Railway management system

Software Engineering

Project Report

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Problem Statement

Railway is one of the most essential parts of our lives. Indian Railways carry more than 5 lakh passengers from one place to another. But, in reality, keeping track of all activities and records on paper is very cumbersome and error-prone. It is also very inefficient and a time consuming process. Observing the continuous increase in population, recording and maintaining all these records are highly unreliable and inefficient. It is also not economically and technically feasible to maintain these records on paper.

Thus keeping the working of manual system as the basis of our project we have developed an automated version of the manual system, named as
'**Railway Management System**'.

The main aim of our project is to keep and manage the whole system in a better and paper-less way. It also aims at low cost reliable automation of the existing systems.
The new system also provides excellent security of data at every level of user system interaction and provides robust and reliable storage and backup facilities.

Process Model

The **Waterfall Model** is used in this project.

Since, the requirements are well known and clear. Also, the product definition is stable that the desired functionality is stable and well defined. Technology that we have to use is understood, we are using python for software development, oracle on the backhand for database. Ambiguous requirements are not encountered in the system. The project is short.

Ample resources with required expertise are available easy as these kinds of systems have been already implemented and there is no new innovation or any idea that leads to difficulty in the implementation of the system.

Software Requirement Specification

1.1 Overall Description

1.1.1 ***Product Functions***

Our project introduces railway system management with the objective of getting the things related to railways more efficient, easier and faster.

As we know, Indian railways is vast in itself, and to get hold or to understand vast concepts is really a tough job. Thus, we have tried to make things more clear. The station facilities, platform, train requirements, passenger requirements, routes and schedules everything need to be planned for a vast system to operate efficiently and smoothly.

The purpose of the project is to build an application program to reduce the manual work of managing trains, timetable, passengers (customers), stations, drivers and other staff. It tracks all details about stations, fare etc.

Also, people face a lot of difficulties for a mere information. Therefore we have tried to establish relation such that any information which is related to a person or a department can be easily accessed using the application.

WE CONSIDER THAT WE NEED THIS SYSTEM BECAUSE:

1. For effective management.
2. Time saving
3. To get information more easily
4. To make work easier and error free
5. User friendly

1.1.2 ***User Characteristics***

The system would be used by four groups of people i.e. management staff, train staff, drivers and passengers (customers). Each of these four types of users has different use of the system so each of them has their own requirements. They must have basic computer knowledge in order to interact with the system.

Management Staff:

The management staff is responsible for updating the station schedule, attendance of the station staff, list of empty platforms during specific hours of the day, addition of new trains and staff to the system and carrying out the transaction with the passengers (customers) and creating and printing bills for the transactions.

Train Staff:

They are responsible for providing services to the passengers, informing/updating the stations about the exact train arrival timings and updating the train staff attendance.

Drivers:

Since they have a dynamic job schedule they update their sign in and signing off credentials and are served with information about rest hours and next report duty.

Passengers:

They use the system for inquiring of trains details (fare, stoppage etc.), booking, payment, status inquiry and cancellation of tickets.

1.1.3 General Constraints

The major technological requirements of the application would be internet, GPS (Global positioning System) and a set of LAN's, hence it is constrained by the speed of the local area network, internet and availability of GPS connections.

The most of the processes are constrained by the capacity of the database. Since the database is shared between multiple operators for retrieval it may be forced to queue incoming requests and therefore increase the time it takes to fetch data.

1.1.5 Assumptions and Dependencies

1. Users will be having valid username and password to access the software.
2. Software is dependent on access to internet.
3. Our software has one assumption that the details of ADMINSTRATOR are already stored within the software. He need not to create the login, he can simply access the software by providing user id and password given to him.

1.2 External Interface Requirements

1.2.1 *User Interfaces*

Management Staff

In this interface the users can view train info (current status), update platform details, update station schedule attendance of the staff, addition of new trains and staff, answer queries and reply to complaints

Train Staff

The screen displays interface which allows users to update the exact location of the train and train staff attendance. It also provides them details of their holidays and penalties.

Drivers

The screen displays an interface to update attendance and are served details of next duty allotment.

Passengers

The screen displays an interface to inquire trains, book tickets, payment, status inquiry and cancellation of tickets.

1.2.2 *Hardware Interfaces*

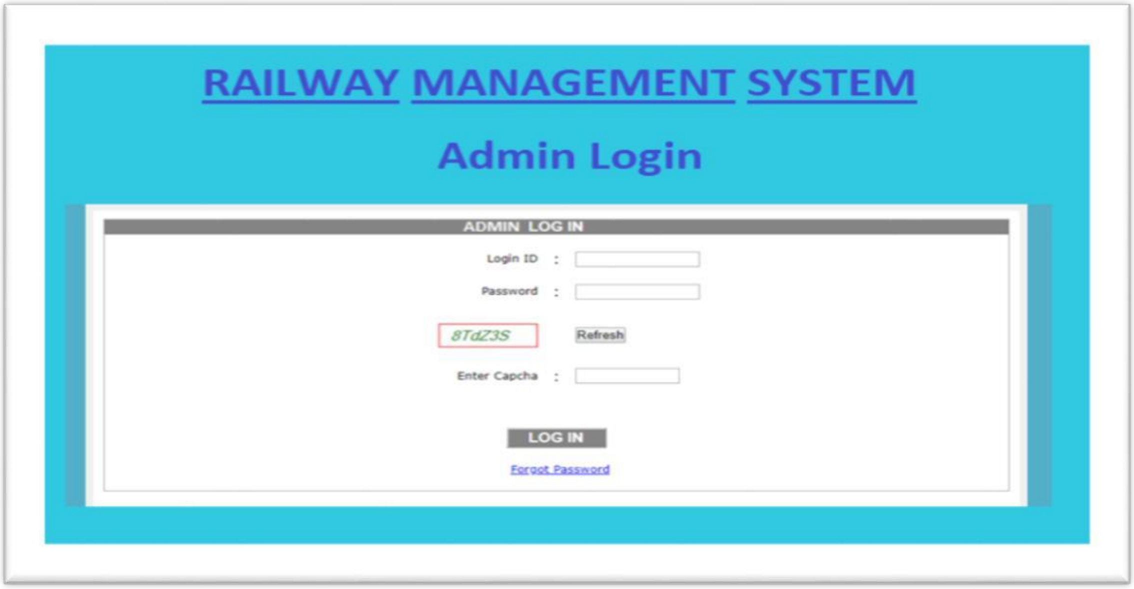
Server Side:

- PC or Laptop
- Hard Disk Processor
- High Speed Processor
- Modem Of High Internet Capacity
- Backup Power Supply; UPS (In case of power failure)

Client Side:

- Smart Phone / PC / Laptop
- Internet Facility

1.2.3 ***Software Interfaces***



RAILWAY MANAGEMENT SYSTEM

Admin Login

ADMIN LOG IN

Login ID :

Password :

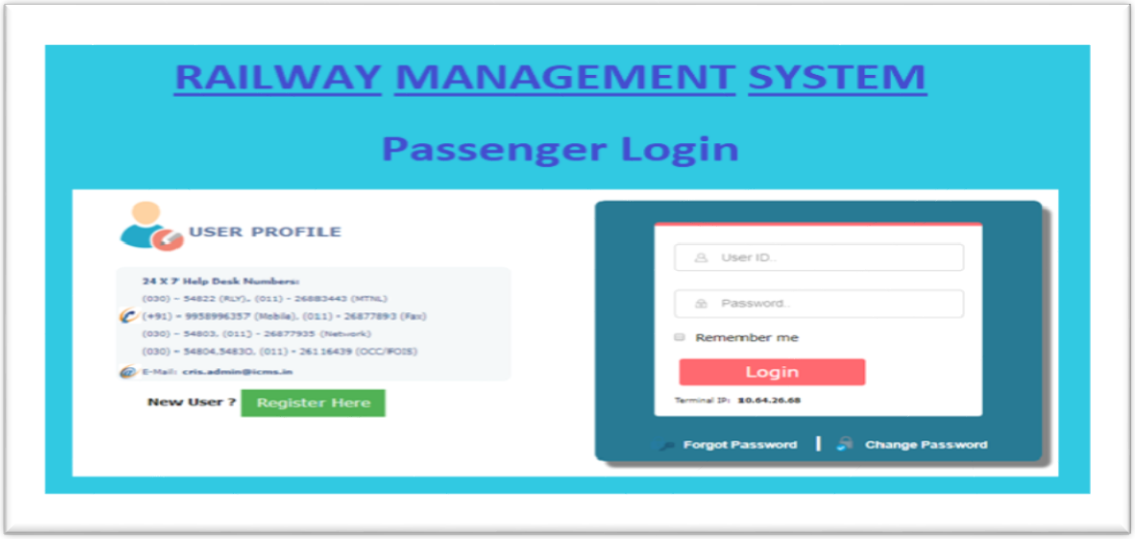
8TdZ3S

Refresh

Enter Capcha :

LOG IN

Forgot Password



RAILWAY MANAGEMENT SYSTEM

Passenger Login

USER PROFILE

24 X 7 Help Desk Numbers:

(030) – 54822 (RLY)., (011) - 26883443 (MTNL)

(+91) - 9958996357 (Mobile), (011) - 26877893 (Fax)

(030) – 54803, (011) - 26877935 (Network)

(030) - 54804,54830, (011) - 26116439 (OCC/FOIS)

E-Mail: cris.admin@icms.in

New User ? Register Here

User ID..

