SIGMAVIAL

Sistema Integrado de Gestión de Mantenimiento Vial

INTEGRATED SYSTEM FOR ROAD MAINTENANCE MANAGEMENT

OVERVIEW AND IMPLEMENTATION APPROACH

HQ Solutions

1. Table of Content

2. Introduction

2.1 Issues Addressing

Currently, there are many cases where maintenance procedures are not specifically defined or fully automated. Process automation have been developed with separate systems that support only parts of the whole process and has not sought their integration into an integrated system.

This is a serious problem when making the integration of data that directly and indirectly impact on different departments of the organization; were combined with the above any of these automated systems did not consider standards and policies regarding software and data structure; or don't' have clearly established administrative procedures to be followed for the control and flow of information.

The lack of automation and / or integration of these processes raise the following issues related to execution of road maintenance:

- Losses:
    - Latin America: more than 50,000 Million of losses due to lacks of efficiency on budgets administration
    - For every Dollar not timely invested on Road Maintenance, you must spend between 3 to 5 on Rehabilitation Works.
- Causes:
    - Lack of Resources: Sufficient, Timely and Continuous.
    - Lack of Effectiveness and Efficiency due to not technical decisions.
- Consequences:
    - Poor average condition and accelerated deterioration of the road network. Loss of road assets.
    - Increased operating costs of public transport and public services and the consequent negative effect on the economy.

In the case of road projects, the feasibility is determined in social terms, which must be defined because the benefits against the cost of the work and recurring maintenance costs, and thus establish whether the public investment can be classified as viable.

Once established as a viable project, you should have a tool to generate:

- Implementation and maintenance of a road inventory according to institutional needs.
- Full Planning (quantity and amount to be disbursed) of the activities or operations of preserving and road maintenance. Verification of compliance with them with established budgetary goals.

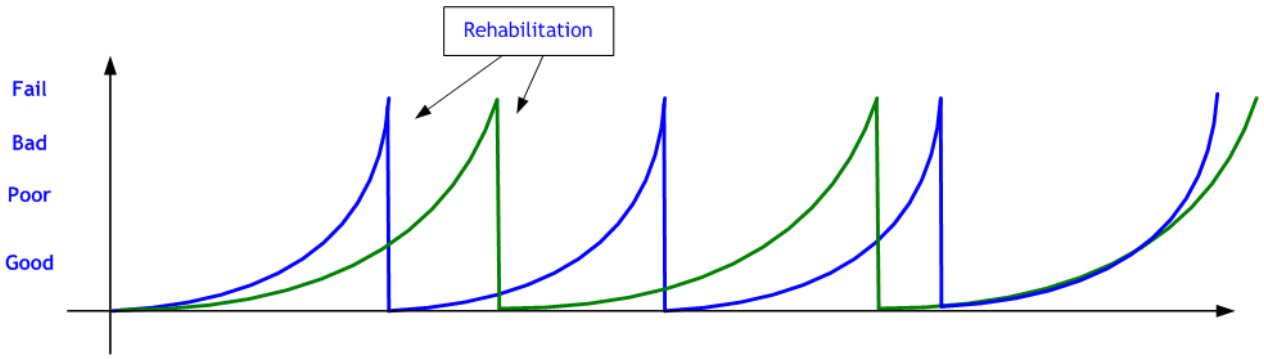
- Monitoring and control of execution (in number and amount paid) of the activities or operations of preserving and road maintenance.
- Control of deviations produced between scheduled and executed conservation and road maintenance.
- Generation of payments for execution as well as a plan of recovery of investment through contributions by improvement.

These issues motivated the development of Integrated System for Road Maintenance Management, in order to provide a comprehensive software solution that is essential for the economic evaluation of projects in order to promote understanding and implementation of the full cycle of a public investment project applied to road networks.

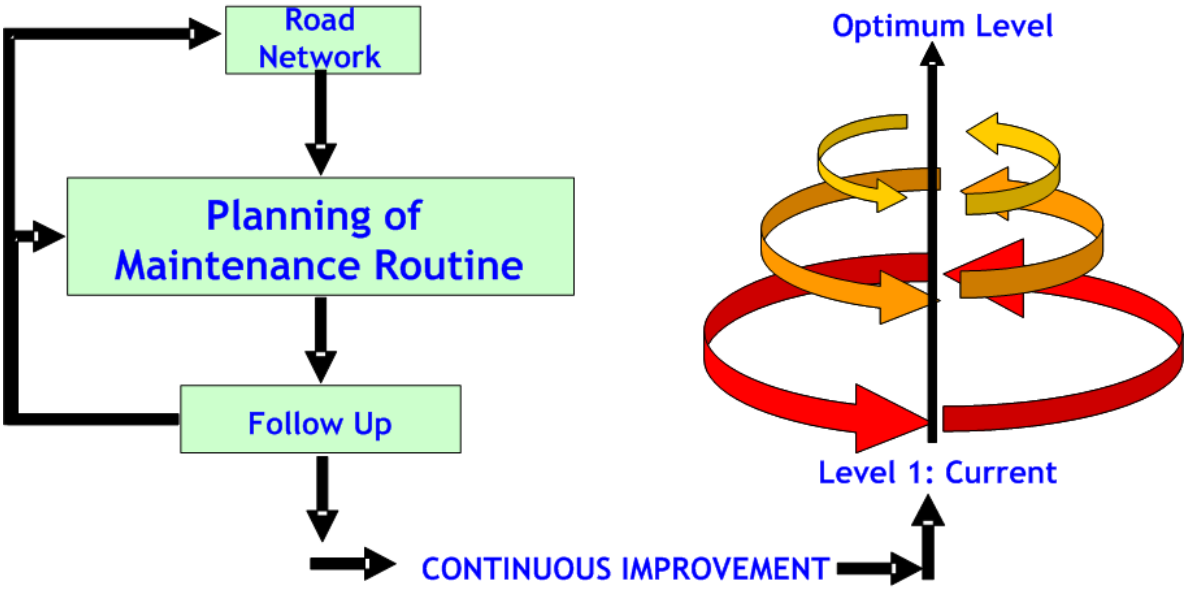
2.2 Integrated Systems for Road Maintenance Management

The Integrated Systems of Road Maintenance Management are important tools to promote good governance and improve maintenance processes, as they provide complete information for decisions making related to maintenance conditions that allow their proper maintenance for sustainable development.

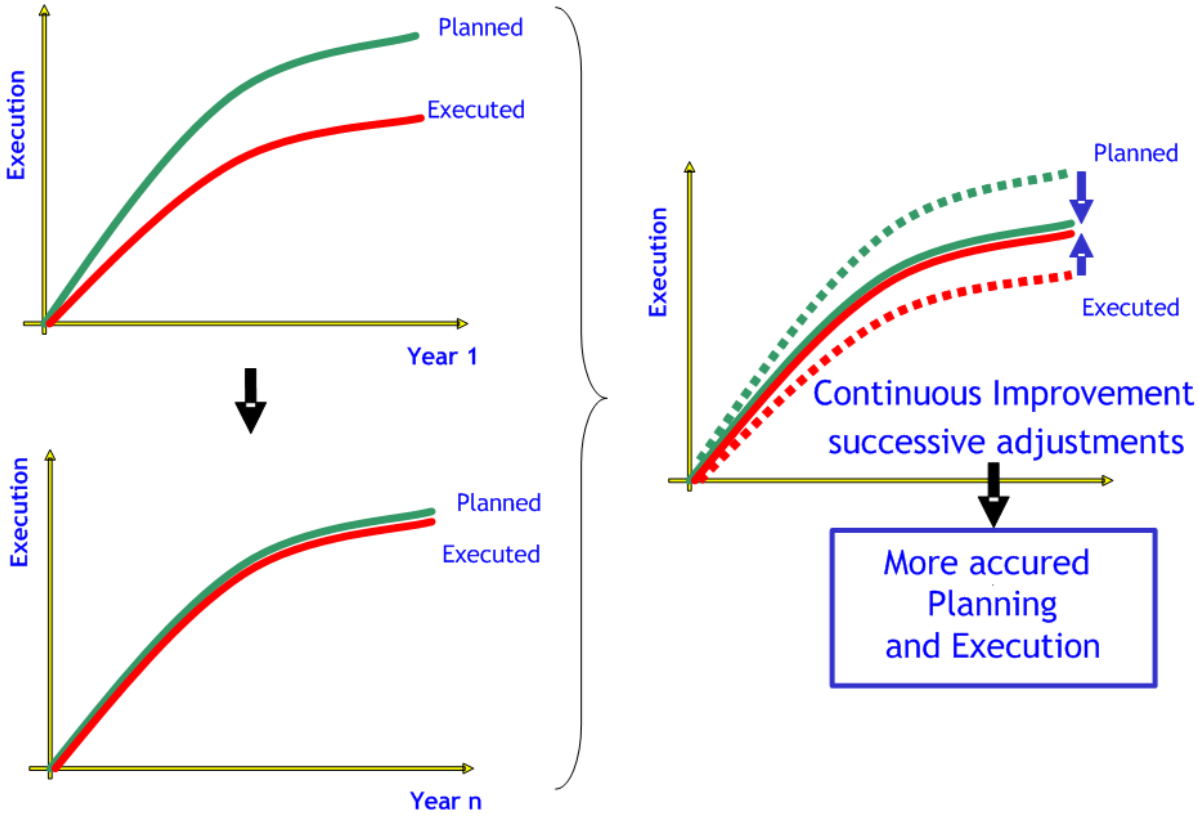
The fundamental idea is to optimize by automating the maintenance process administration in order to slow the deterioration of all components of the road network (road inventory) and also to make a better financial management of the network and generate savings in maintenance costs. This can be seen at the graph below, where you can see that the cycle of Maintenance Management that can be applied to the Conservation and Maintenance Routine Road, where cycles without Routine Maintenance and Conservation (blue) and cycles where apply Maintenance and Preservation Routine (green):



This is done through a cyclic maintenance management by improving the information collected and processed, as shown in the following chart:



This process of continuous improvement will improve the standards established on the formulas and costs defined for each of the maintenance activities for the road network, thus existing initial differences between planned (year 1) will be getting smaller reaching minimum values (year n), as shown in the following graph:



2.3 Strengths

Through SIGMAVIAL we seeks to contribute with ongoing solutions to activities of road maintenance control and management by incorporating system information tools and equipment that will improve the processes in terms of quality, scope, opportunity and efficiency

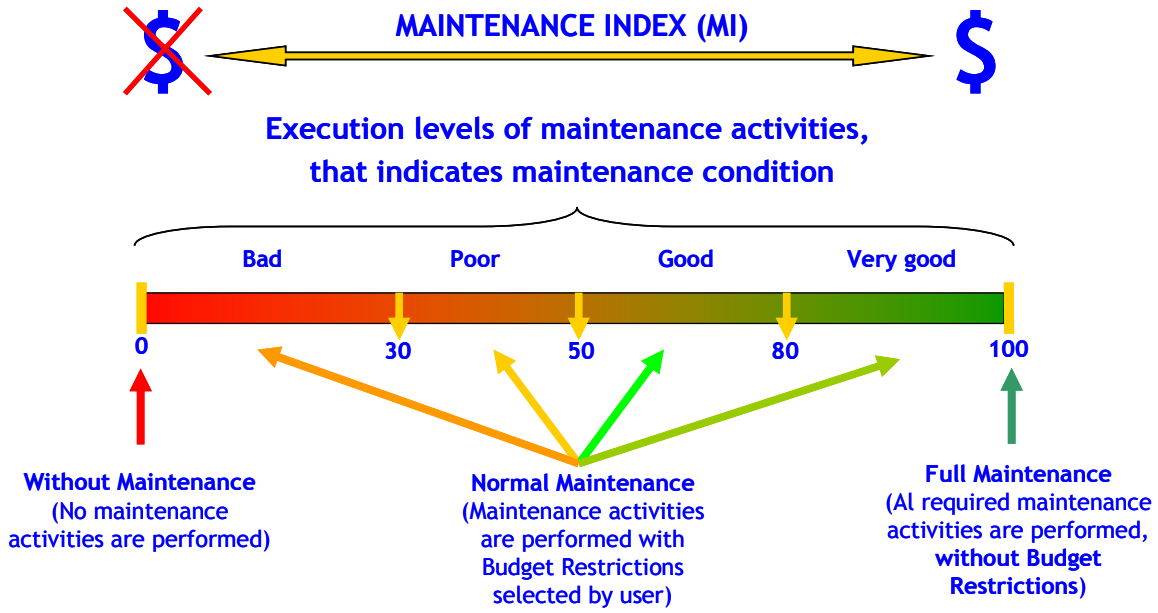
The focus is to have a fully integrated tool for management of road network maintenance, with different platforms and a single database with on line access.

But the final object is not only to implement a software or information system, the goal is to obtain a solution than involve the whole implementation, from software development to inventory execution, providing a complete package of service with professional advice both on road engineering, and information technology.

2.4 Maintenance Index Concept (MI).

The maintenance rate (hereafter MI) will be the main indicator used to assess the state of maintenance of the road network. This MI can be calculated by the system at level of segment, route, zone, and department or for the entire network, according to user needs; this will give you an accurate assessment of the conservation status of all inventory items of the road network in detail.

As a definition of MI, we can describe it as a percentage with a range from a null value (no maintenance performed on the section analyzed) to 100% (maintenance done completely without budget constraints, in a fully ideal condition). This makes the MI always be located at intermediate values, tending to find the upper limit of 100%. The following chart shows this concept:



On those grounds, the MI is an index that is related technical and economically with each of the maintenance operations performed on the network. If all maintenance (ideally) is made, we will have an MI of 100%. If, due to budget restrictions, not all operations will be performed, then SIGMAVIAL will calculate which is the MI value depending on operations that will be performed, and then we can decide if it is acceptable and we can analyze it against budgetary constraints that forced a reduction of maintenance activities. The system allows the analysis of multiple combinations of budget implementation that will result on different MI calculations to achieve the optimal network condition according to the technical criteria and budgetary constraints.

