen will display all warehouse name and warehouse code. If the user select any one of the warehouse name from the list, it will display distance (In km) and traveling time (in hr) for selected warehouse.

5.1.6. Vehicle Planning

This is the most important module in this system. In this module the user are going to select optimized vehicles either single vehicle or multiple vehicles for selected cargoes. The Vehicle Planning module contains two type of vehicle selection.

- Single Vehicle Selection
- Multiple Vehicle Selection

Single Vehicle Selection

Single vehicle selection is used to find out if the entire load could be accommodated in a single vehicle itself or not.

Multiple vehicle selection

Multiple vehicle selection is used to frame the various sets of combinations possible from the available vehicles.

Module description

In this vehicle selection module if the user gives any planning id or route code, it will display the following two tabs.

- CWB Details
- Available Vehicles

CWB details tab contain information (cwb_no, RouteCode, Plan_Date, Consignor_Code, Consignee_Code, Planned Quantity, Actual Quantity etc) about the eligible CWB of given dates.

Available vehicle tab contain information (Vehicle number, Service provide, Capacity, Width, Length, Volume etc) about the available vehicle of given dates.

Optimization result

In this module contain optimization result link for display optimized output. If the users click that link after selecting CWB list, it will display optimized vehicle and route for transferring cargoes from one location to another.

CHAPTER 6

SYSTEM IMPLEMENTATION AND TESTING

6.1. SYSTEM IMPLEMENTATION

Implementation is the state in the system where the theoretical design is turned into a working system. The system can be implemented only after through testing is done and if found to work according to the specification. The most crucial stage in achieving a new successful system relies in giving confidence for the users on the new system that will work efficiently and effectively.

6.1.1. SYSTEM VERIFICATION

In vehicle and route optimization, verification determines if the system is consistent, adheres to standards, user reliable techniques and prudent practices, and performs the selected functions in the correct manner. In data access, it verifies whether the right data is being accessed, in terms of right place and in the right way.

6.1.2. SYSTEM VALIDATION

In this project, validation checks whether the developer is moving towards the right product, whether the development is moving towards the actual intended product that was agreed upon in the beginning. validation also determines if vehicle and route optimization compiles with the requirements and platforms functions for which it is intended and meets the organization's goals and user needs. It is traditional and is performed at the end of the project.

6.2. TESTING

Software testing is a critical element of software quality assurance and represents the ultimate reviews of specification, design and coding testing represents interesting anomaly for the software. During earlier definition and development phases, it was attempted to build software from an abstract concept to tangible implementation.

The testing phase involves the testing of developed system using various test data. Preparation of the test data plays vital role in the system testing. After preparing the test data the system under study was tested using those data. While testing the system, errors were found and corrected by using the following testing steps and corrections are also noted for future use. Thus, a series of testing is performed for the proposed system was ready for the implementation.

6.2.1. Unit Testing

Module or Unit Testing is the process of testing all program units that make up a system. Unit testing focuses on an individual module thus allowing one to uncover all the errors made logically and while coding in the module.

Unit testing was done in this project to uncover the errors that occurred at the time of development. Each module was tested with a set of predefined data. The interface between the modules is also tested to ensure proper information flow. The test must satisfy all the pre defined conditions and post conditions. Each and every unit in the module specified must undergo testing.

6.2.2. Integration Testing

Integration testing tests the process of integrating the various modules to form the completed system. Integration starts with a set of units each individually tested in isolation and ends when the entire application has been build. Integration testing verifies that the combined units function together correctly. It facilitates in finding problem that occur at interface or communication between the individual parts.

Vehicle and route optimization followed top-down integration testing. Modules were linked to the main menu in a sequence as required in the real time operating mode of the system. This process is continued from the page level to module level, finally to the system level. In the final stage, the whole system is taken together and tested for integration. This test if the change has affected any part of vehicle and route optimization negatively after the change was made.

6.2.3. System Testing

System testing is actually a serious of different tests, whose primary purpose is to fully exercise the compute-based system. It verifies the entire product after having integrated all software and hardware components, and validates it according to the original project requirement.

In vehicle and route optimization system testing is done at each level to verify

- Proper input of data
- Successful storage and retrieval of data from table.

The following were tested and found to be working correctly

- Database connectivity
- Insert, Select, Update and Delete Commands
- Links in each form
- Passing of values between forms
- Command controls

CHAPTER 7

CONCLUSION AND FUTURE ENHANCEMENT

CONCLUSION

This project **Vehicle and Route Optimization** was prepared with guidance and discussion with personnel involved in this project and technical staff.