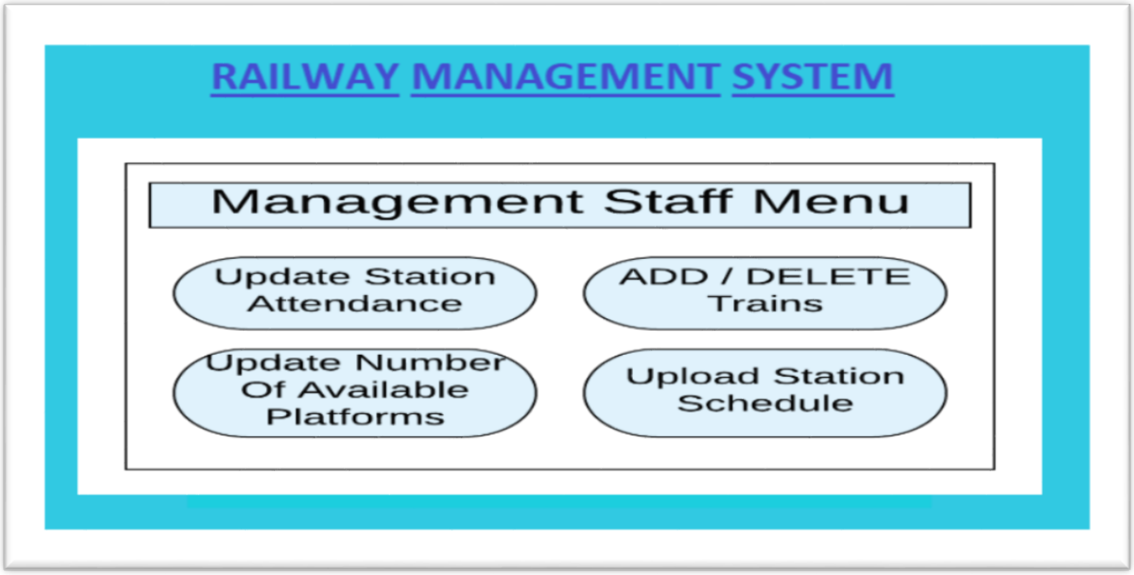
Password..

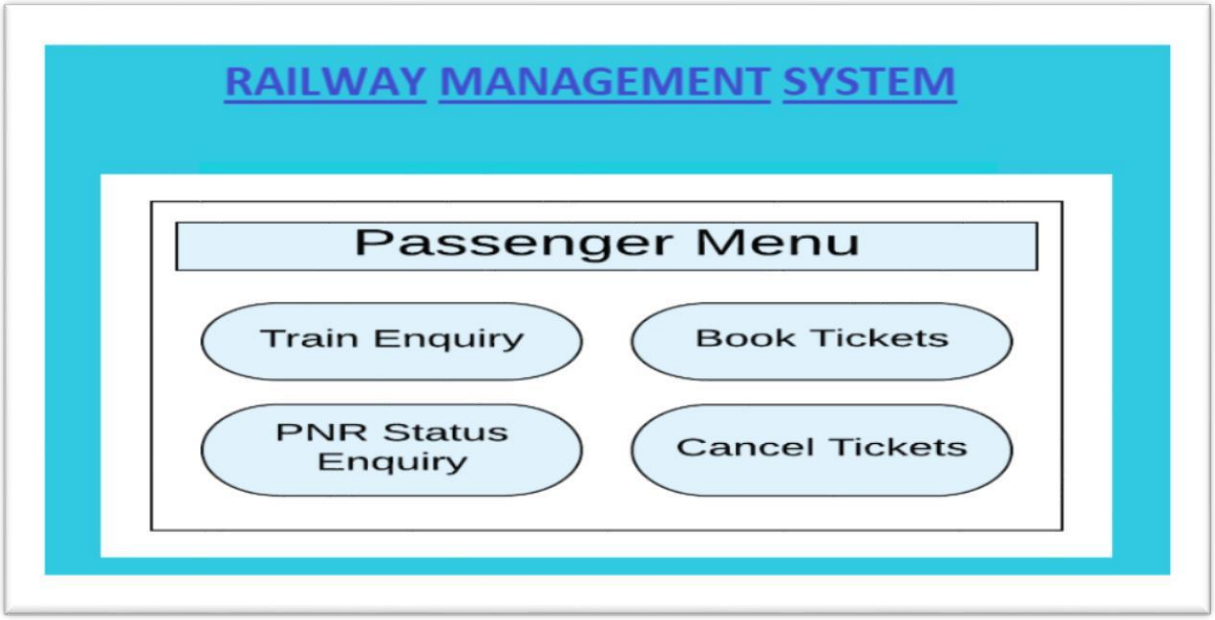
□ Remember me

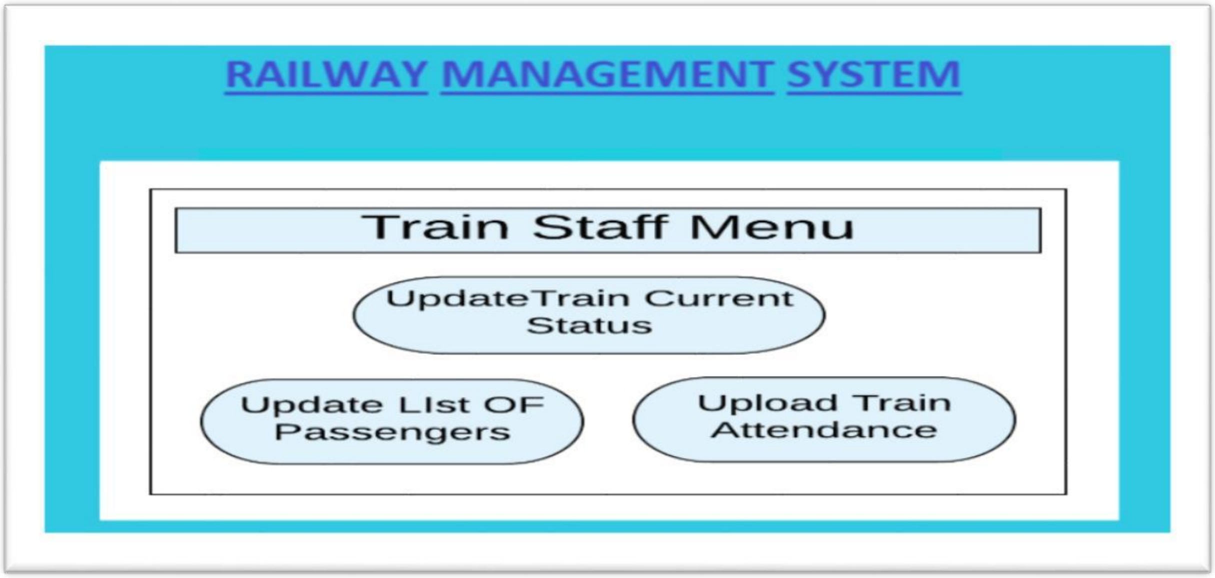
Login

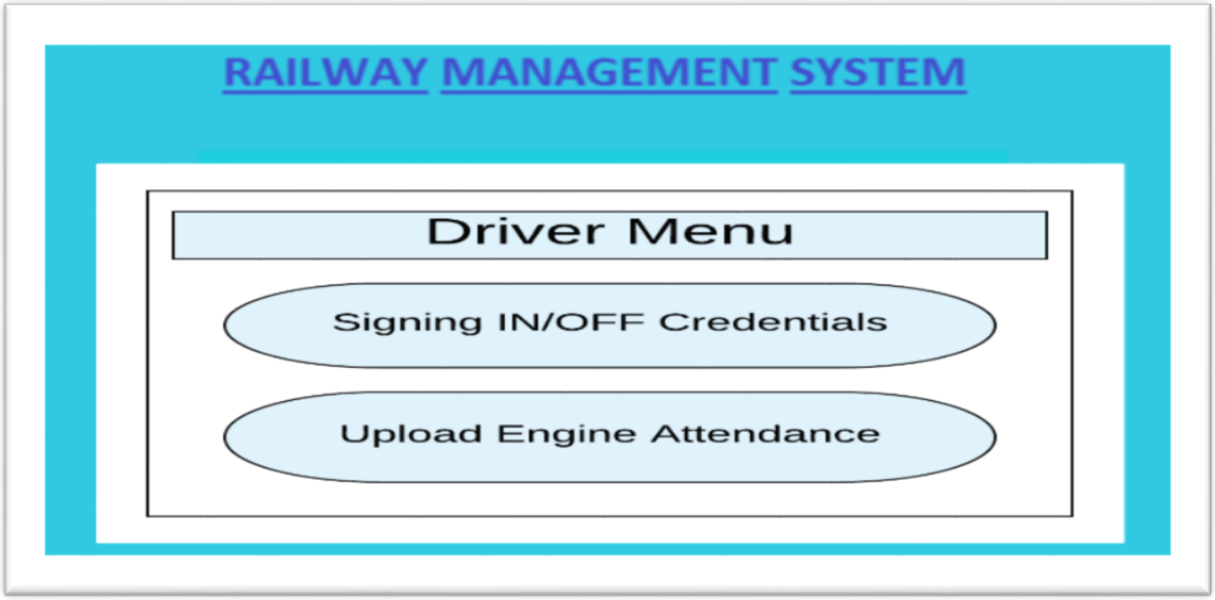
Terminal IP: 10.64.26.68

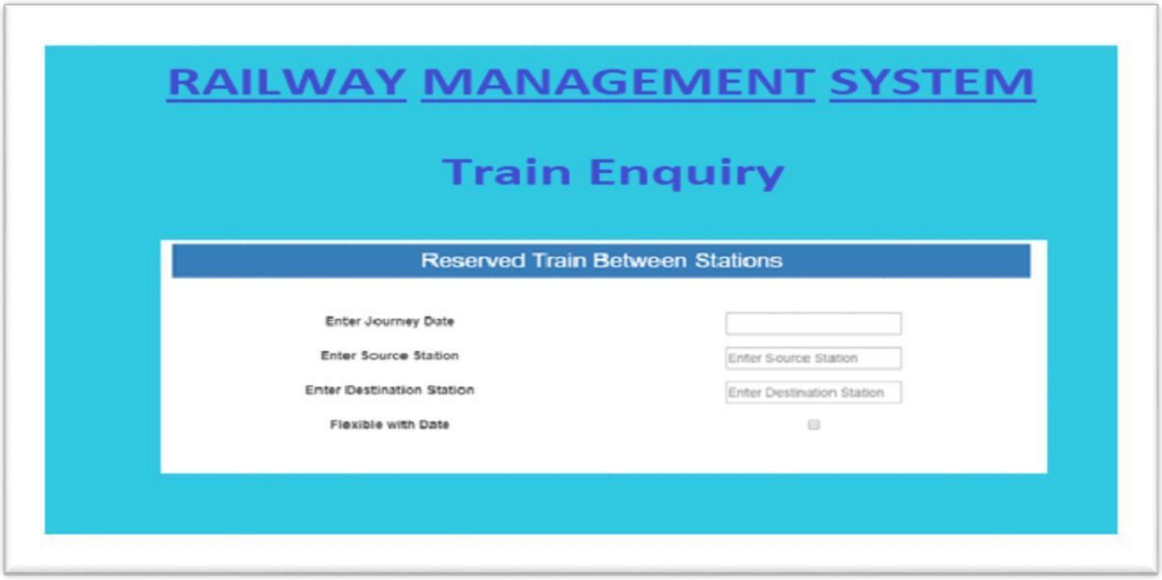
Forgot Password | Change Password


RAILWAY MANAGEMENT SYSTEM
Management Staff Menu
Update Station Attendance
ADD / DELETE Trains
Update Number Of Available Platforms
Upload Station Schedule