The MI can be programmed or actual as defined below:

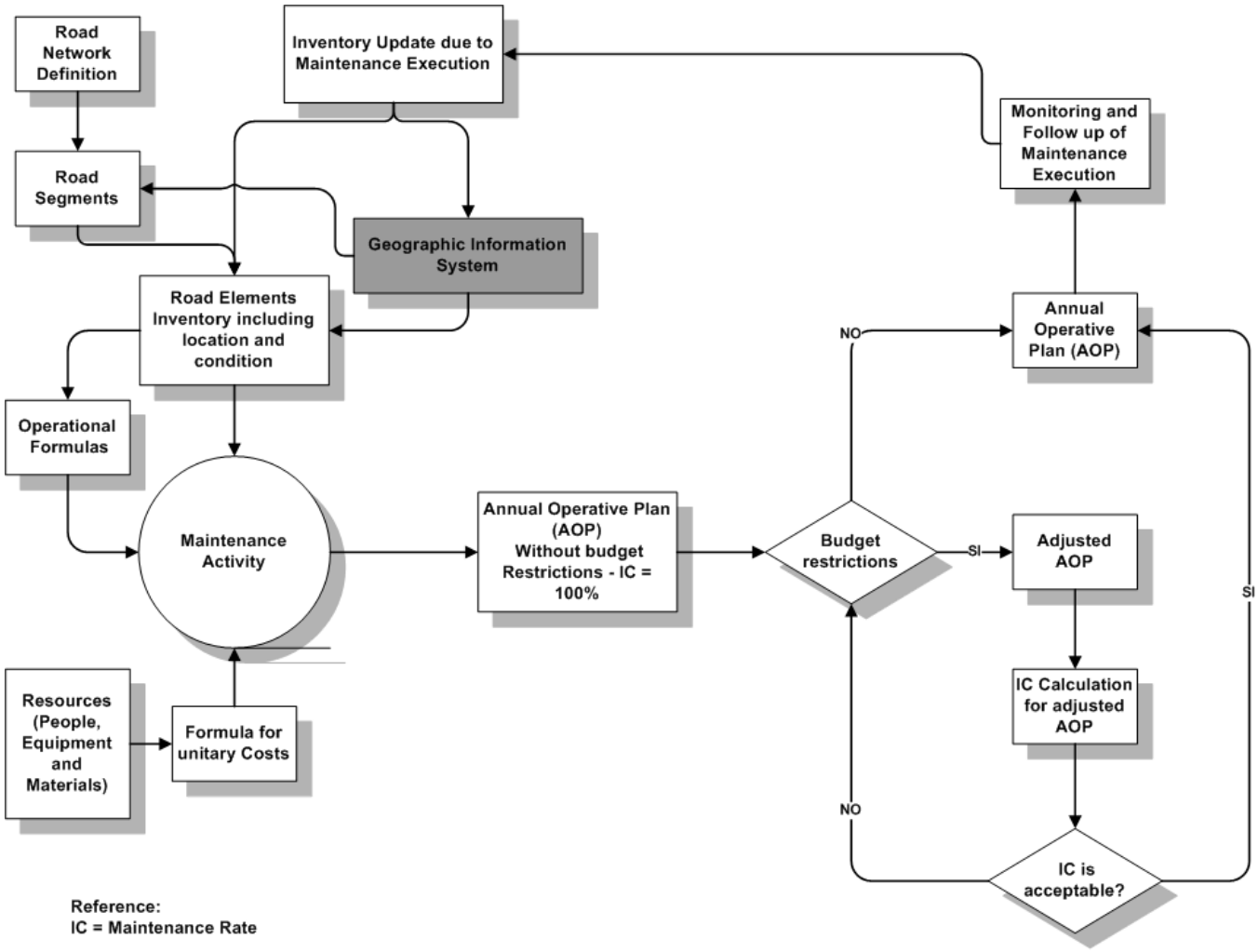
Programmed MI: It is based on maintenance activities planning. Therefore it indicates the MI that will be obtained if these planned operations are performed.

Real MI: It is calculated from the maintenance operations actually carried out. Therefore it indicates the MI value as the operations are performed.

Therefore, there will be differences between both rates and their comparison will allow us to make adjustments to optimize future planning.

2.5 Control Flow Model.

From the above, then presents a logical model of operation of the proposed solution, where we can see the realization of an Annual Operating Plan (AOP) for ideal conditions (without budgetary constraints and MI = 100) from which successive iterations are performed with budget constraints to find the final POA that will apply for all programming and planning of network maintenance. This final AOP, will be used to monitor and control the execution of road maintenance in order to establish deviations between scheduled and executed in the conservation of all or part of the road network that will be analyzed.



3. System Features Overview

3.1 Road Network Definition and Inventory

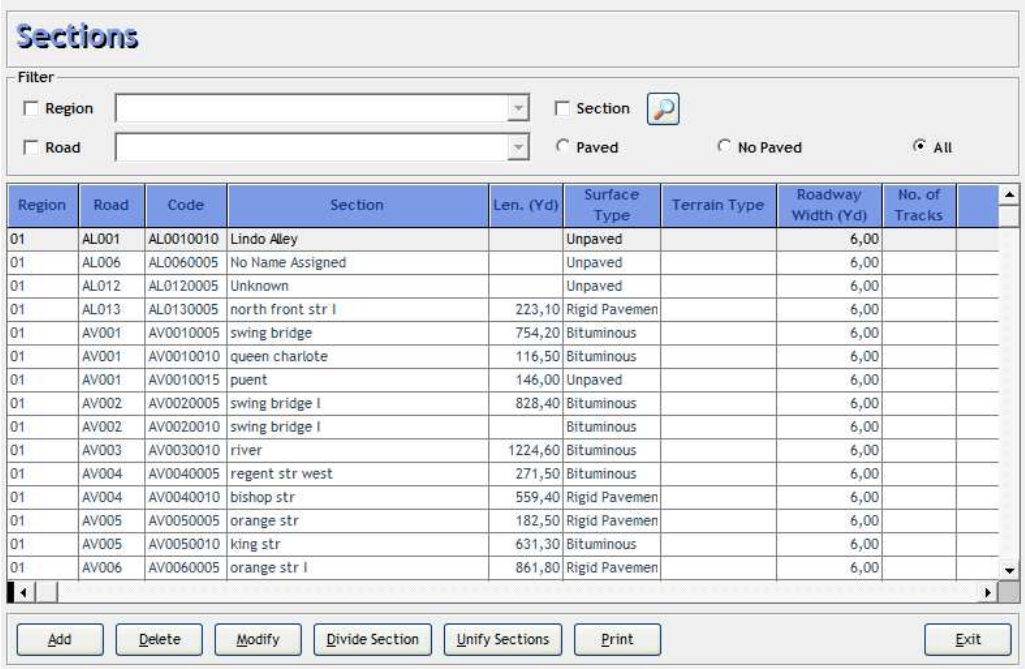
3.1.1 MAIN FEATURES DESCRIPTION

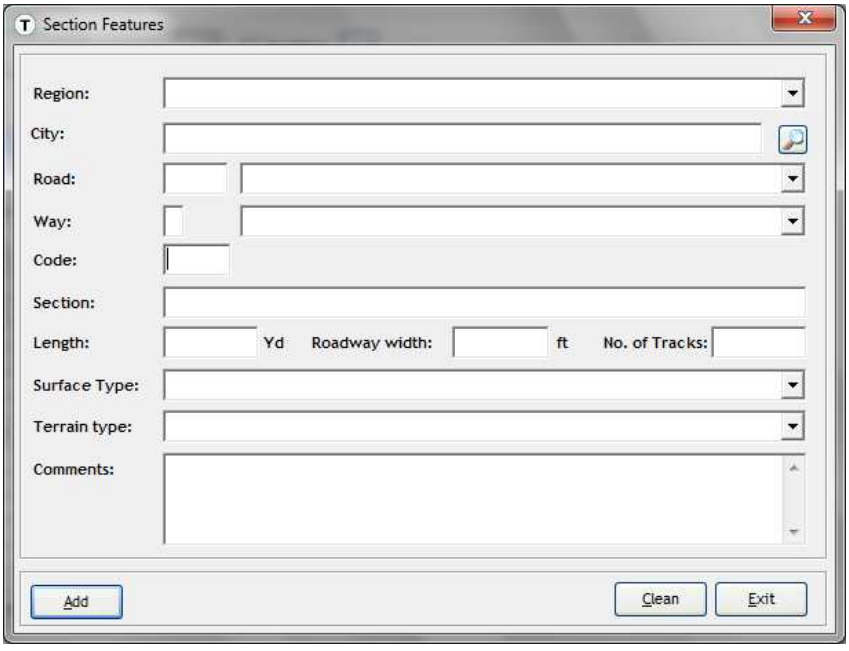
- Flexibility to manage Zones or Conservation Districts in which the network may be divided for ease of administration.
- Flexibility to define details levels as roads segments in the network.
- Administration or Walkways and geometries.
- Capacity to group routes and segments by administration zone
- Functionality for registration of GPS location, geometry and condition of inventory components in relation to the road network for each type of element (road surface, transverse and longitudinal drains, verges, signs and markings, bridges, safety elements, additional information characteristics and additional reports of incidents, etc.), with the following breakdown:
    - Road way surface.
    - Road and way width.
    - Number of ways.
    - Verges.
    - Vertical signage.
    - Horizontal markings.
    - Longitudinal drains.
    - Cross drains.
    - Safety devices.
    - Artworks (Bridges, content walls, etc.)
    - Luminaries and Light signals
    - Interferences.
- This module allow register data directly from jobs of field data gathering for every inventory element not only regards GPS location and element characteristics but also its state of maintenance, photo captures, and other observations that brings accurate information of the element current situation.
- The systems manage road progressive measures calculated directly from GPS road tracks. It has functionality to relate pictures, videos, and maps to GPS positions and routes progressives' marks.
- Flexibility to classify elements by type and other grouping levels cording to user needs.

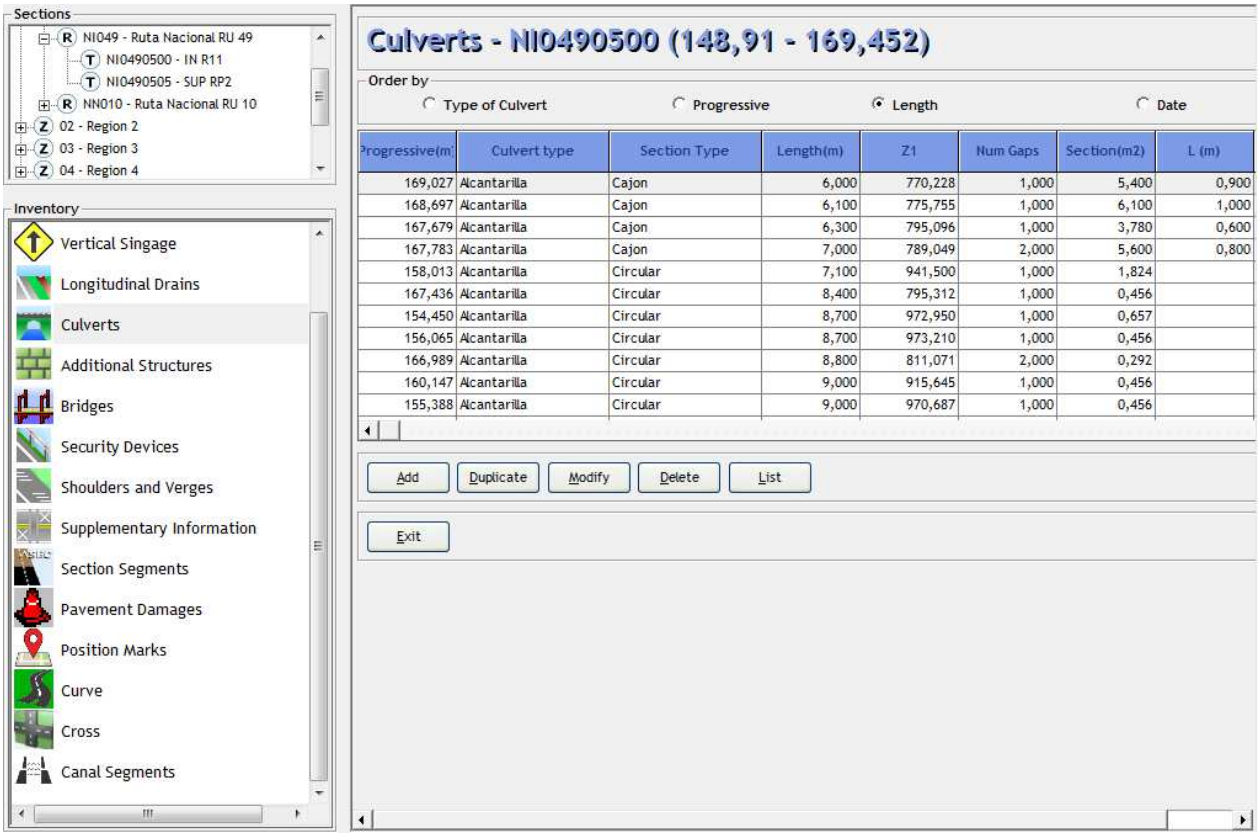
- Administration of the resource requirements for the realization of maintenance activities including the following features:
    - Human resources effort required for each maintenance activity
    - Requirements of tools and equipments for maintenance activities realization, such as road machinery and vehicles
    - Materials management including stock administration for different warehouses