This project has developed with maximum care. It has been developed with an eye on expansion and flexibility at every stage of all the modules. This is, developed to meet almost all the requirements of the user. This will replace the existing manual system. This is more advantageous over the existing system as it assigns 100% weight and 95% of volume utilization vehicle and correct route for transferring cargoes to destination. It is accurate and very fast and produces various kinds of detailed reports.

Further enhancements can be made at any later point of time. Reports can be represented in all-necessary perspectives. Added options can be included in designing reports. This project is developed in a user friendly manner in GUI software. The user can perform the operations such as addition, deletion, and modification of the database very easily but in a specified manner.

FUTURE ENHANCEMENT

The proposed system could be effectively implemented using **Vehicle and Route Optimization** with single vehicle selection and combination of vehicle selection and also select proper route for vehicles. In this system will give some report to the user for selecting the vehicles.

In future, there is a plan to implement the **Bin Packing** methodology. This methodology will help how the cargoes can be fitted with in a selected vehicle's. Here we can able to see 3D view of fitted cargoes so that we can transfer more cargoes in a single/multiple vehicle.

APPENDICES

LOGIN

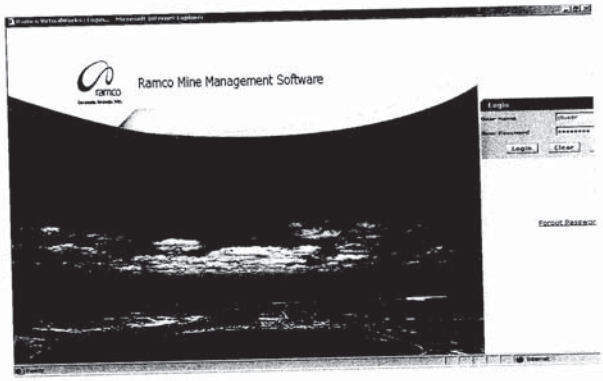

Figure A.1 Login Screen

Ramco Virtual Works

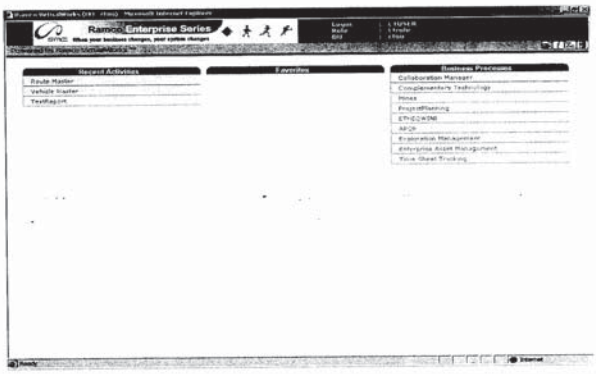

Figure A.2 Ramco Virtual Works Home Screen

Project Home Page

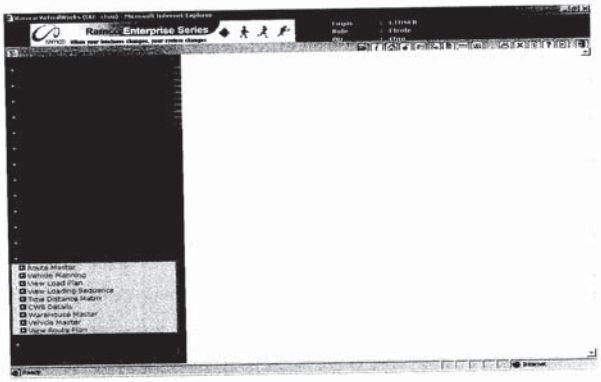

Figure A.3 Project Home Screen

Warehouse Master

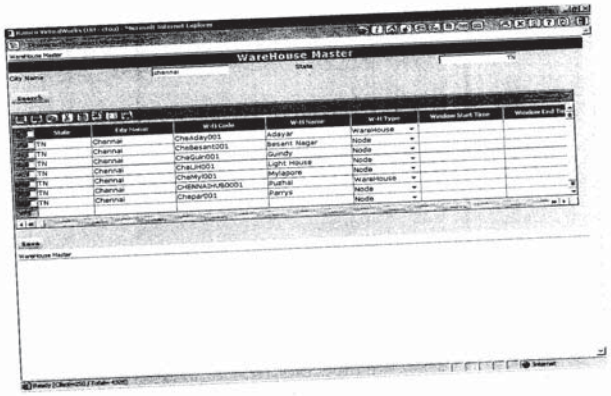

Figure A.4 Warehouse Master Screen

Route Master

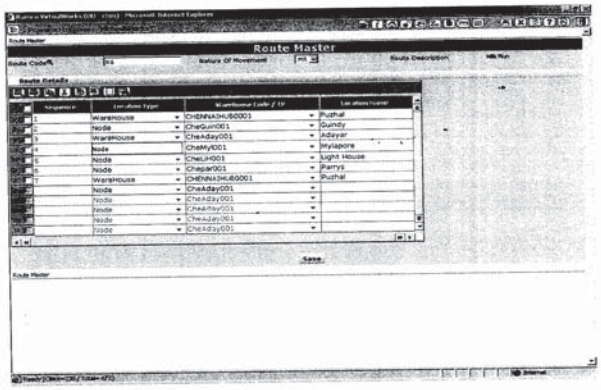

Figure A.5 Route Master Screen

Vehicle Master

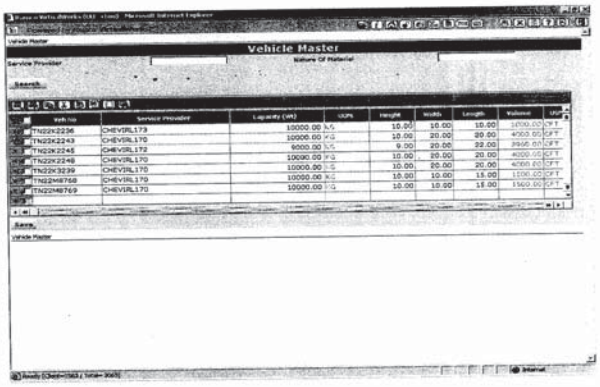

Figure A.6 Vehicle Master Screen

Eligible CWB Details

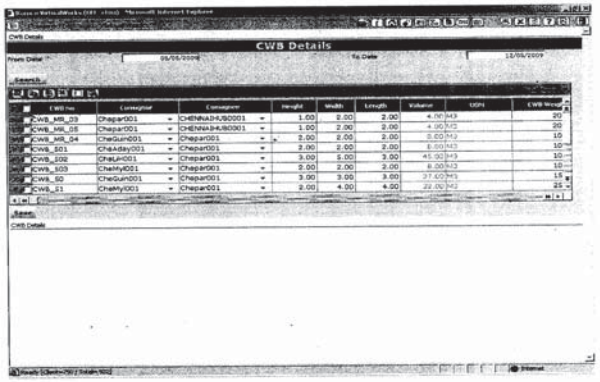

Figure A.7 Eligible CWB Details Screen

Time Distance Matrix