RAILWAY MANAGEMENT SYSTEM
Passenger Menu
Train Enquiry
Book Tickets
PNR Status Enquiry
Cancel Tickets


RAILWAY MANAGEMENT SYSTEM
Train Staff Menu
UpdateTrain Current Status
Update LIst OF Passengers
Upload Train Attendance


RAILWAY MANAGEMENT SYSTEM
Driver Menu
Signing IN/OFF Credentials
Upload Engine Attendance

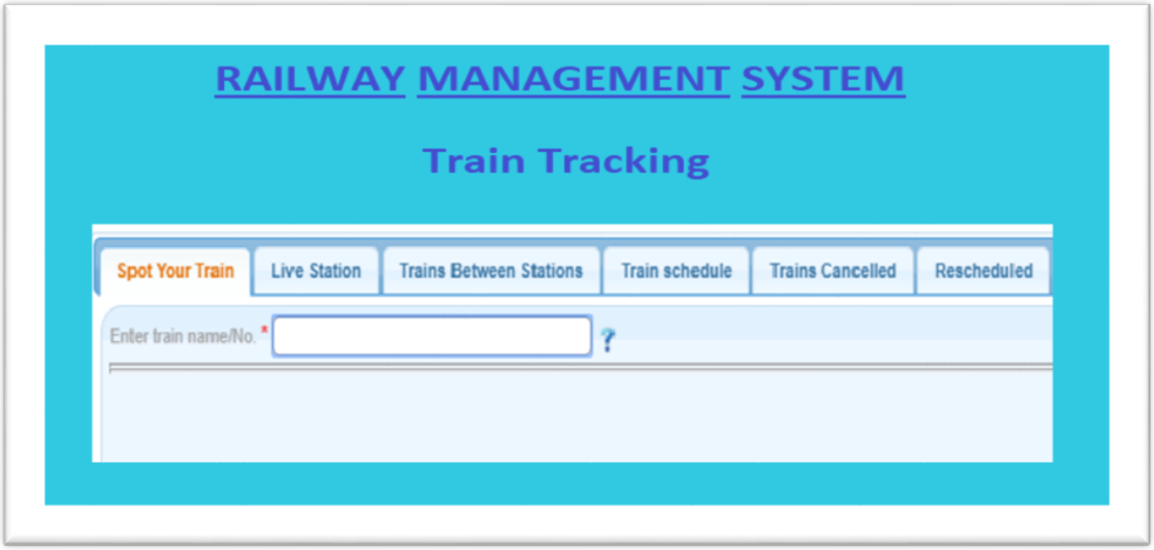


RAILWAY MANAGEMENT SYSTEM

Train Enquiry

Reserved Train Between Stations

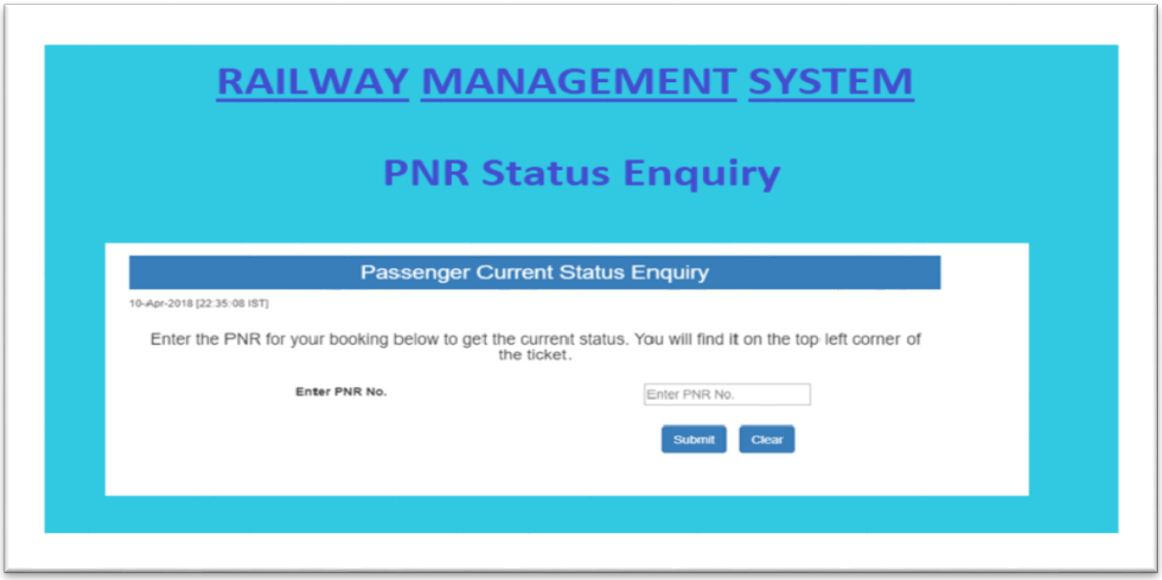
Enter Journey Date	
Enter Source Station	Enter Source Station
Enter Destination Station	Enter Destination Station
Flexible with Date	□



RAILWAY MANAGEMENT SYSTEM

Train Tracking

Enter train name/No. * ?



RAILWAY MANAGEMENT SYSTEM

PNR Status Enquiry

Passenger Current Status Enquiry

10-Apr-2018 [22:35:08 IST]

Enter the PNR for your booking below to get the current status. You will find it on the top left corner of the ticket.

Enter PNR No.

1.3 Functional Requirements

1. REGISTER COMPLAINT

Description of Feature

This feature allows users to file complaints through the site. The user does not require a registration. He can give his name, email-id, phone number, address and other details along with the complaints. The admin will reply to the complaints sent by user.

FR01. System must be able to verify information.
FR02. System must be able to store the information in database.
FR03. System must be able to retrieve information when required by admin.

2. BOOK TICKETS

Description of Feature

This feature allows the user to register and book travel tickets online (for registered users), thereby saving their valuable time. Users need to login with their registered id & password and can recharge their tickets online. It also allows them to view their journey history.

FR04. User id is provided when they register.
FR05. The system must be able to show the users journey history.
FR06. The user must be able to login by providing Id and password and logout after they finish booking.

3. TRAIN TIME TABLE

Description of Feature

This feature allows the admin to view the train time table. The admin is required to enter the details of the station and platforms, when they enter the data then the system will show them the list of trains.

FR07. System must allow the users to enter the station and platform details.
FR08. System must be able to process information from database.

4. MANAGEMENT STAFF

Description of Feature

This feature allows the admin to view and reply to complaints. Admin can add stations, routes, train, and trip. Admin can also add and update fare details, and even add a new admin. Actually, the admin is a panel consisting of a group of authorized persons.

FR08. The system must allow admin to add train, stations, routes, fare, metro timetable and even add a new admin.
FR09. The system must also allow admin to reply to the complaints send by the user.
FR010. The system should be designed in such a way that only authorized people should be allowed to access some particular modules.
FR011. The records should be modified by only administrators and no one else
FR012. System must manage train details such as add and remove trains and update train time table.

5. FARE AND ROUTEMAP

Description of Feature

This feature allows the users to view the fare and route map. Users are required to enter the source and destination station, when they enter the data then the system will display fare details and the route map.

FR013. System must allow the users to enter the source and destination stations.
FR014. System must be able to retrieve information from the database.

6. Train Staff**:**

Description of Feature:

It has many features like to find out list of empty platforms, occupied platforms, add and remove trains etc.

FR015. System must allow to update train current status.

FR016. System must allow to update train attendance.

FR017. System must be able to retrieve information from platform database.

1.4 Performance Requirements

- **User satisfaction:** The system is such that it stands up to all user expectations.
- **Response time:** The response of all operations is good. This has been made possible by careful programming.
- **Error handling:** Response to user errors and undesired situations has been taken care to ensure that the system operates without halting.
- **Safety and Robustness:** The system is able to avoid or tackle disastrous action that is it should be foul proof. The system safeguards against undesired events, without human intervention.
- **Portable:** The software should not be architectural specific. It should be easily transferable to other platforms if needed.
- **User Friendliness:** The system should be easy to learn and understand. A native user can also use the system effectively, without any difficulty!

1.5 Design Constraints

Software Constraint:

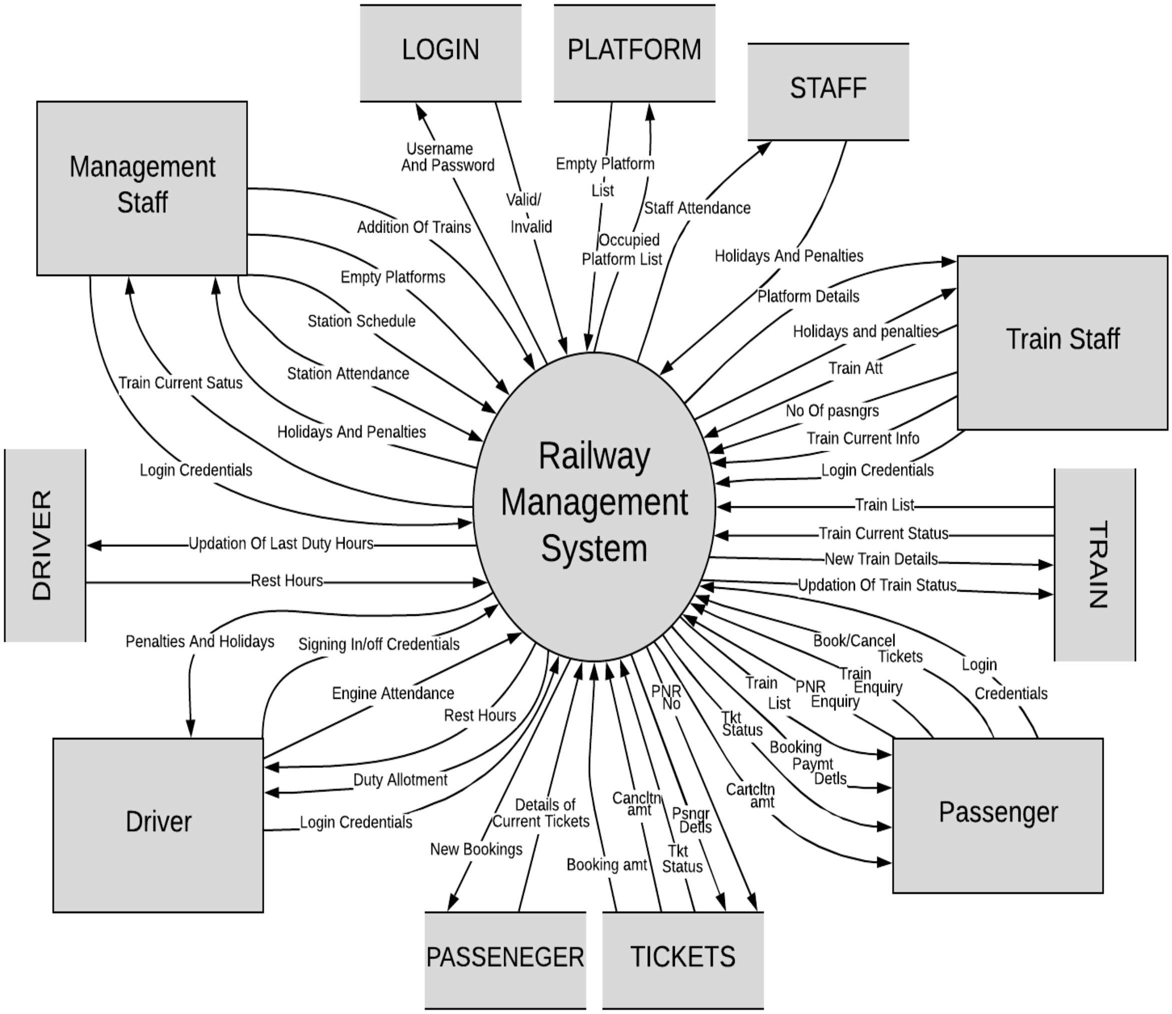
The software is to run under the windows operating system. At the client side there should be the software installed where the team will operate the system during the whole course and booking the tickets.