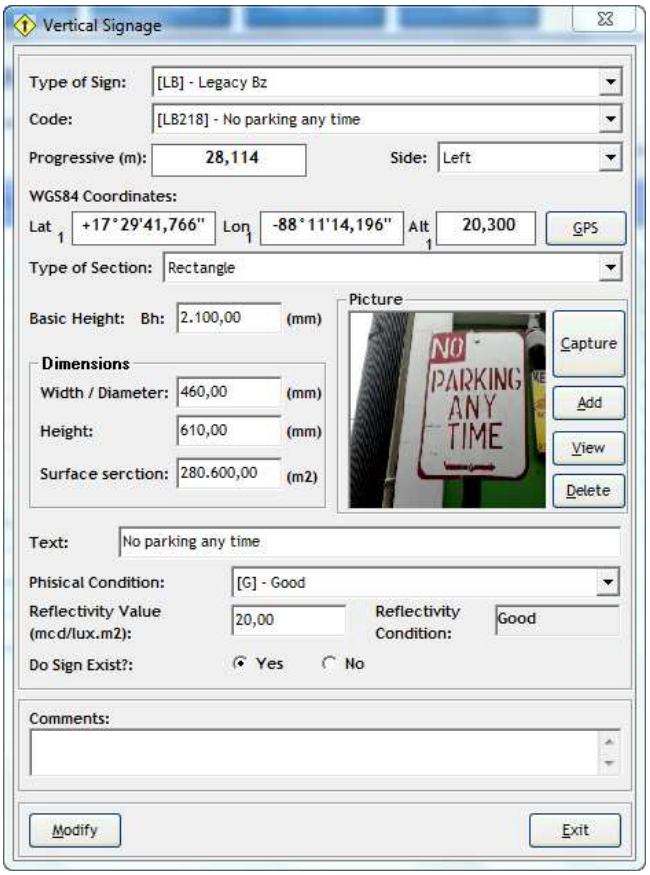
3.1.2 SAMPLE SCREENSHOTS

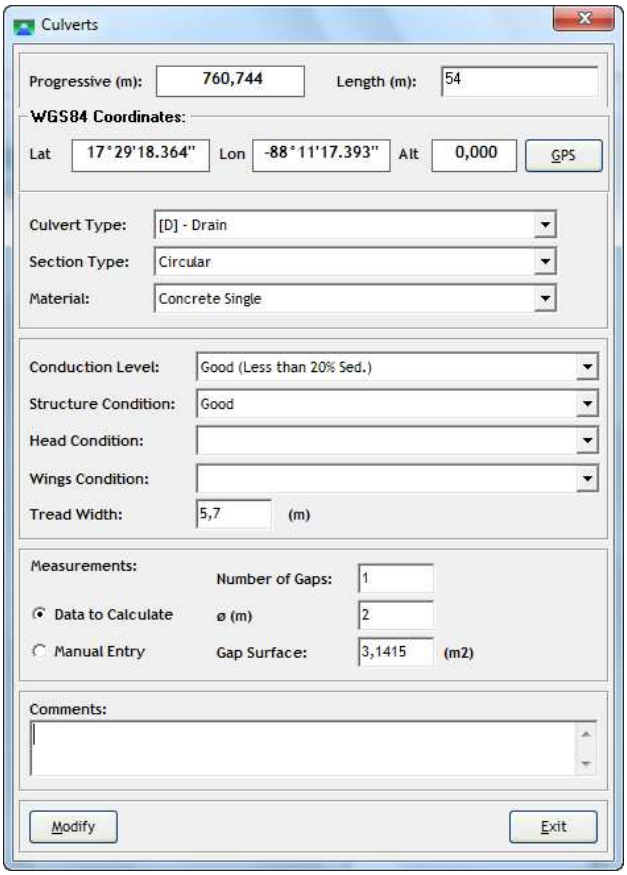
This section shows sample screenshots from the Road Maintenance Application

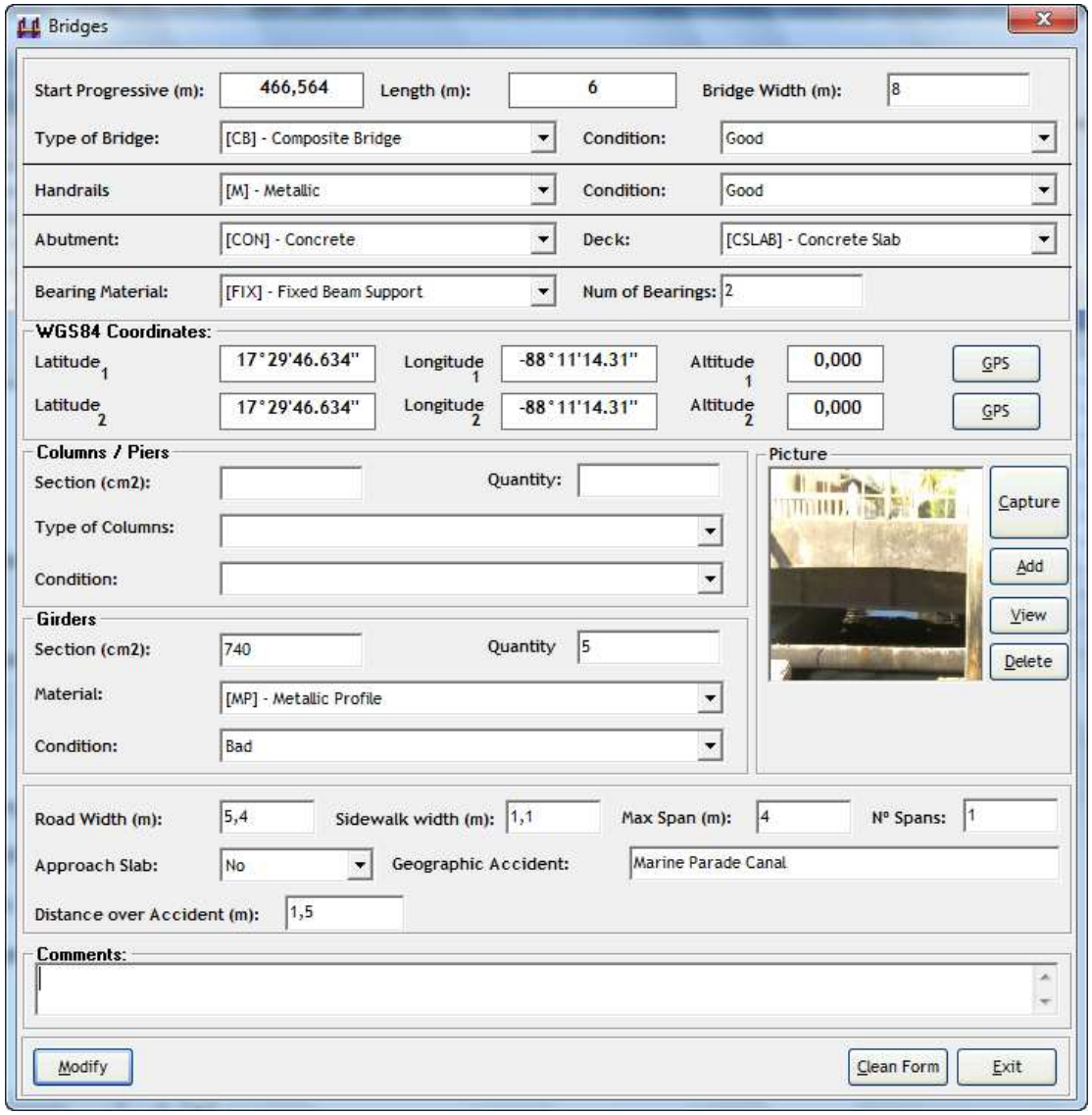


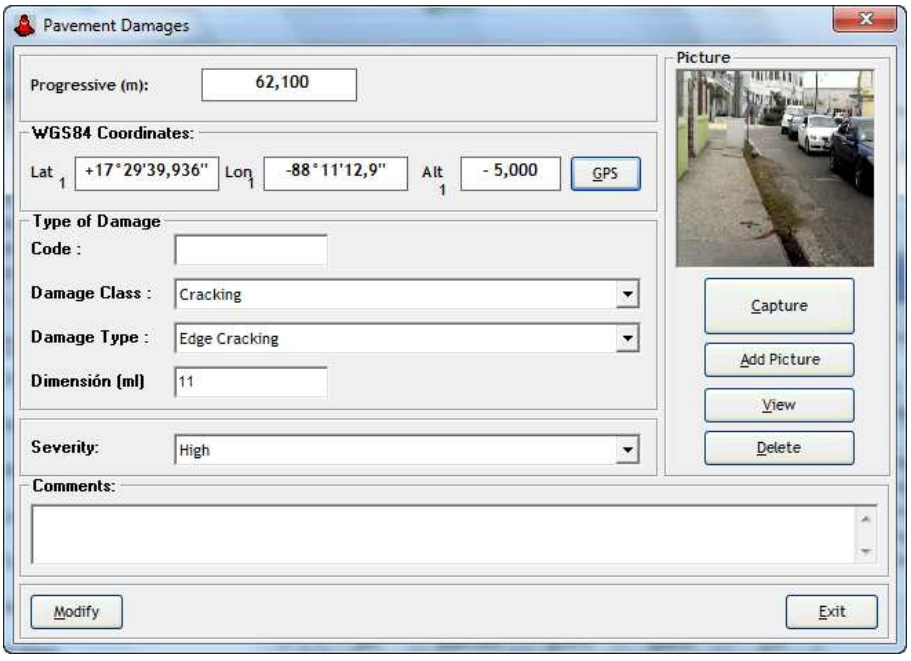



Sections
NI049 - Ruta Nacional RU 49
NI0490500 - IN R11
NI0490505 - SUP RP2
NN010 - Ruta Nacional RU 10
02 - Region 2
03 - Region 3
04 - Region 4
Inventory
Vertical Singage
Longitudinal Drains
Culverts
Additional Structures
Bridges
Security Devices
Shoulders and Verges
Supplementary Information
Section Segments
Pavement Damages
Position Marks
Curve
Cross
Canal Segments
Culverts - NI0490500 (148,91 - 169,452)
Order by
Type of Culvert
Progressive
Length
Date
Progressive(m)
Culvert type
Section Type
Length(m)
Z1
Num Gaps
Section(m2)
L (m)
169,027 Alcantarilla Cajon 6,000 770,228 1,000 5,400 0,900
168,697 Alcantarilla Cajon 6,100 775,755 1,000 6,100 1,000
167,679 Alcantarilla Cajon 6,300 795,096 1,000 3,780 0,600
167,783 Alcantarilla Cajon 7,000 789,049 2,000 5,600 0,800
158,013 Alcantarilla Circular 7,100 941,500 1,000 1,824
167,436 Alcantarilla Circular 8,400 795,312 1,000 0,456
154,450 Alcantarilla Circular 8,700 972,950 1,000 0,657
156,065 Alcantarilla Circular 8,700 973,210 1,000 0,456
166,989 Alcantarilla Circular 8,800 811,071 2,000 0,292
160,147 Alcantarilla Circular 9,000 915,645 1,000 0,456
155,388 Alcantarilla Circular 9,000 970,687 1,000 0,456
Add
Duplicate
Modify
Delete
List
Exit


Vertical Signage
Type of Sign: [LB] - Legacy Bz
Code: [LB218] - No parking any time
Progressive (m): 28,114
Side: Left
WGS84 Coordinates:
Lat 1 +17°29'41,766"
Lon 1 -88°11'14,196"
Alt 1 20,300
GPS
Type of Section: Rectangle
Basic Height: Bh: 2.100,00 (mm)
Dimensions
Width / Diameter: 460,00 (mm)
Height: 610,00 (mm)
Surface serction: 280.600,00 (m2)
Picture
NO PARKING ANY TIME
Capture
Add
View
Delete
Text: No parking any time
Phisical Condition: [G] - Good
Reflectivity Value (mcd/lux.m2): 20,00
Reflectivity Condition: Good
Do Sign Exist?: Yes No
Comments:
Modify
Exit


Culverts
Progressive (m): 760,744
Length (m): 54
WGS84 Coordinates:
Lat 17°29'18.364"
Lon -88°11'17.393"
Alt 0,000
GPS
Culvert Type: [D] - Drain
Section Type: Circular
Material: Concrete Single
Conduction Level: Good (Less than 20% Sed.)
Structure Condition: Good
Head Condition:
Wings Condition:
Tread Width: 5,7 (m)
Measurements:
Data to Calculate
Manual Entry
Number of Gaps: 1
ø (m) 2
Gap Surface: 3,1415 (m2)
Comments:
Modify
Exit


Bridges
Start Progressive (m): 466,564
Length (m): 6
Bridge Width (m): 8
Type of Bridge: [CB] - Composite Bridge
Condition: Good
Handrails: [M] - Metallic
Condition: Good
Abutment: [CON] - Concrete
Deck: [CSLAB] - Concrete Slab
Bearing Material: [FIX] - Fixed Beam Support
Num of Bearings: 2
WGS84 Coordinates:
Latitude 1: 17°29'46.634"
Longitude 1: -88°11'14.31"
Altitude 1: 0,000
GPS
Latitude 2: 17°29'46.634"
Longitude 2: -88°11'14.31"
Altitude 2: 0,000
GPS
Columns / Piers
Section (cm2):
Quantity:
Type of Columns:
Condition:
Girders
Section (cm2): 740
Quantity: 5
Material: [MP] - Metallic Profile
Condition: Bad
Picture
Capture
Add
View
Delete
Road Width (m): 5,4
Sidewalk width (m): 1,1
Max Span (m): 4
Nº Spans: 1
Approach Slab: No
Geographic Accident: Marine Parade Canal
Distance over Accident (m): 1,5
Comments:
Modify
Clean Form
Exit


Pavement Damages
Progressive (m): 62,100
WGS84 Coordinates:
Lat 1: +17°29'39,936"
Lon 1: -88°11'12,9"
Alt 1: - 5,000
GPS
Type of Damage
Code :
Damage Class : Cracking
Damage Type : Edge Cracking
Dimensión (ml): 11
Severity: High
Picture
Capture
Add Picture
View
Delete
Comments:
Modify
Exit