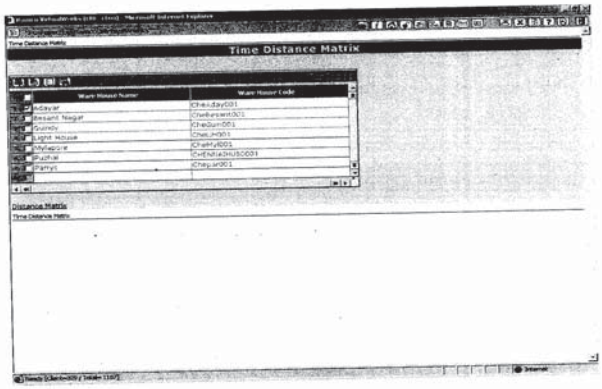

Figure A.8 Time Distance Matrix Screen

Time Distance Matrix

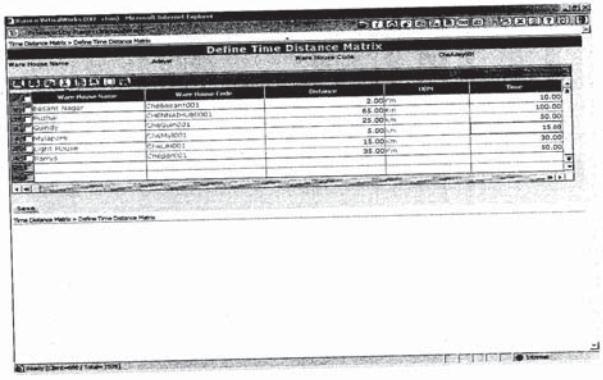

Figure A.9 Time Distance Matrix Screen

Vehicle Planning

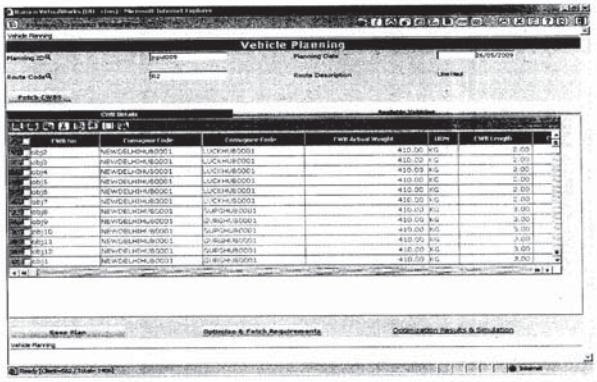

Figure A.10 Vehicle Planning Screen

Available Vehicle details

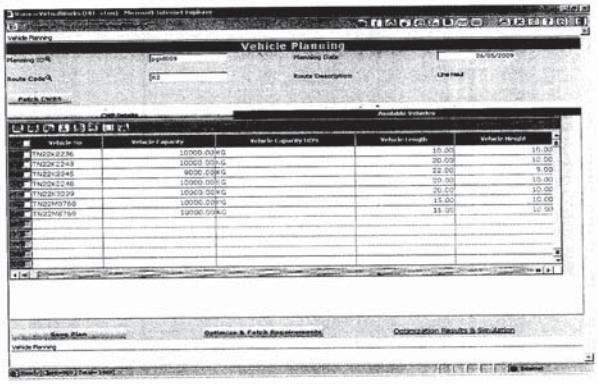

Figure A.11 Available Vehicle details in Vehicle Planning Screen

Single Vehicle Selection

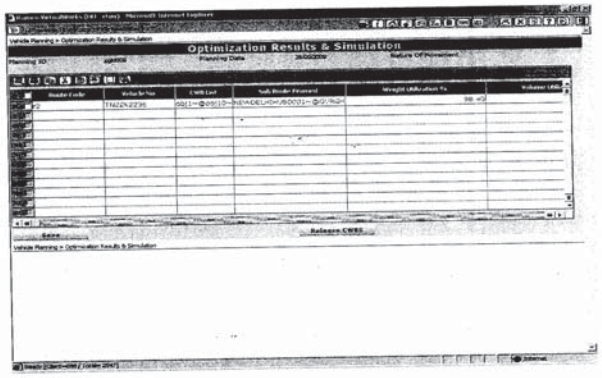

Figure A.12 Single Vehicle Optimization Screen

Vehicle Planning

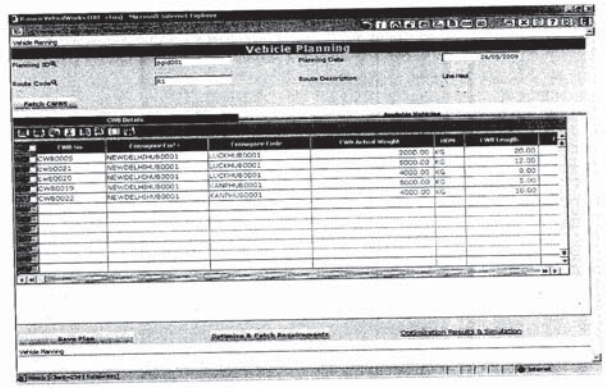

Figure A.13 Vehicle Planning Screen

Multiple Vehicle Selection

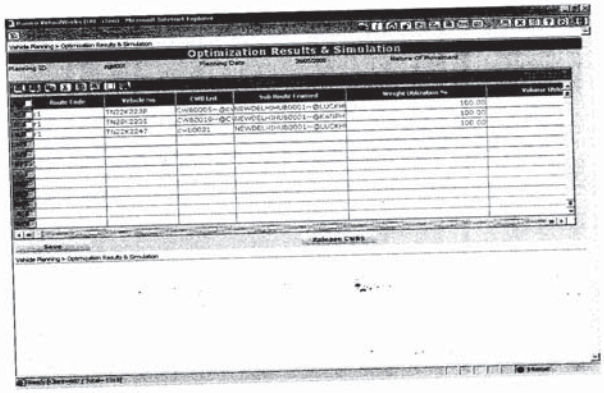

Figure A.14 Multiple Vehicle Optimization Screen

REFERENCES

BOOKS

1. Christian Nagel and Bill Evjen (2005), "**PROFESSIONAL C# 2005",** Wiley-India.
2. Christian Holm, Mike Kruger, and Bernhard Spuida (2003), "**Dissecting a C# Application: Inside SharpDevelop",** Wrox Press.
3. Andrew J Brust and Stephen Forte (2006), **"Programming Microsoft SQL Server 2005",** Microsoft Press.