Hardware Constraint:

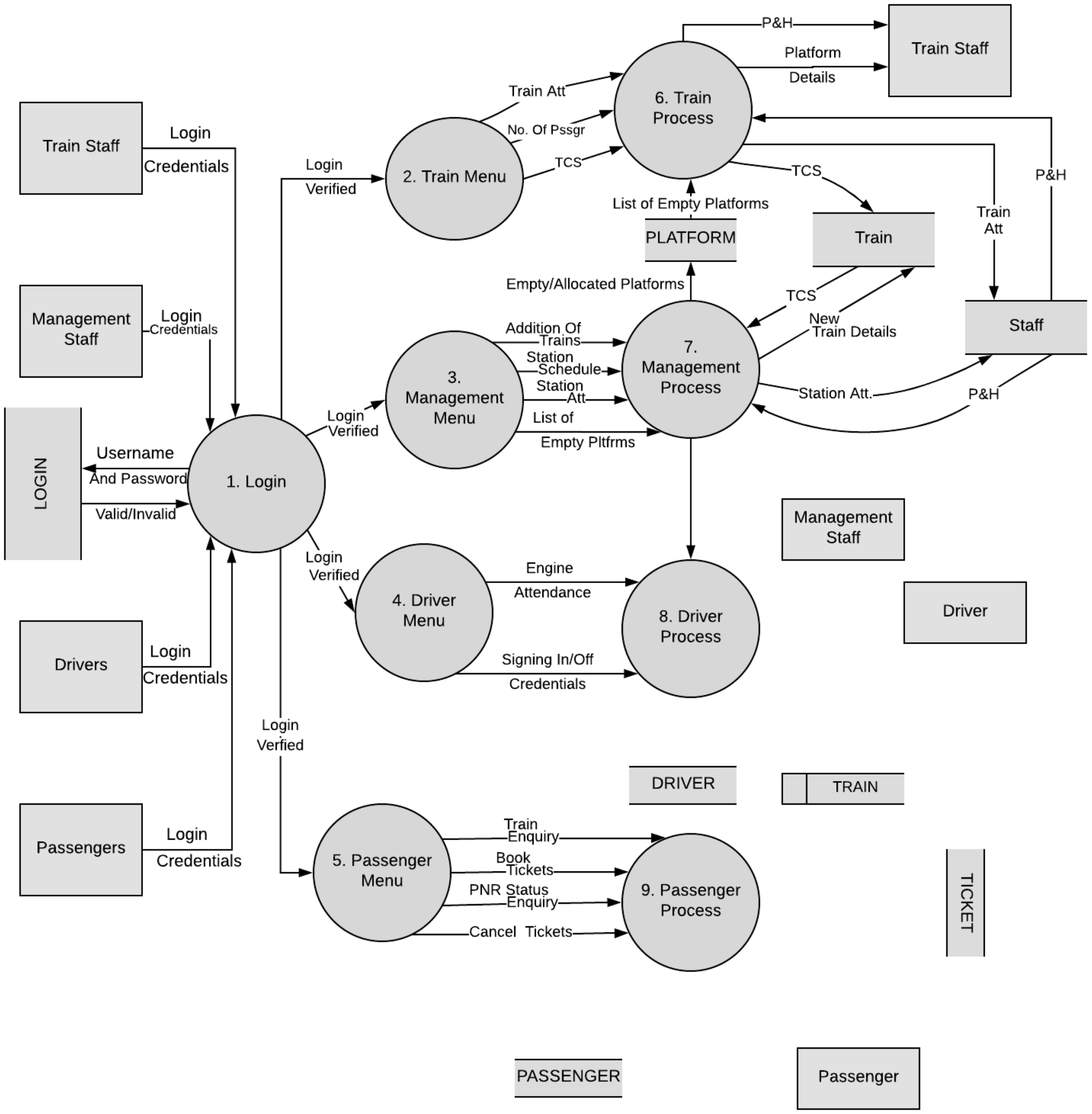
- **Processor:** x86 Compatible processor with 1.5 GHZ clock speed or more.
- **RAM:** 512 MB or more.
- **Hard Disk:** 10 GB of free disk space
- **Monitor:** CRT/LCD/LED
- **Keyboard:** 104 keys
- **Mouse:** 2 button/3 button/trackpad
- **Power Backup:** 24 hours
- **Storage Capacity:** 2 Tb or more
- **Internet:** Speed of 2 Mbps or more
- **Printer:** Inkjet/ Laser jet

1.6 Data Flow Diagram

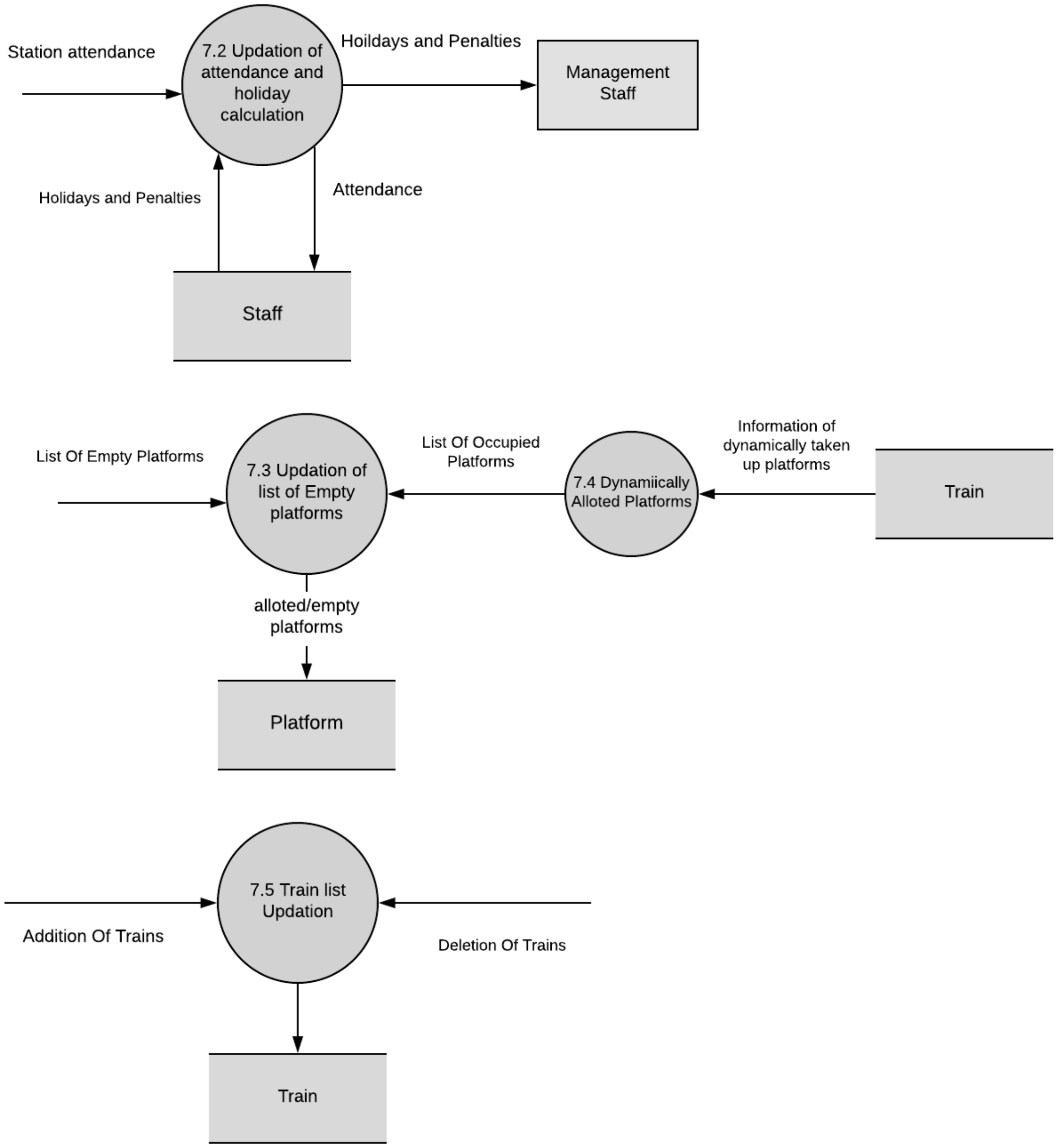
1.6.1 Context Level (LEVEL 0)