3.2 Road Maintenance Planning and Monitoring

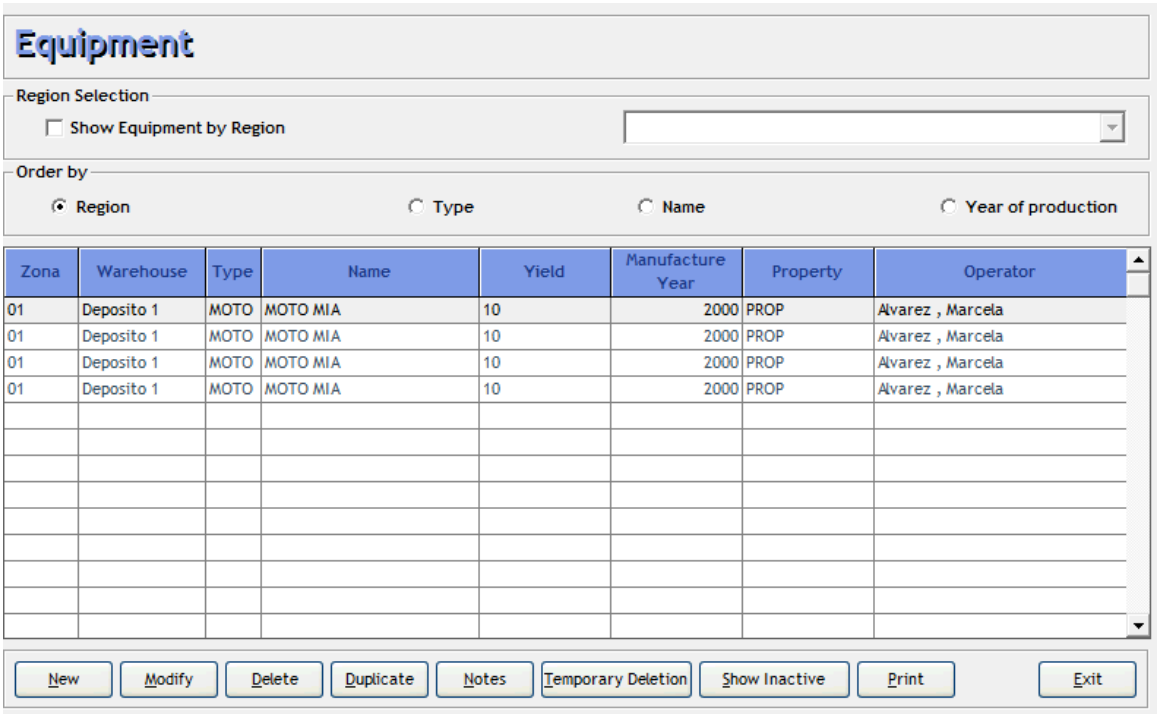
3.2.1 MAIN FEATURES DESCRIPTION

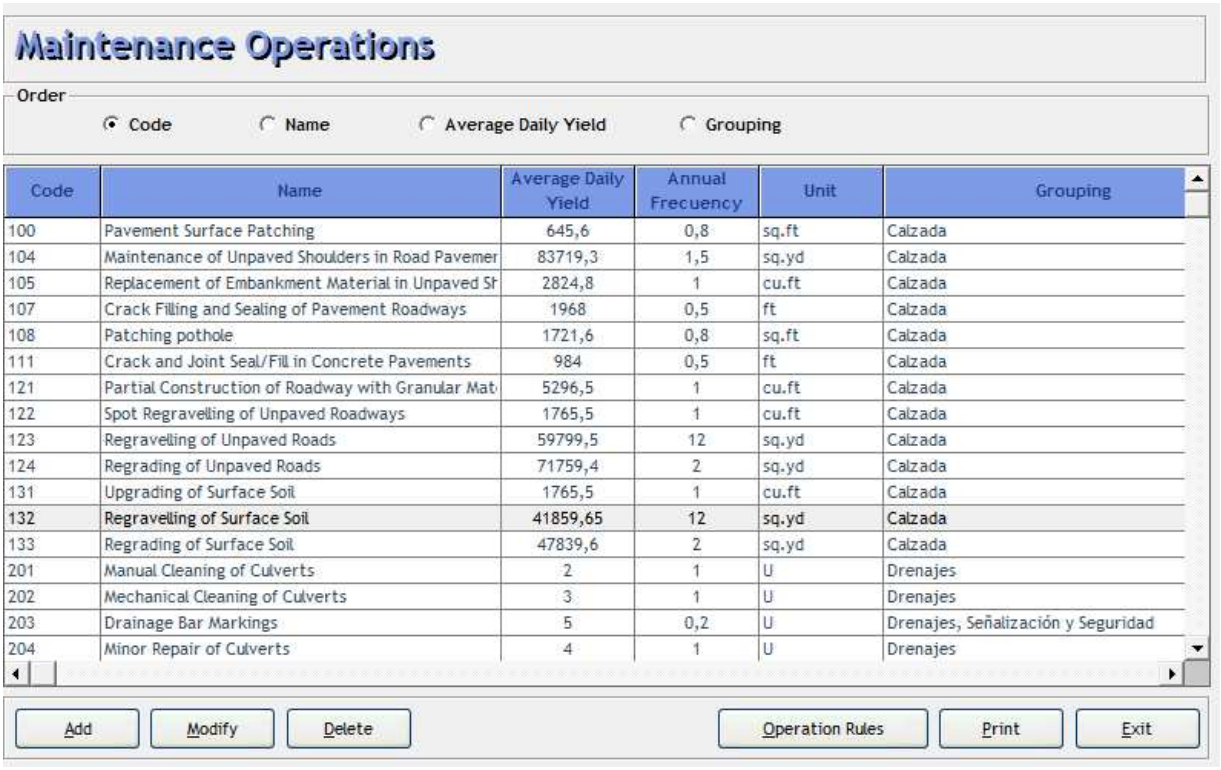
- Module for road maintenance planning including the following features:
    - Definition of maintenance operations considering all maintenance and repair activities both for routine maintenance (such as cracks sealing, vertical signs painting, drains cleaning, etc.) and for those of proactive, seasoning, or eventual maintenance (such as obstruction of a sewer by weeds, deep or shallow pavement patching, repair culverts and ditches, etc)
    - Definitions of resources requirements for each maintenance activity
    - Management of road maintenance level rates based on condition of the road surface and condition of each inventory component.
    - Creation of budgets and annual operative planning (POAs) based on inventory maintenance data
    - Activity maintenance scheduling and programming based on defined operative plans.
- Module of maintenance execution monitoring and control, including the following features:
    - Registration of progress of maintenance activities considering both own staff and contractors
    - Reports and Queries for maintenance budgets follow up
    - Executed vs. Planned analysis including maintenance operations and compared maintenance rates.
    - Real vs. planned resource consumption
    - Executed vs. Planned deviation
- Regarding planning functions, the system allowed to define and manage different maintenance activities according to user requirements and current agency policies. It is possible to define calculation formulas with conditional terms to calculate annual maintenance requirements based on state of each inventory element and road surface condition and damages.
- Using planning tools, included in the system, it is possible to analyze different scenarios with different maintenance rates depending on budget availability

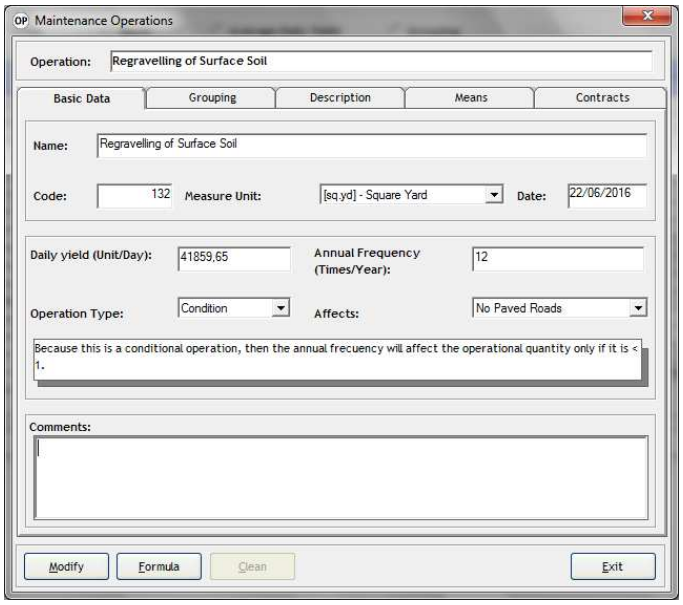
- Integration with HDM-4 software in order to apply models of deterioration and get profitability indicators for different maintenance policies. It is possible to bring information at the level of projects, programs and strategies.

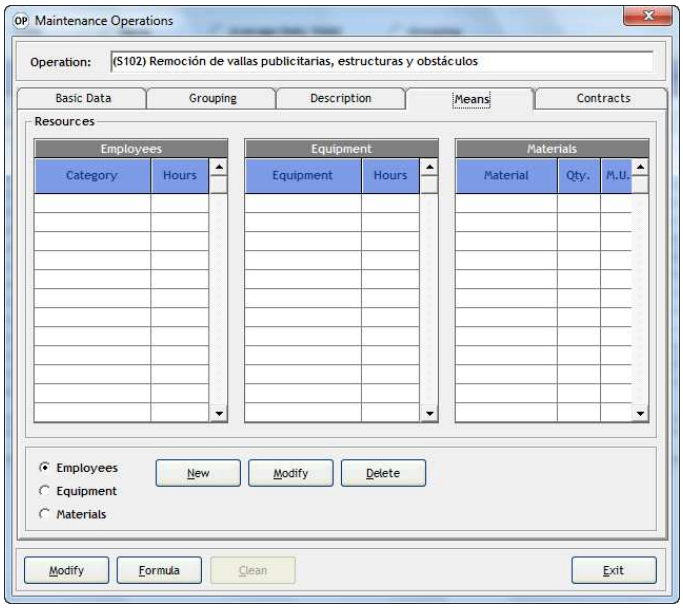
3.2.2 SAMPLE SCREENSHOTS

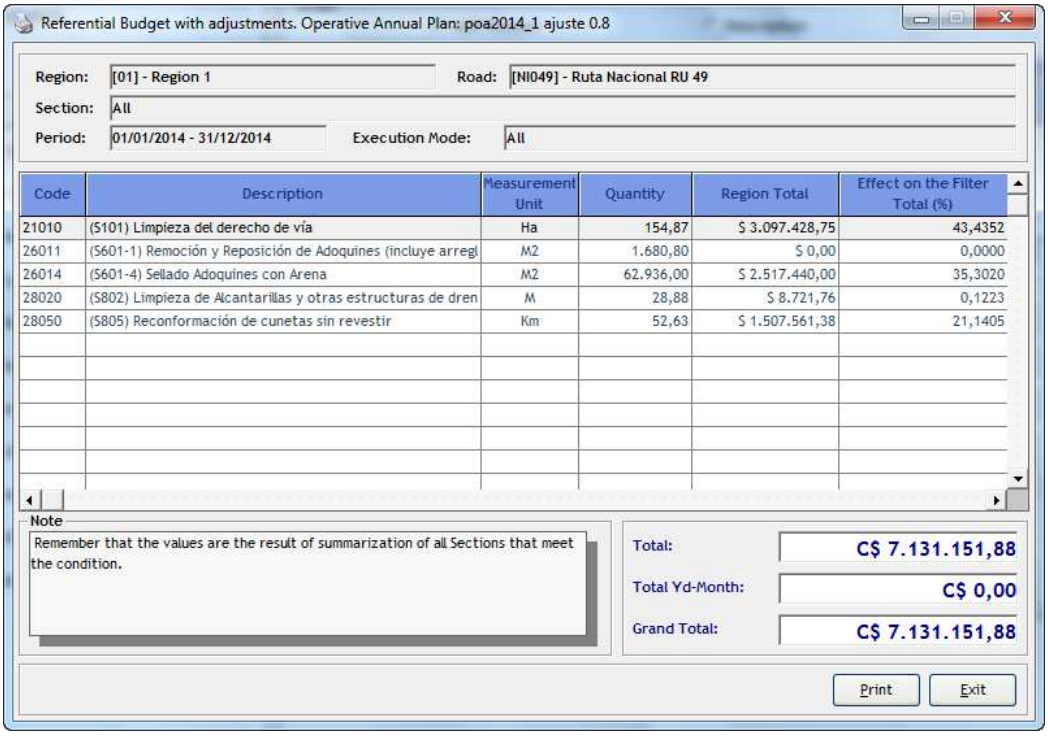
This section shows sample screenshots from the Road Maintenance Application