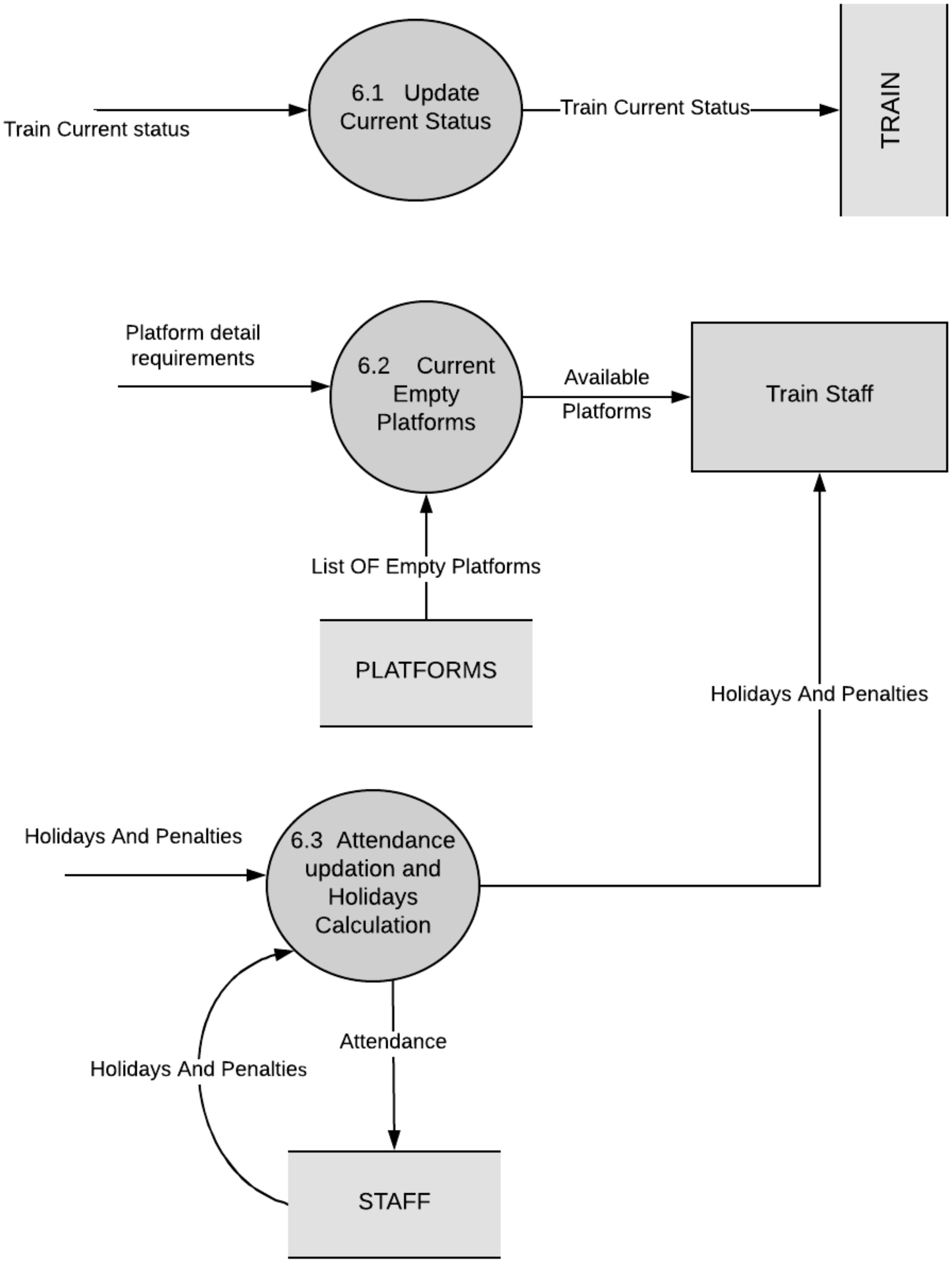


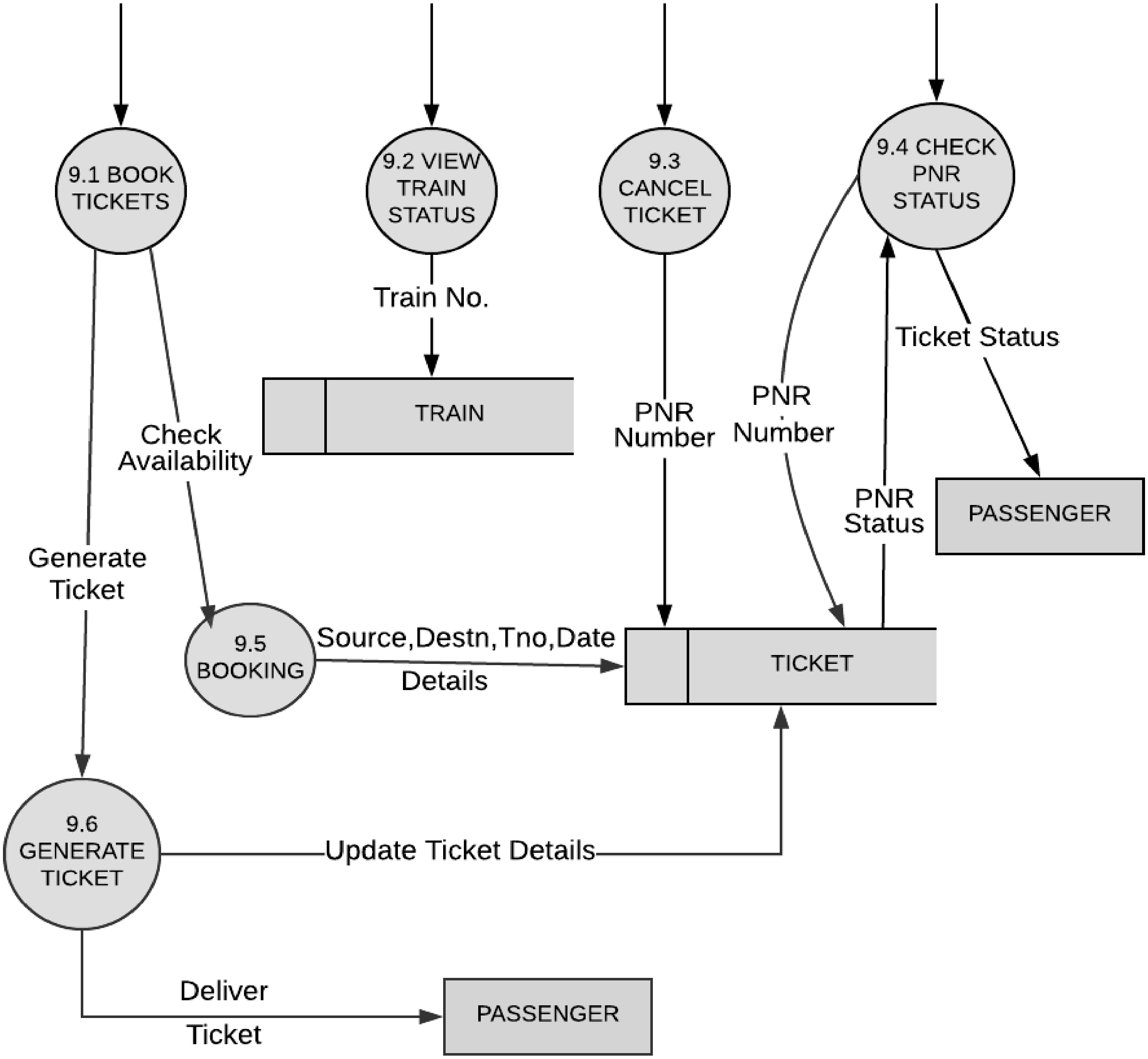
1.6.2 LEVEL 1


Train Staff
Login
Credentials
Management Staff
Login
Credentials
LOGIN
Username
And Password
Valid/Invalid
1. Login
Drivers
Login
Credentials
Passengers
Login
Credentials
Login
Verified
2. Train Menu
Train Att
No. Of Pssgr
TCS
6. Train Process
P&H
Platform
Details
Train Staff
List of Empty Platforms
PLATFORM
TCS
Train
Train
Att
P&H
Staff
Login
Verified
3. Management Menu
Addition Of
Trains
Station
Schedule
Station
Att
List of
Empty Pltfrms
Empty/Allocated Platforms
7. Management Process
TCS
New
Train Details
Station Att.
P&H
Login
Verified
4. Driver Menu
Engine
Attendance
Signing In/Off
Credentials
8. Driver Process
Management Staff
Driver
Login
Verfied
DRIVER
TRAIN
5. Passenger Menu
Train
Enquiry
Book
Tickets
PNR Status
Enquiry
Cancel Tickets
9. Passenger Process
TICKET
PASSENGER
Passenger

1.6.3 LEVEL 2


Station attendance
7.2 Updation of attendance and holiday calculation
Hoildays and Penalties
Management Staff
Holidays and Penalties
Attendance
Staff
List Of Empty Platforms
7.3 Updation of list of Empty platforms
List Of Occupied Platforms
7.4 Dynamiically Alloted Platforms
Information of dynamically taken up platforms
Train
alloted/empty platforms
Platform
7.5 Train list Updation
Addition Of Trains
Deletion Of Trains
Train


Train Current status
6.1 Update Current Status
Train Current Status
TRAIN
Platform detail requirements
6.2 Current Empty Platforms
Available Platforms
Train Staff
List OF Empty Platforms
PLATFORMS
Holidays And Penalties
Holidays And Penalties
6.3 Attendance updation and Holidays Calculation
Attendance
Holidays And Penalties
STAFF


9.1 BOOK TICKETS
9.2 VIEW TRAIN STATUS
9.3 CANCEL TICKET
9.4 CHECK PNR STATUS
Train No.
TRAIN
Ticket Status
Check Availability
PNR Number
PNR Number
PNR Status
PASSENGER
Generate Ticket
9.5 BOOKING
Source,Destn,Tno,Date
Details
TICKET
9.6 GENERATE TICKET
Update Ticket Details
Deliver
Ticket
PASSENGER

1.7 Data Dictionary

Name	Component	Source	Destination
TCS	Train Current Status (Location + Expected Delay)	Train Staff	Management Staff
P&H	Penalties + Holidays	STAFF DRIVER (datastore)	Management Staff Train Staff Drivers
Login_Credentials	User_id + Password	Management Staff Train Staff Drivers Passenger	Login
Tkt_Status	Ticket Status (Reserved / Waiting)	TICKET (datastore)	Passenger

ESTIMATION

2.1 Function Points

All the fi questions **fi**

F1. Does the system require reliable backup and recovery?

Ans: Yes, the system require backup of data for further use of information. 5

F2. Are data communications required?

Ans: Communication is required as to confirm selection of products. 5

F3. Are there distributed processing functions?

Ans: Not much, but most data is distributed to diff sellers 2

F4. Is performance critical?

Ans: Sometimes it gets critical, when product is selected and is not found in quantity and quality 2

F5. Will the system run in an existing, heavily utilized operational environment?

Ans: Beside some applications, most of the application of application of software can run in an existing, heavily utilized operation environment. 4

F6. Does the system require on-line data entry?

Ans: The whole software is based on online data entry that is stored in online databases 5

F7. Does the on-line data entry require the input transaction to be built over multiple screens or operations?

Ans: Yes, the input data entry will get stored at multiple screen i.e. at admin website, and at customers profile. 5

F8. Are the ILF's updated on-line?

Ans: The data that reside within the applications boundary and is maintained via external input is updated as soon as user changes any of its information. 5

F9. Are the inputs, outputs, files or inquiries complex?

Ans: Yes a lot of time. Inquiries of the product and the selection or rejection of that can result in complexion. 3

F10. Is the internal processing complex?

Ans: The database maintenance can be a little bit complex and operating system used also affects the internal processing. 3

F11. Is the code designed to be reusable?

Ans: Not every part of the code, but some part of the code can be made reusable to use existing information. 3

F12. Are conversion and installation included in the design?

Ans: YES, only one(conversion of decimal to binary form) 3

F13. Is the system designed for multiple installations in different organizations?

Ans: Yes, software is operating system independent. 5

F14. Is the application designed to facilitate change and ease of use by the user?

Ans: Yes, the software facilitate the changes and ease of use and information modified will be kept safe & private 5

Total 55

External inquiries	□ Stoppage station inquiry □ Train inquiry □ PNR station inquiry	3
External inputs (EIs)	□ Number of passengers □ Train current info □ Train attendance □ Station schedule □ Empty platforms □ Addition of trains □ Signing in/off credentials □ Engine attendance □ Book tickets □ Cancel tickets □ Station attendance	11
External outputs (EOs)	□ Duty allotment □ Booking payment details □ Total cancellation amount	6
Internal logical files (ILFs)	□ Holidays and penalties □ Rest hours □ Ticket status □ Total booking amount □ Train current status □ New train details	3
External interface files (EIFs)	□ Train list □ Platform details	3

Measurement Paramenters	Count	Simple	Avergae	Complex	Calculated
External inputs	6x 5x	3 3	4 4	6 6	18 20
External Outputs	3x	4	5	7	12
Internal Inquiries	3x	3	4	6	18
Internal Logical Files	6x	7	10	15	42
External interface Logical	2x	5	7	10	10
Count Total					**120**

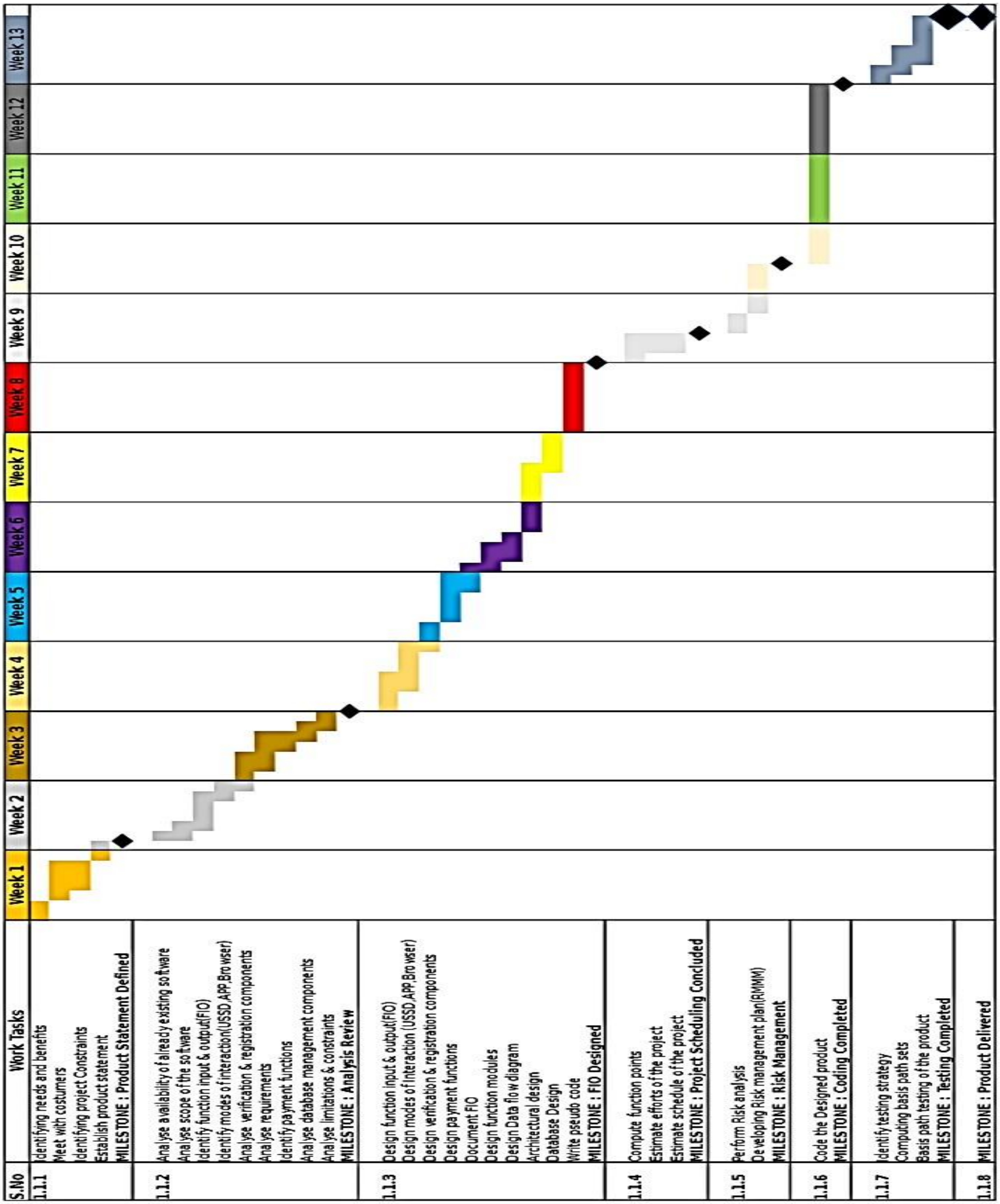
Computing Function Point:

FUNCTION POINT = COUNT TOTAL * [0.65 + 0.01 * SUM (Fi)]
=120 * [0.65 + (0.01 * 55)] = 144

2.2 Efforts

The organizational productivity for systems of such type is 5 FP/pm. Single labor for such project would approximate around $5000/pm. So the production of Single Function Point would be $1000. This means that the total cost of Function Points Product will come out to be $138,000. As we target to complete the project in 13 weeks, we would require a labor force of 9 people.

3. Scheduling



S.No	Work Tasks
1.1.1	Identifying needs and benefits Meet with costumers Identifying project Constraints Establish product statement **MILESTONE : Product Statement Defined**
1.1.2	Analyse availability of already existing software Analyse scope of the software Identify function input & output(FIO) Identify modes of interaction(USSD,APP,Browser) Analyse verification & registration components Analyse requirements Identify payment functions Analyse database management components Analyse limitations & constraints **MILESTONE : Analysis Review**
1.1.3	Design function input & output(FIO) Design modes of Interaction (USSD,APP,Browser) Design verification & registration components Design payment functions Document FIO Design function modules Design Data flow diagram Architectural design Database Design Write pseudo code **MILESTONE : FIO Designed**
1.1.4	Compute function points Estimate efforts of the project Estimate schedule of the project **MILESTONE : Project Scheduling Concluded**
1.1.5	Perform Risk analysis Developing Risk management plan(RMMM) **MILESTONE : Risk Management**
1.1.6	Code the Designed product **MILESTONE : Coding Completed**
1.1.7	Identify testing strategy Computing basis path sets Basis path testing of the product **MILESTONE : Testing Completed**
1.1.8	**MILESTONE : Product Delivered**

4. Risk Management

4.1 Risk Identification

1. **Server breaks down**
   Due to the breakdown of server, our customers will not be able to connect to our website.

2. **Data loss**
   Sometimes, the computer may crash due to which all our data will be lost and this is a major issue.

3. **Security issues**
   The website may get hacked intentionally by someone and this will lead to huge loss in terms of both money and data.

4. **End users resist system**
   It is possible that users are more adaptive to some other manual method and hence, it would be a big problem to maintain simultaneous records, and it is quite difficult to convince people to opt for online system because there are many people who prefer physical/manual system.

4.2 Risk Table

RISKS	**CATEGORY**	**PROBABILITY**	**IMPACT**
Data loss	TI	70%	1
End users resist system	BU	20%	1
Server breaks down	TI	10%	1
Security issues	TI	10%	1

Impact Value	Impact Type
1	Catastrophic
2	Critical
3	Marginal
4	Negligible

4.3 Risk Mitigation, Monitoring And Management

RISK: DATA LOSS

Mitigation
A loss of data will result in huge loss. As a result, the organisation is taking steps to make multiple back-up copies of the software in development and all documentation associated with it, in multiple locations. Multiple backup files would be maintained at various locations, backup would be taken at different times for different system to minimise the data loss (if it occurs).

Monitoring
When working on the product or documentation, we should always be aware of the stability of the computing environment they are working in. Any changes in the stability of the environment should be recognized and taken seriously.

Management
The lack of stable-computing environment is extremely hazardous to a software development team. In the event that the computing environment is found unstable, the development team should cease the work on that system until the environment is made stable again, or should move to a system that is stable to use and continue working there.

RISK: END USERS RESIST SYSTEM

Mitigation
In order to prevent this from happening, the software will be developed with the end user having an idea of the final product (a prototype can be delivered). The user-interface will be designed in a way to make use of the system convenient and pleasurable. Specific training methods would be constructed to make the system more adaptable to users.