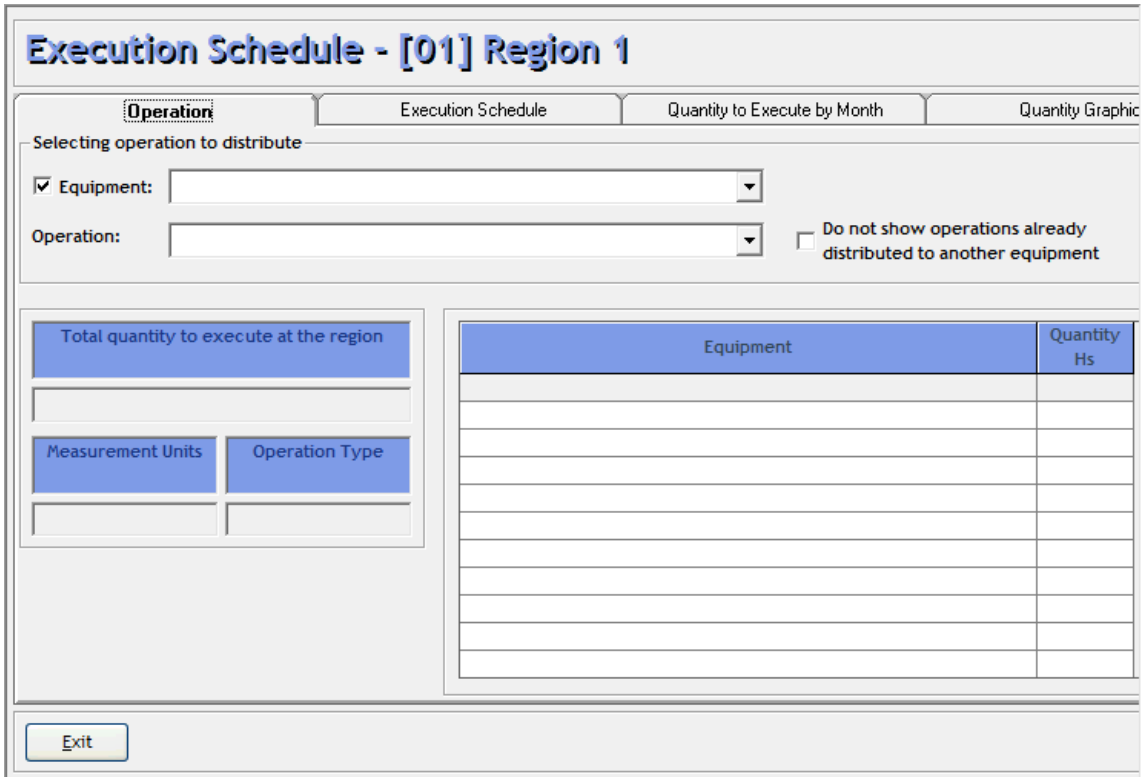


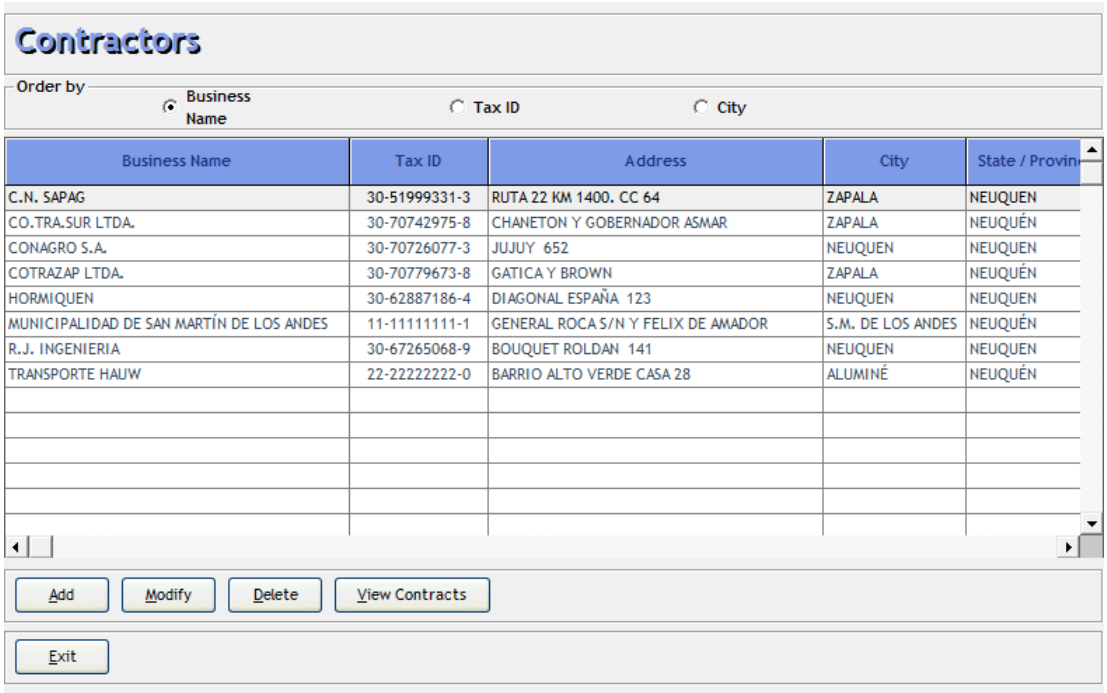


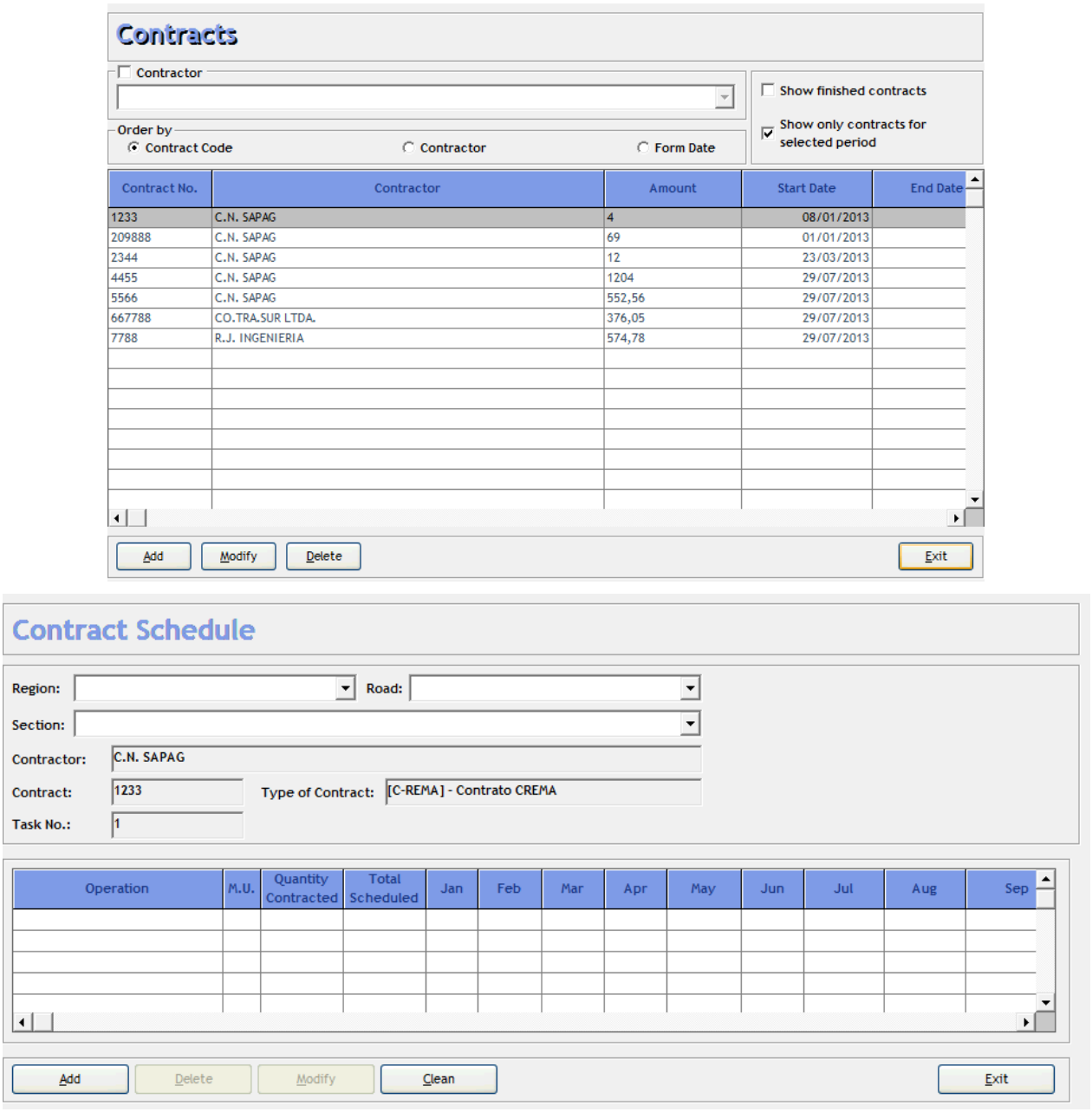

Maintenance Operations
Operation: Regravelling of Surface Soil
Basic Data
Grouping
Description
Means
Contracts
Name: Regravelling of Surface Soil
Code: 132
Measure Unit: [sq.yd] - Square Yard
Date: 22/06/2016
Daily yield (Unit/Day): 41859,65
Annual Frequency (Times/Year): 12
Operation Type: Condition
Affects: No Paved Roads
Because this is a conditional operation, then the annual frecuency will affect the operational quantity only if it is < 1.
Comments:
Modify
Formula
Clean
Exit

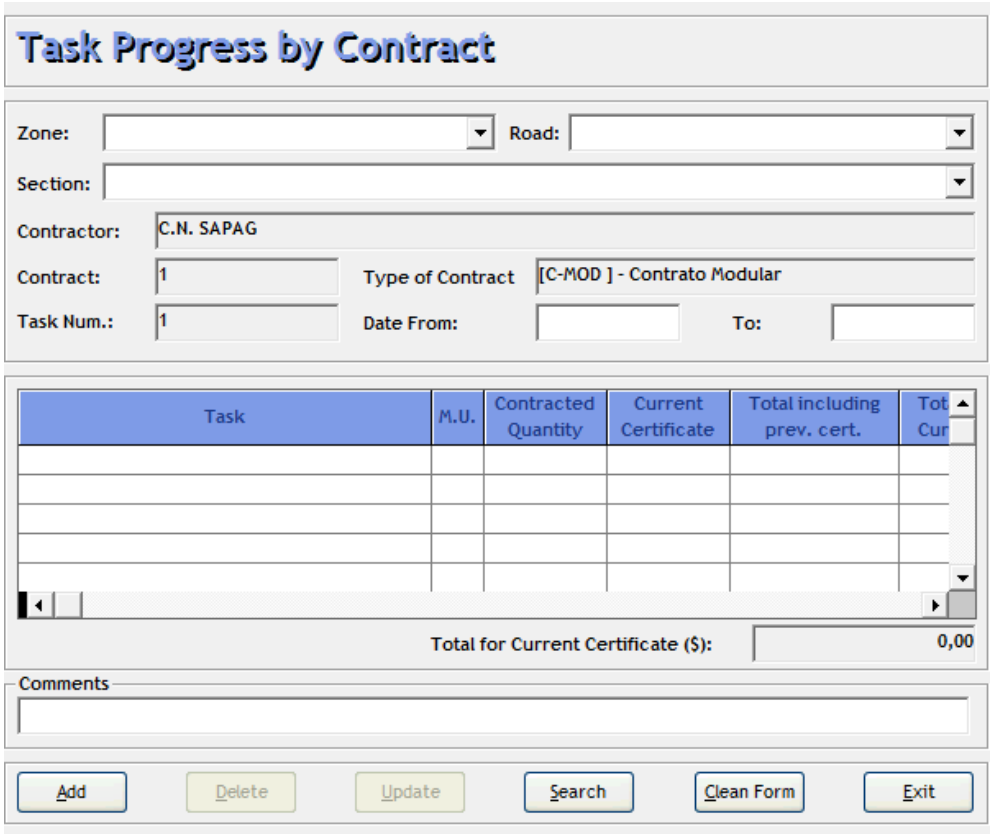

Maintenance Operations
Operation: (S102) Remoción de vallas publicitarias, estructuras y obstáculos
Basic Data
Grouping
Description
Means
Contracts
Resources
Employees
Category
Hours
Equipment
Equipment
Hours
Materials
Material
Qty.
M.U.
Employees
Equipment
Materials
New
Modify
Delete
Modify
Formula
Clean
Exit

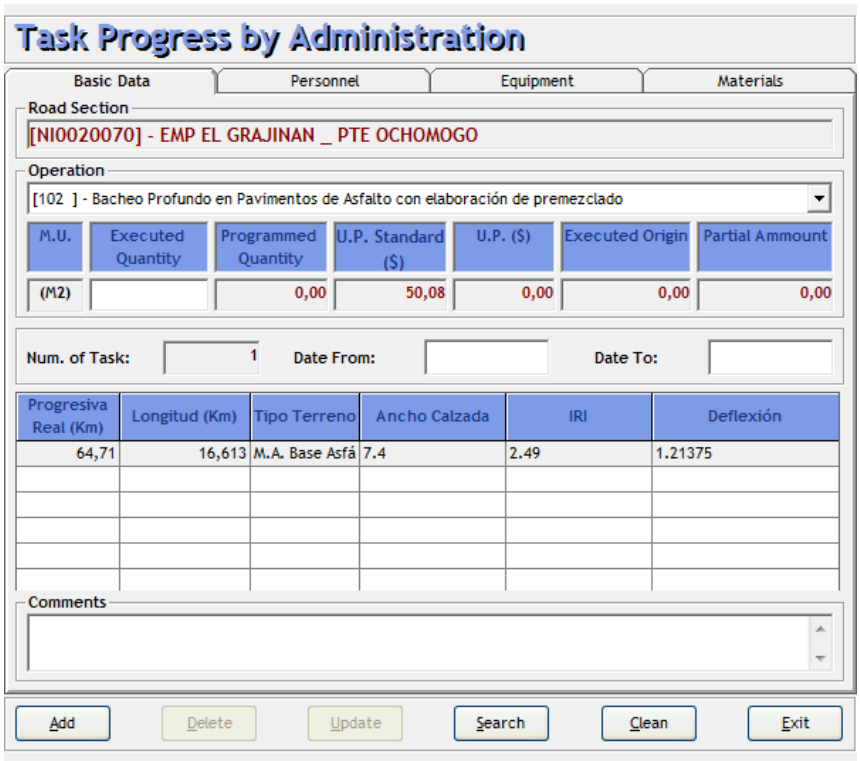

Referential Budget with adjustments. Operative Annual Plan: poa2014_1 ajuste 0.8
Region: [01] - Region 1
Road: [NI049] - Ruta Nacional RU 49
Section: All
Period: 01/01/2014 - 31/12/2014
Execution Mode: All
Code
Description
Measurement Unit
Quantity
Region Total
Effect on the Filter Total (%)
21010 (S101) Limpieza del derecho de vía Ha 154,87 $ 3.097.428,75 43,4352
26011 (S601-1) Remoción y Reposición de Adoquines (incluye arregl M2 1.680,80 $ 0,00 0,0000
26014 (S601-4) Sellado Adoquines con Arena M2 62.936,00 $ 2.517.440,00 35,3020
28020 (S802) Limpieza de Alcantarillas y otras estructuras de dren M 28,88 $ 8.721,76 0,1223
28050 (S805) Reconformación de cunetas sin revestir Km 52,63 $ 1.507.561,38 21,1405
Note
Remember that the values are the result of summarization of all Sections that meet the condition.
Total: C$ 7.131.151,88
Total Yd-Month: C$ 0,00
Grand Total: C$ 7.131.151,88
Print
Exit