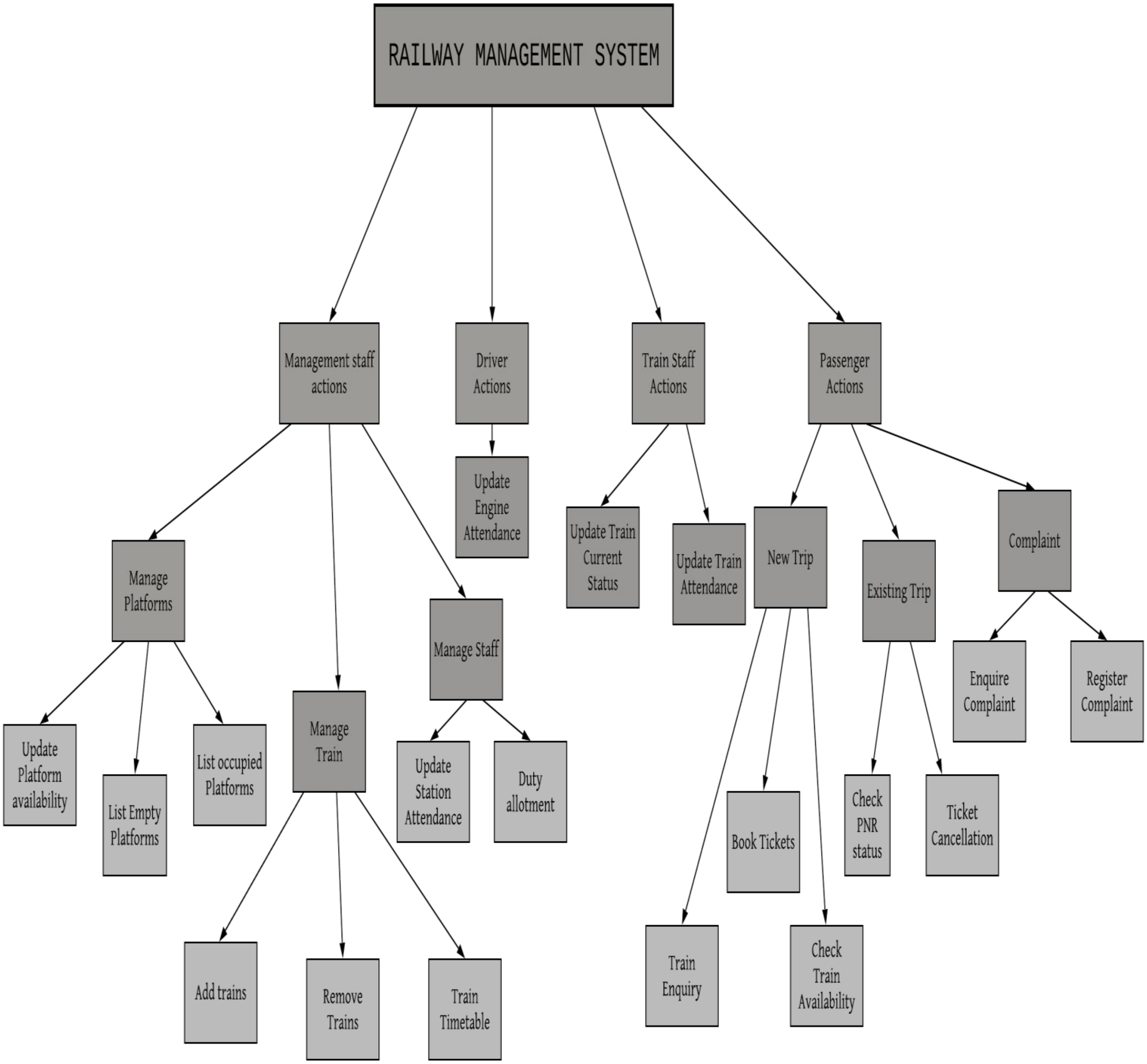
Monitoring
The software will be developed with the end user in mind. The development team will ask the opinion of various outside sources throughout the development phases. Specifically, the user-interface developer will be sure to get a thorough opinion from others. Various help assistant dialog boxes/ check boxes will be added to keep a check on input values

Management
Should the program be resisted by the end user, the program will be thoroughly examined to find

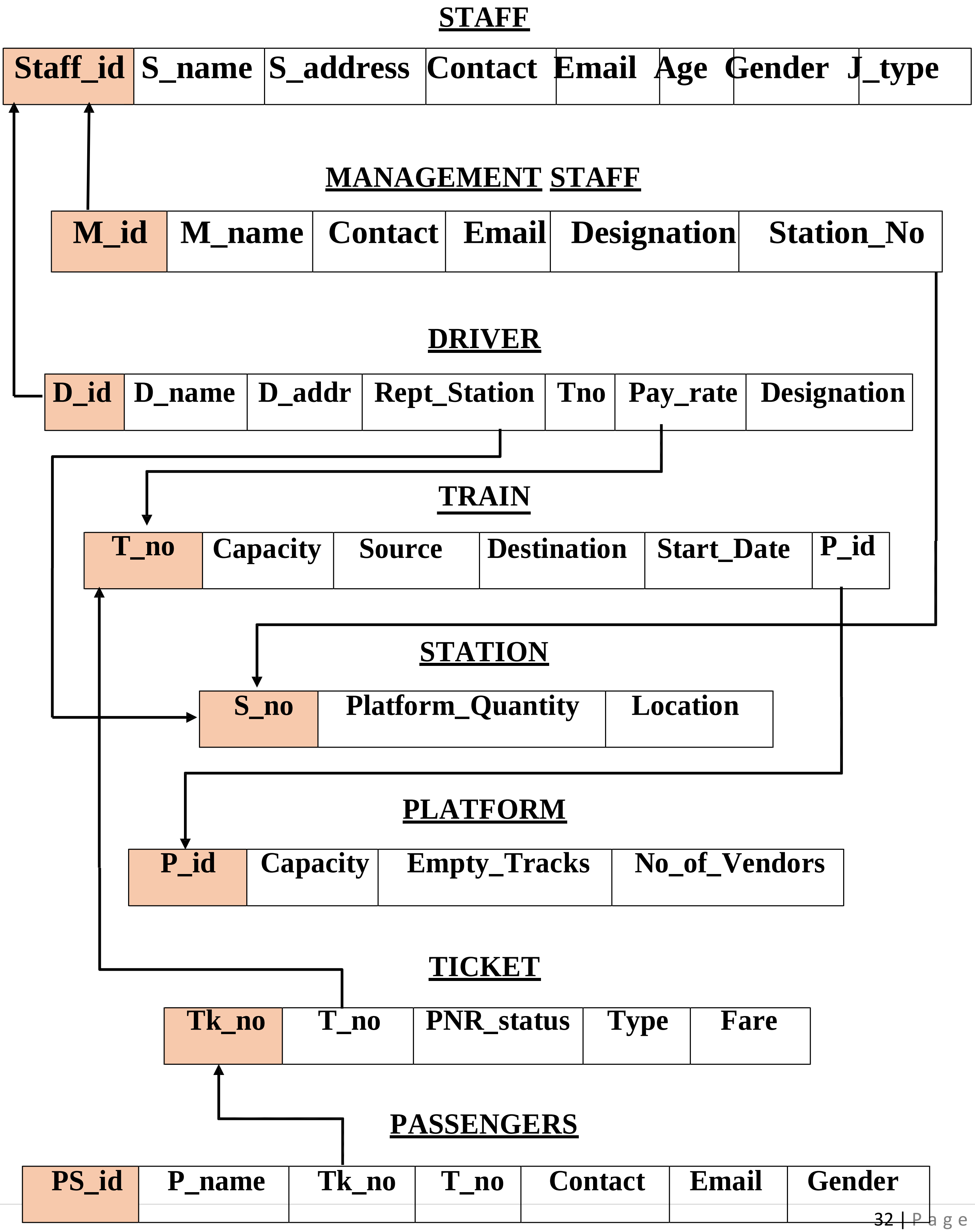
the reasons that this is so. Specifically, the user interface will be investigated and if necessary, revamped into a solution.

5. Design

5.1 Architectural Design



5.2 Data Design



STAFF

Staff_id	S_name	S_address	Contact	Email	Age	Gender	J_type

MANAGEMENT STAFF

M_id	M_name	Contact	Email	Designation	Station_No

DRIVER

D_id	D_name	D_addr	Rept_Station	Tno	Pay_rate	Designation

TRAIN

T_no	Capacity	Source	Destination	Start_Date	P_id

STATION

S_no	Platform_Quantity	Location

PLATFORM

P_id	Capacity	Empty_Tracks	No_of_Vendors

TICKET

Tk_no	T_no	PNR_status	Type	Fare

PASSENGERS

PS_id	P_name	Tk_no	T_no	Contact	Email	Gender

5.3 Schema Design

Train Schema

ATTRIBUTES	**DATA TYPE**	**CONSTRAINTS**
T_ID	INTEGER	PRIMARY KEY
CAPACITY	VARCHAR(11)	NOT NULL
SOURCE	VARCHAR(20)	NOT NULL
DESTINATION	VARCHAR(20)	NOT NULL
START DATE	DATE	NOT NULL
P_ID	INTEGER	FOREIGN KEY

Station Schema

ATTRIBUTES	**DATA TYPE**	**CONSTRAINTS**
S_NO	INTEGER	PRIMARY KEY
QUANTITY_PLATFORM	INTEGER	NOT NULL
LOCATION	VARCHAR(20)	NOT NULL

Platform Schema

ATTRIBUTES	**DATA TYPE**	**CONSTRAINTS**
NO OF VENDORS	INTEGER	NOT NULL
P_ ID	INTEGER	PRIMARY KEY
CAPACITY	DATE	NOT NULL
EMPTY TRACKS	BOOLEAN	NOT NULL

Ticket Schema

ATTRIBUTES	DATA TYPE	CONSTRAINTS
TK_NO	INTEGER	PRIMARY KEY
PNR STATUS	INTEGER	FOREIGN KEY
TYPE(RES./WAITING)	VARCHAR(20)	NOT NULL
FARE	INTEGER	NOT NULL

Staff Schema

ATTRIBUTES	DATA TYPE	CONSTRAINTS
M_ID	INTEGER	PRIMARY KEY
M_NAME	VARCHAR(25)	NOT NULL
CONTACT	VARCHAR(13)	NOT NULL
EMAIL	VARCHAR(30)	NOT NULL
AGE	INTEGER	NOT NULL
DESIGNATION	VARCHAR(6)	NOT NULL
STATION_NO	INTEGER	NOT NULL

Management Staff Schema

ATTRIBUTES	DATA TYPE	CONSTRAINTS
STAFF_ID	INTEGER	PRIMARY KEY
S_NAME	VARCHAR(25)	NOT NULL
S_ADDRESS	VARCHAR(75)	NOT NULL
CONTACT	VARCHAR(13)	NOT NULL
EMAIL	VARCHAR(30)	NOT NULL
AGE	INTEGER	NOT NULL
GENDER	VARCHAR(6)	NOT NULL