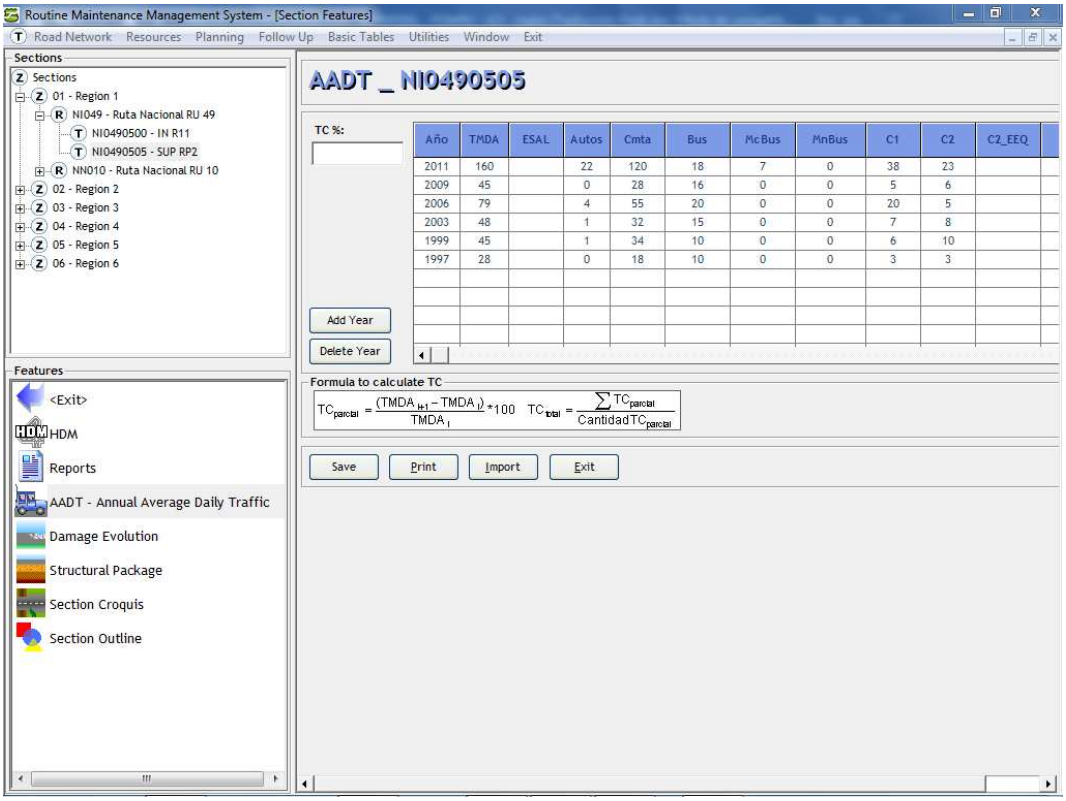

Execution Schedule - [01] Region 1
Operation
Execution Schedule
Quantity to Execute by Month
Quantity Graphic
Selecting operation to distribute
Equipment:
Operation:
Do not show operations already distributed to another equipment
Total quantity to execute at the region
Measurement Units
Operation Type
Equipment
Quantity Hs
Exit

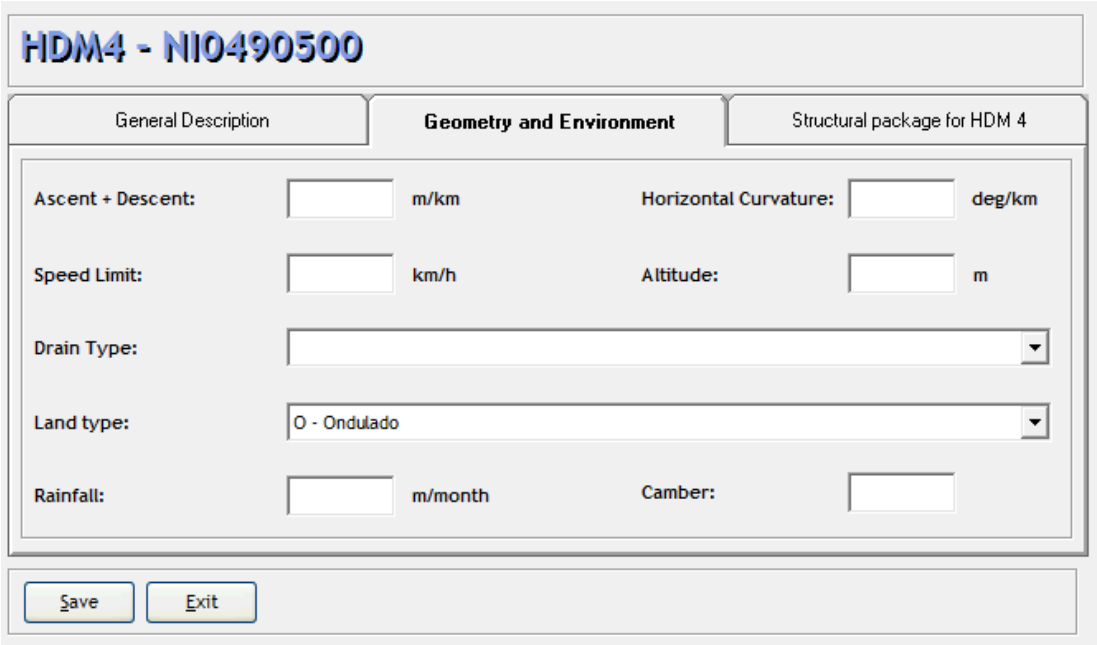

Contractors
Order by
Business Name
Tax ID
City
Business Name
Tax ID
Address
City
State / Provin
C.N. SAPAG 30-51999331-3 RUTA 22 KM 1400. CC 64 ZAPALA NEUQUEN
CO.TRA.SUR LTDA. 30-70742975-8 CHANETON Y GOBERNADOR ASMAR ZAPALA NEUQUÉN
CONAGRO S.A. 30-70726077-3 JUJUY 652 NEUQUEN NEUQUEN
COTRAZAP LTDA. 30-70779673-8 GATICA Y BROWN ZAPALA NEUQUÉN
HORMIQUEN 30-62887186-4 DIAGONAL ESPAÑA 123 NEUQUEN NEUQUEN
MUNICIPALIDAD DE SAN MARTÍN DE LOS ANDES 11-11111111-1 GENERAL ROCA S/N Y FELIX DE AMADOR S.M. DE LOS ANDES NEUQUÉN
R.J. INGENIERIA 30-67265068-9 BOUQUET ROLDAN 141 NEUQUEN NEUQUEN
TRANSPORTE HAUW 22-22222222-0 BARRIO ALTO VERDE CASA 28 ALUMINÉ NEUQUÉN
Add
Modify
Delete
View Contracts
Exit


Contracts
Contractor
Show finished contracts
Show only contracts for selected period
Order by
Contract Code
Contractor
Form Date
Contract No.
Contractor
Amount
Start Date
End Date
1233 C.N. SAPAG 4 08/01/2013
209888 C.N. SAPAG 69 01/01/2013
2344 C.N. SAPAG 12 23/03/2013
4455 C.N. SAPAG 1204 29/07/2013
5566 C.N. SAPAG 552,56 29/07/2013
667788 CO.TRA.SUR LTDA. 376,05 29/07/2013
7788 R.J. INGENIERIA 574,78 29/07/2013
Add
Modify
Delete
Exit
Contract Schedule
Region:
Road:
Section:
Contractor: C.N. SAPAG
Contract: 1233
Type of Contract: [C-REMA] - Contrato CREMA
Task No.: 1
Operation
M.U.
Quantity Contracted
Total Scheduled
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Add
Delete
Modify
Clean
Exit


Task Progress by Contract
Zone:
Road:
Section:
Contractor:
C.N. SAPAG
Contract:
1
Type of Contract
[C-MOD] - Contrato Modular
Task Num.:
1
Date From:
To:
Task
M.U.
Contracted Quantity
Current Certificate
Total including prev. cert.
Tot Cur
Total for Current Certificate ($):
0,00
Comments
Add
Delete
Update
Search
Clean Form
Exit


Task Progress by Administration
Basic Data
Personnel
Equipment
Materials
Road Section
[NI0020070] - EMP EL GRAJINAN _ PTE OCHOMOGO
Operation
[102] - Bacheo Profundo en Pavimentos de Asfalto con elaboración de premezclado
M.U.
Executed Quantity
Programmed Quantity
U.P. Standard ($)
U.P. ($)
Executed Origin
Partial Ammount
(M2)
0,00
50,08
0,00
0,00
0,00
Num. of Task:
1
Date From:
Date To:
Progresiva Real (Km)
Longitud (Km)
Tipo Terreno
Ancho Calzada
IRI
Deflexión
64,71
16,613
M.A. Base Asfá
7.4
2.49
1.21375
Comments
Add
Delete
Update
Search
Clean
Exit





3.3 Mobile Platform

The system included mobile functionality using Tablet PCs with GPS receivers to make data gathering directly on field. This mobile system have the capacity to integrate image captures with other detailed data specified for each type of inventory element as part of the road network, including road surface characteristics. The mobile software included all necessary data to work off line on locations with poor communication infrastructure

and is totally integrated with the core maintenance system through synchronization functions.

This mobile software brings the capacity not only to enter specific data of inventory elements, but also to be used to register maintenance state.

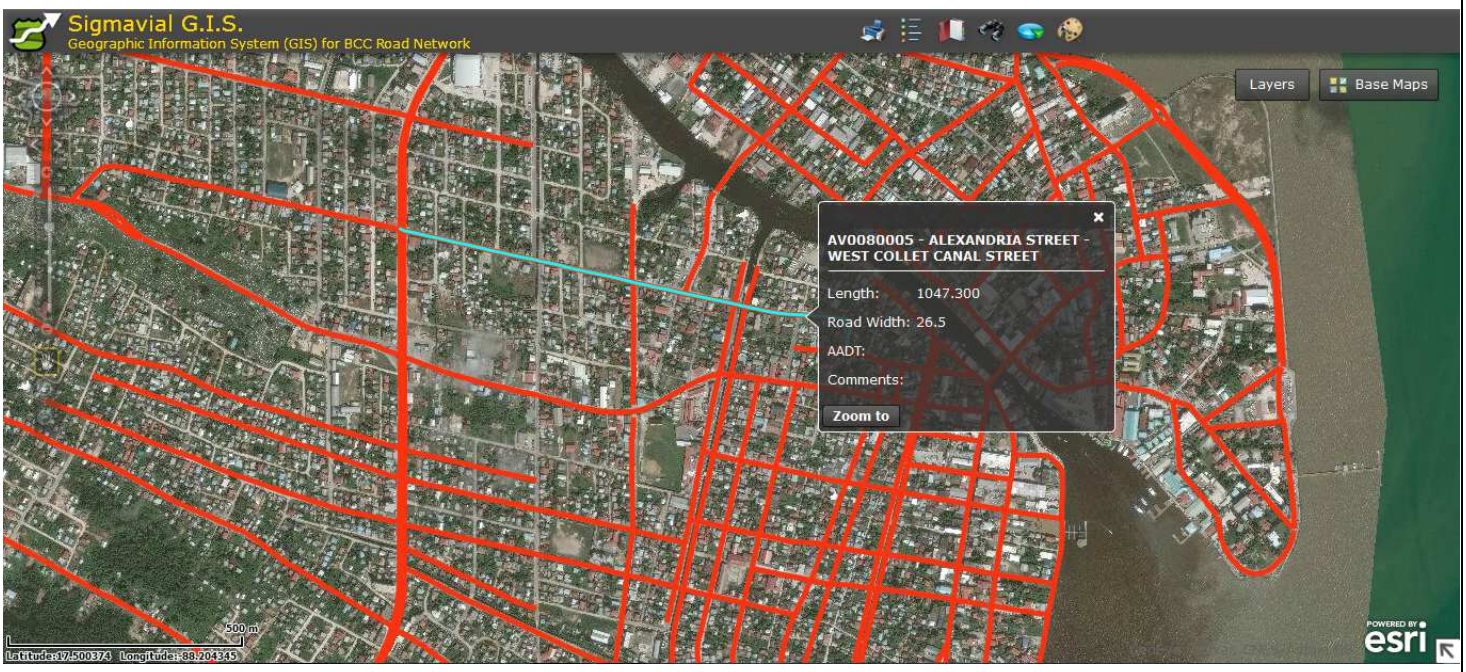
The system has functionality to capture photos and videos related to progressive marks automatically gathered through the GPS receiver.

3.4 Geographic Information System (GIS)

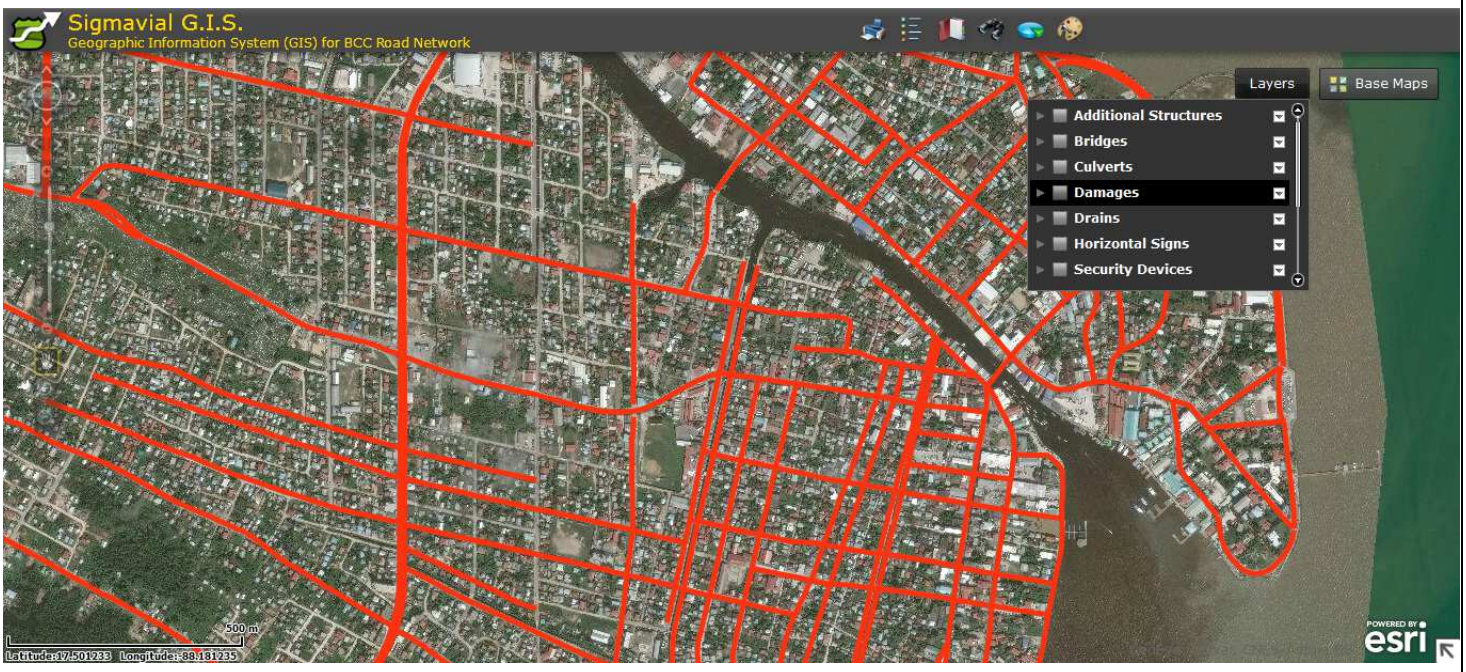
The solution includes a Fully Integrated Geographic Information System that brings completed and updated visual information.

The following screenshots shown examples of this functionality

Geographical references of the whole network with updated and detailed information