Driver Schema

ATTRIBUTES	DATA TYPE	CONSTRAINTS
D_ID	INTEGER	PRIMARY KEY
D_NAME	VARCHAR(11)	NOT NULL
EXPERIENCE	INTEGER	NOT NULL
DUTY HOURS	INTEGER	NOT NULL

Paasenger Schema

ATTRIBUTES	DATA TYPE	CONSTRAINTS
PS_ID	INTEGER	PRIMARY KEY
TK_NO	INTEGER	FOREIGN KEY
T_NO	INTEGER	FOREIGN KEY
CONTACT	VARCHAR(13)	NOT NULL
EMAIL	VARCHAR(30)	NOT NULL
GENDER	VARCHAR(6)	NOT NULL

6. Code

```
 do {
  enter name
  while(name) is valid {
    enter password
   if (password) matches
           break;
   else error=true;
   }
   }while error = true;
Select an option from menu and enter your choice
Menu: 1. Booking 2. View status 3. Feedback 4. Send enquiry 5. Ticket cancellation
6. View train details
cin>>choice
switch(choice)  {
      case 1: Book_tickets();
          break;
   case 2: Show train live status
          break;
   case 3: Enter Feedback
          break;
   case 4: Enter enquiry
          break;
   case 5:Cancel_tickets();
          break;
   case 6:Show train details
          break;
   default: choose a valid option
          break;
 Print the result of selected case

//Function to book tickets
Book_tickets() {
      while(source station) is valid {
       Enter destination station
            while(destination station) is valid {
          check path availability
               if(path) is valid
                  show all available trains
               else
                  terminate();
            }
      }
  Enter date of journey, number of tickets
     Check ticket availability
      if(ticket) available
          Book ticket
      else
           add to waiting list.
  return result
}
//Function to Cancel Booked Tickets
 Cancel_tickets() {
  Enter ticket number
    while(ticket number) is valid  {
       send cancellation confirmation
     }
  return result
}
```

7.Testing

Two types of testing are used in testing the developed software:

1. Black box testing
2. White Box testing

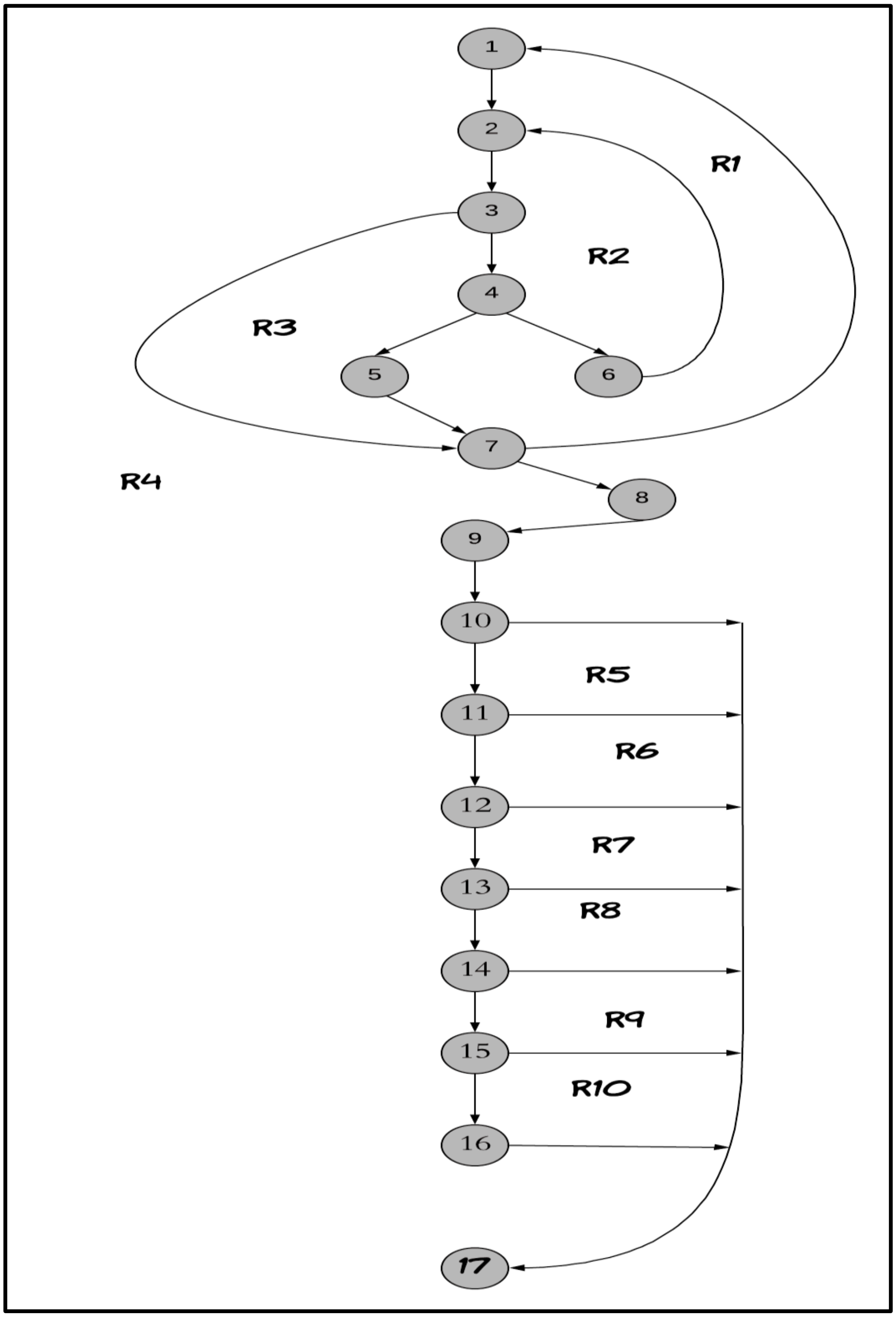
White Box Testing:

White Box testing of software is predicted on close examination of procedural detail providing test cases that exercise specific conditions or loops test logical paths within the software.

We are writing a demo program using white box testing. We are doing this to check validation of independent paths.

Pseudocode:

```
do {                          }  ← 1
  enter name               }  ← 2
  while(name) is valid {  }  ← 3
    enter password           }  ← 4
        if (password) matches  }
         break;                }  ← 5
        else error=true;  }
   }                      }  ← 6
   }while error = true;  }  ← 7
Select an option from menu and enter your choice
Menu: 1. Booking 2. View status 3. Feedback 4. Send         }
5. Ticket cancellation 6. View train details        enquiry }  ← 8
cin>>choice
 switch(choice)  {  }  ← 9
      case 1: Book_tickets();  }
        break;                 }  ← 10
   case 2: Show train live status  }
        break;                     }  ← 11
   case 3: Enter Feedback  }
        break;             }  ← 12
   case 4: Enter enquiry  }
        break;            }  ← 13
   case 5:Cancel_tickets();  }
        break;               }  ← 14
   case 6:Show train details  }
        break;                }  ← 15
   default: choose a valid option  }
        break;                     }  ← 16
 Print the result of selected case  }  ← 17
```



Predicate Nodes = 3, 4, 7, 10, 11, 12, 13, 14, 15

No. of Edges = 25 **No. of Nodes** = 17

No. of Regions = 10

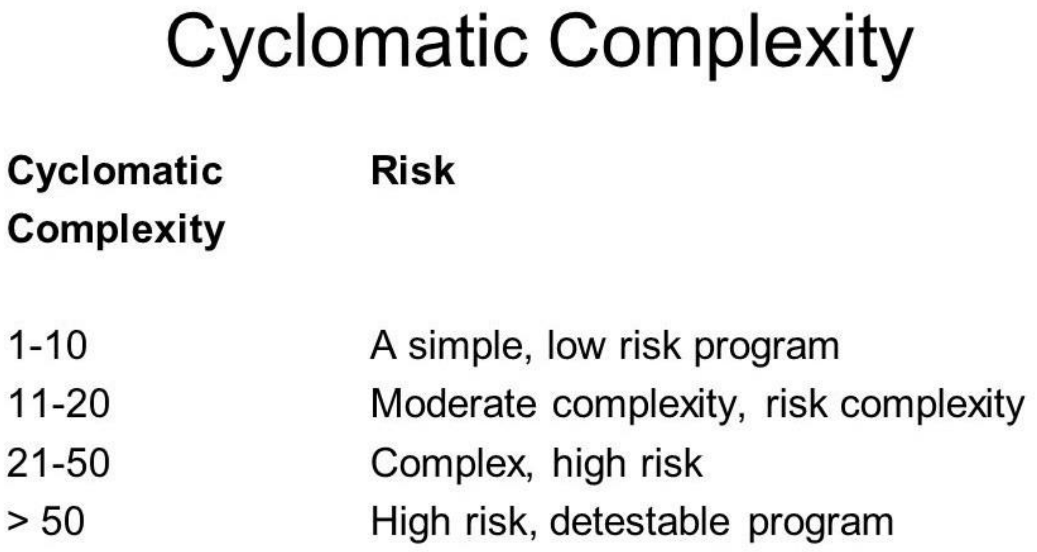
<u>Cyclomatic Complexity</u>:

V(G) = no of regions => V(G) = 10

V(G) = no of edges – no of nodes + 2 = 25 – 17 + 2 => V(G) = 10

V(G) = no of predicate nodes + 1 = 9 + 1 => V(G) => 10

The value of above function implies that the code is well structured, with high testability. The cost and effort associated with the program is low.



Cyclomatic Complexity

Cyclomatic Complexity	Risk
1-10	A simple, low risk program
11-20	Moderate complexity, risk complexity
21-50	Complex, high risk
> 50	High risk, detestable program

.

Independent Paths:

PATH 1:	1-2-3-4-5-7-8-9-10-17
PATH 2:	1-2-3-4-5-7-8-9-11-17
PATH 3:	1-2-3-4-5-7-8-9-12-17
PATH 4:	1-2-3-4-5-7-8-9-13-17
PATH 5:	1-2-3-4-5-7-8-9-14-17
PATH 6:	1-2-3-4-5-7-8-9-15-17
PATH 7:	1-2-3-4-5-7-8-9-16-17
PATH 8:	1-2-3-4-6…………………………….

8. References

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- P Jalote, An Integrated Approach To Software Engineering (2nd Edition), Narosa Publishing House (2003)
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