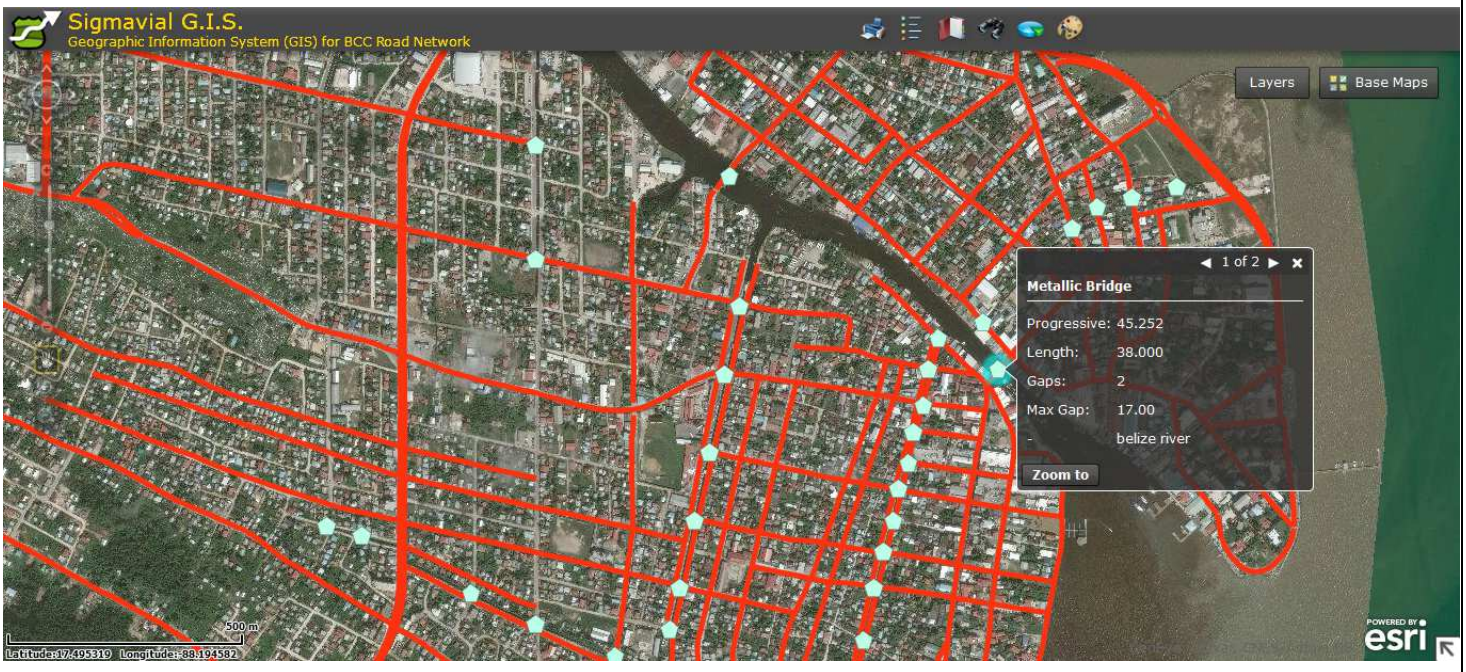


Detailed inventory data with layers for each type of element

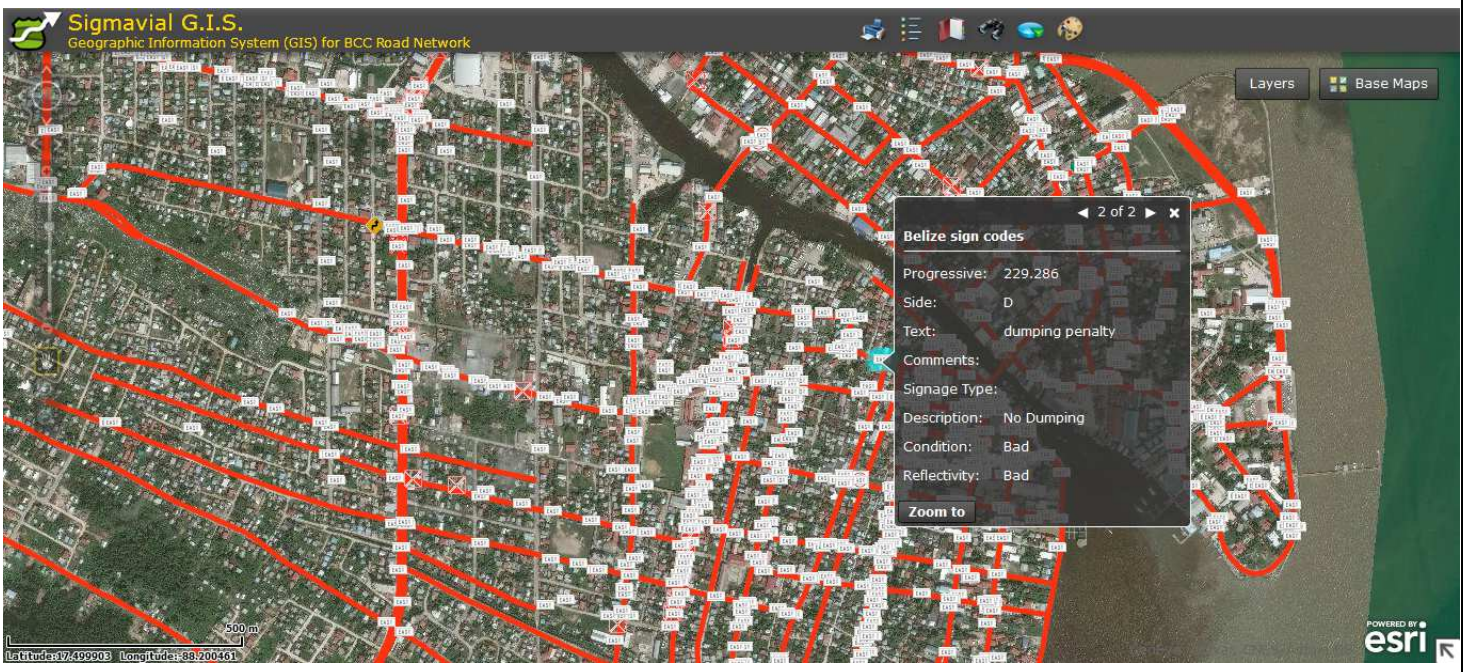


Detailed and updated information for each inventory element

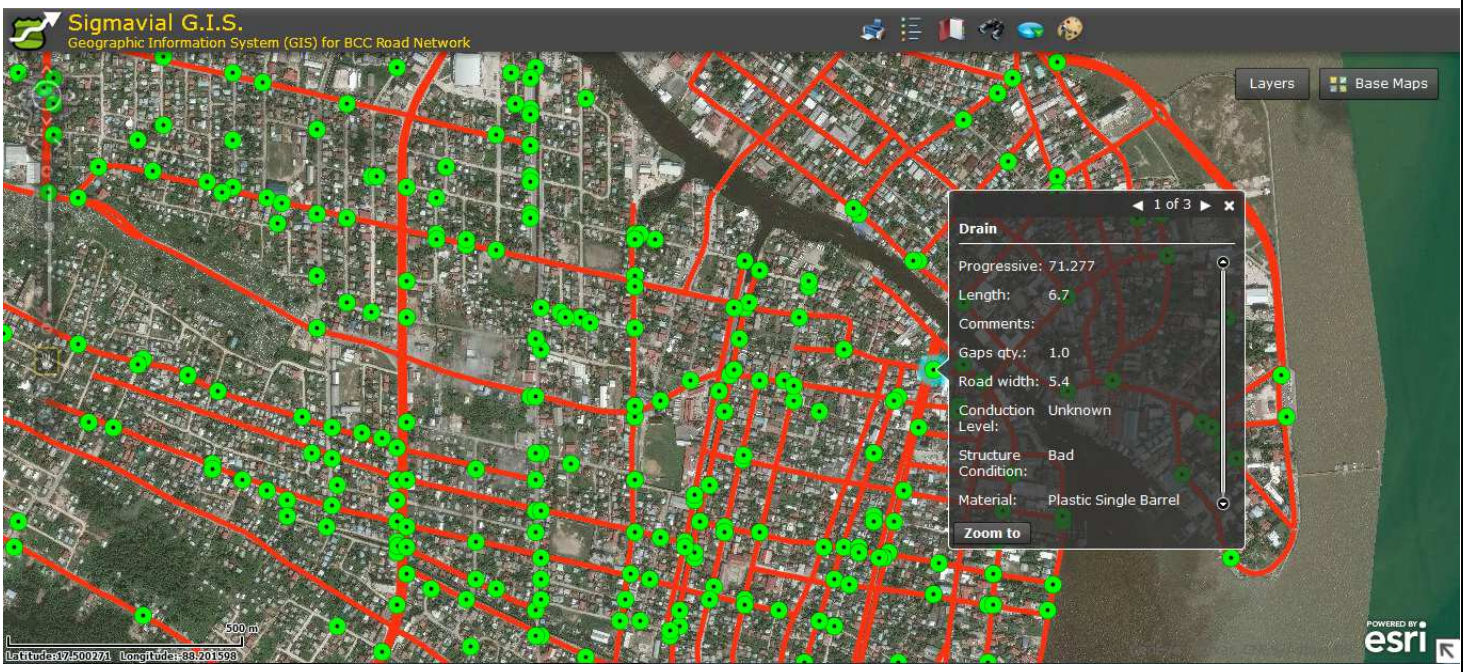
Bridges



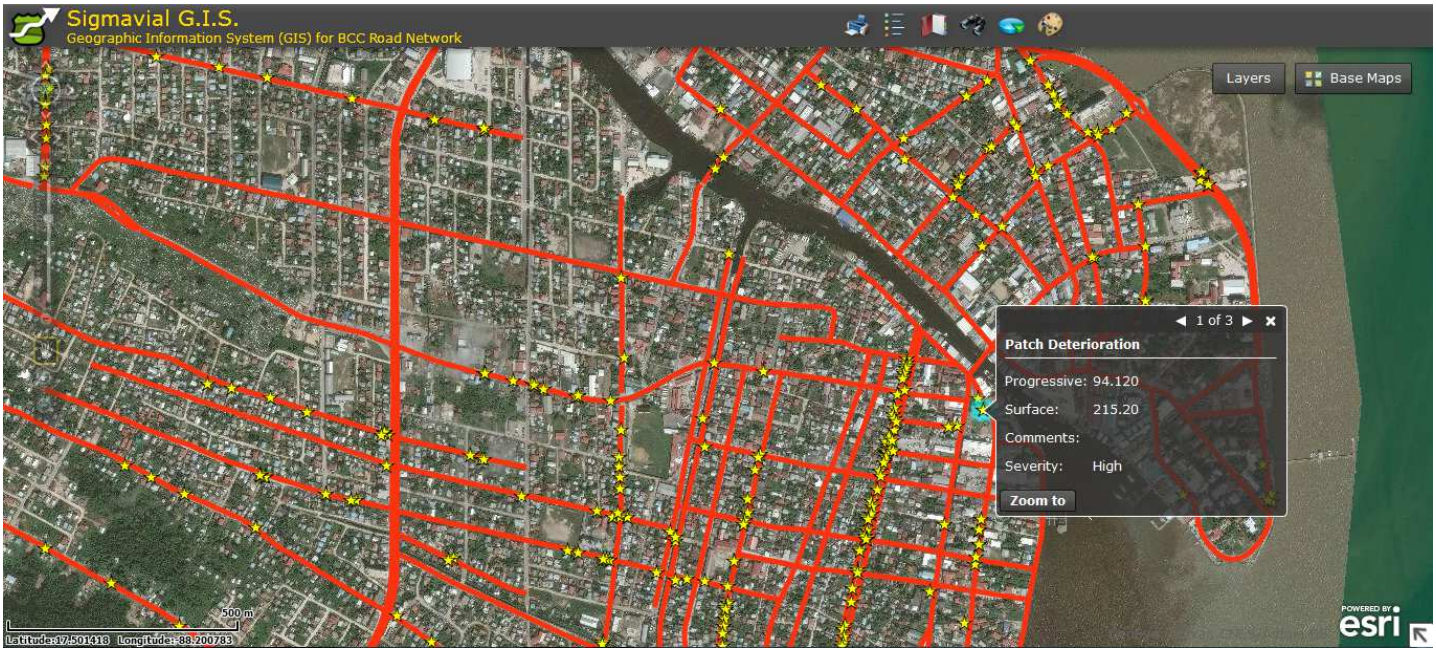
Signs



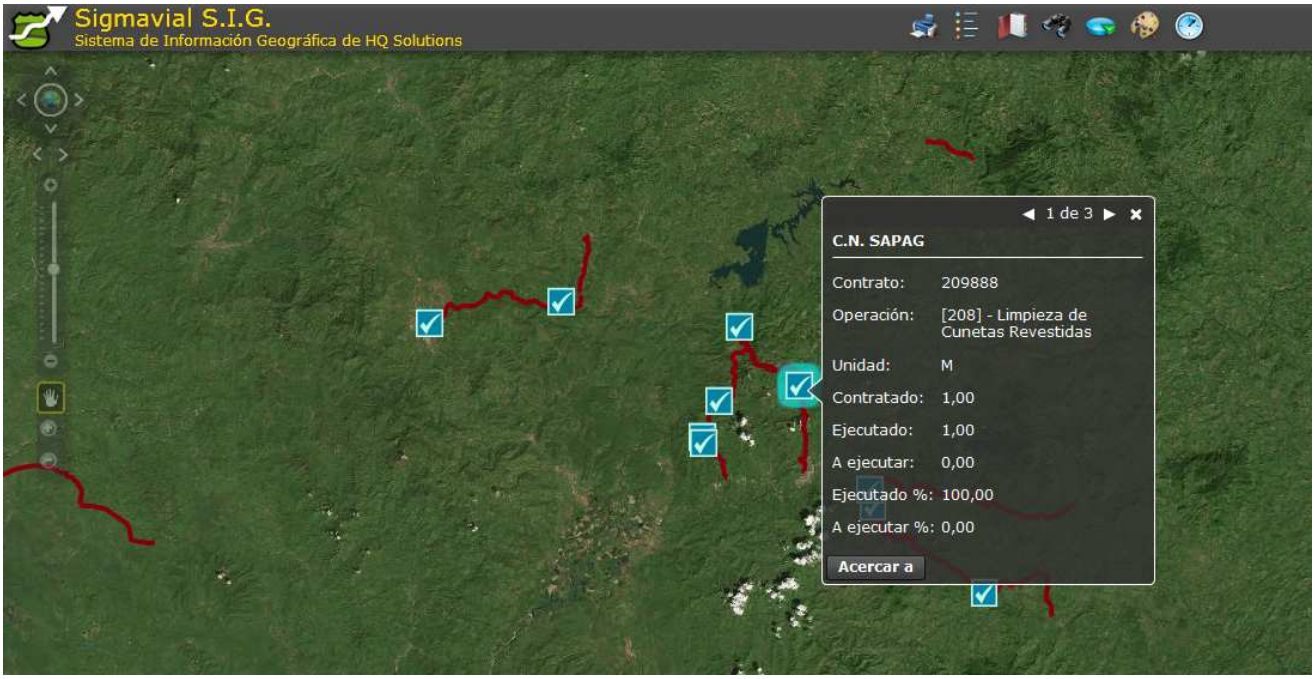
Drains



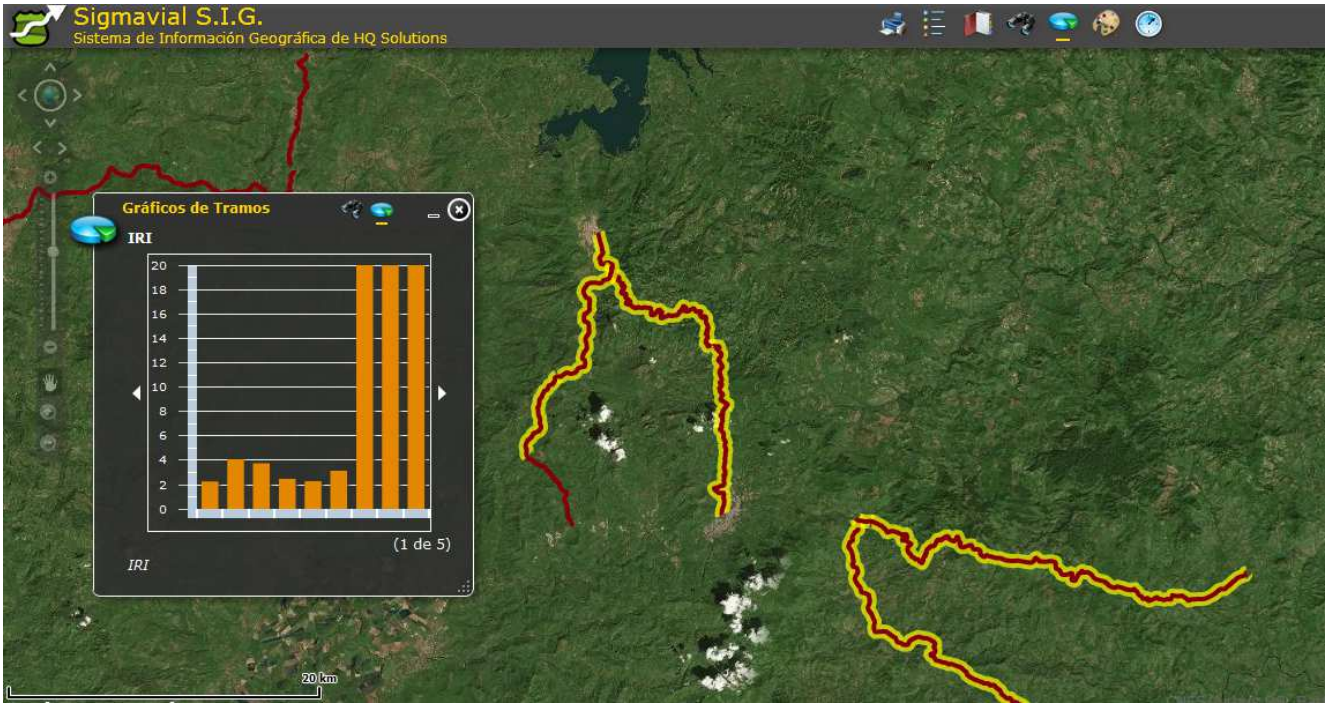
Damages



Information related to planning and execution of maintenance activities



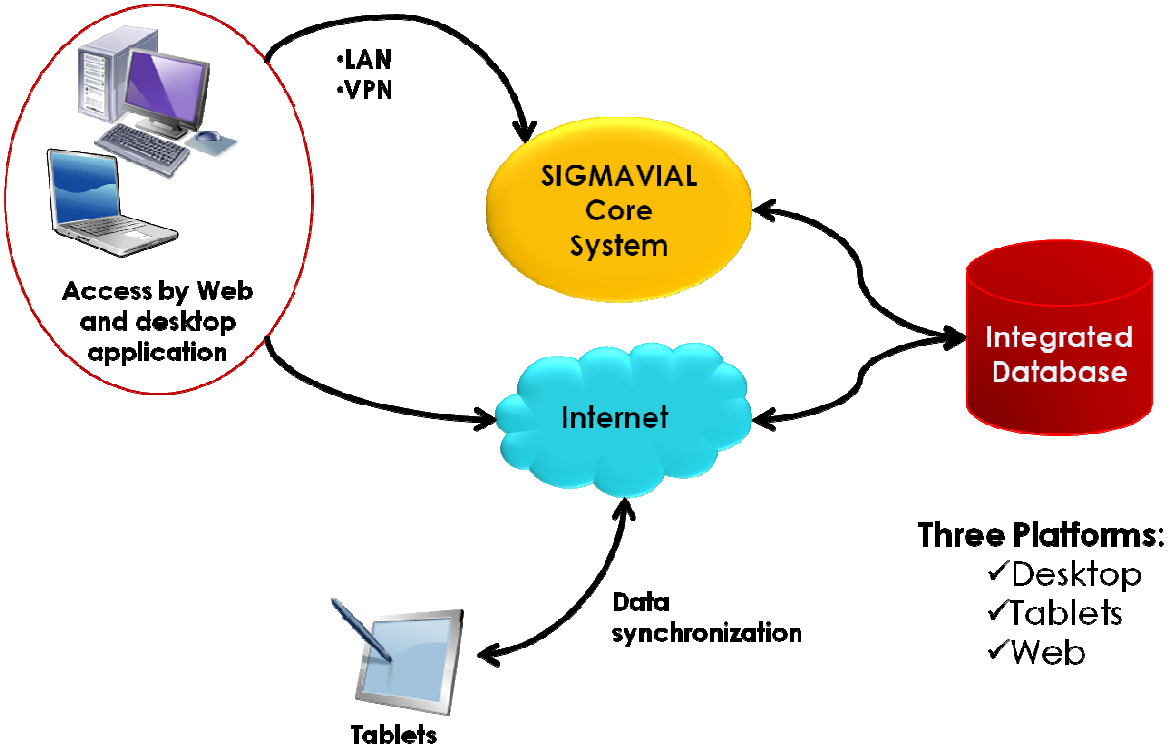
Graphical comparison for different segment attributes (IRI Measurements)



3.5 Architecture of SIGMAVIAL

3.5.1 TECHNICAL APPROACH

The following chart shows an overview of the technical architecture of SIGMAVIAL solutions. It is implemented in three platforms that works fully integrated with an on line unique Database.



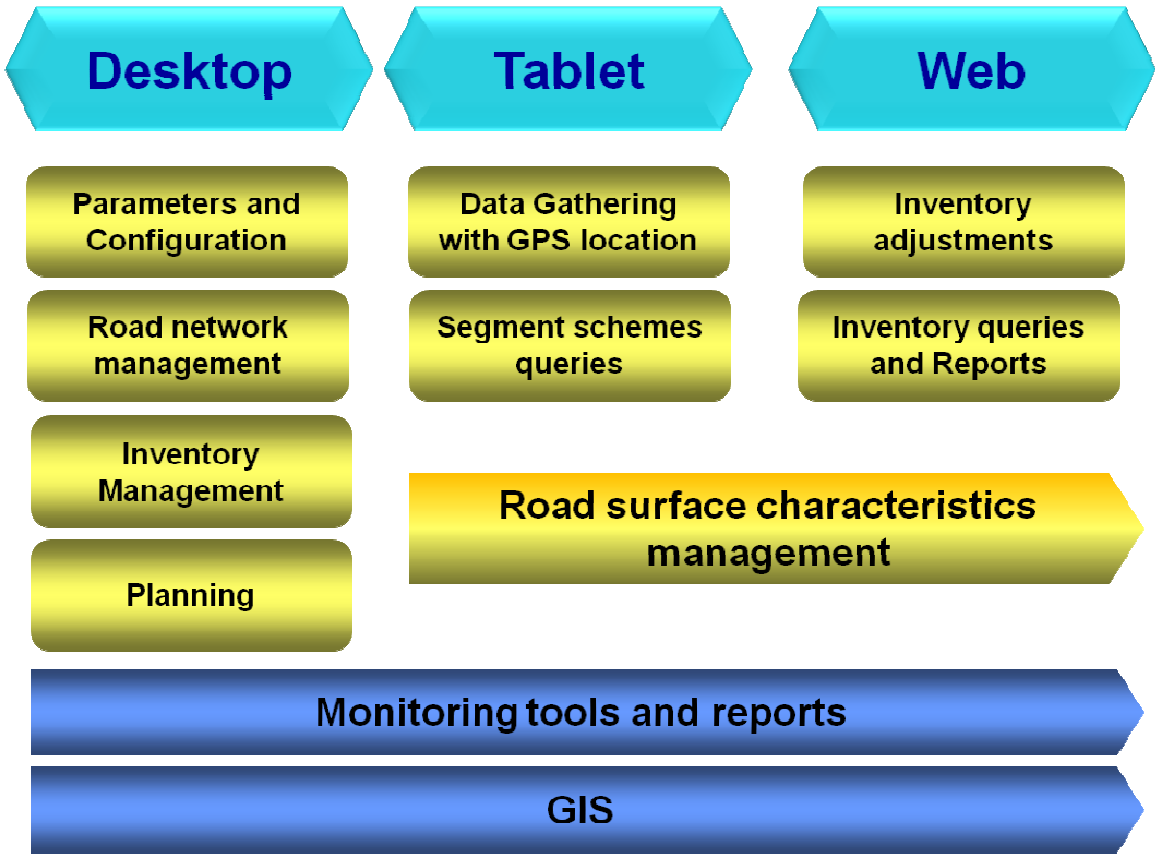
3.5.2 FUNCTIONALITY BY PLATFORM

The following chart shows the functional approach for each platform. These three operational environments or platforms where designed to cover specific user needs.

Desktop: This is a fully operational environment that leverages the flexibility and versatility of the desktop user interface. From this platform you have access to operative functions and all the administrative and setting tools.

Tablet: This is the mobile environment designed to field needs. It has a user interface adapted to optimize the field data gathering with direct GPS location. It is a platform capable of running offline that can operate with full functionality in remote locations without any connection.

Web: The web platform is designed to provide easy access from any available computer. It covers both the central system specific functionality as the full functionality of Geographic Information System (GIS)



4. Implementation Methodology Approach

This section presents a brief description of activities and consultant support in a typical project to implement the software and make de initial data Gathering to achieve the system go live.

4.1 Segments Definition and Road Traces

- Definition of standards for segments codification for the total length of the network included as part of the Project. It is recommended to implement an initial pilot project including segments for all types of roads (pavement and not pavement).
- GPS data gathering of road tracks including with the following characteristics:
    - Getting geographical coordinates for points located on the axis of each road segment using a GPS receiver with static accuracy of 1-3 meters and dynamic accuracy of 5-7 meters. The geographical coordinates of each measurement shall be performed by dynamic readings every second from a moving vehicle.
    - In the case of roads with more than one lane in each direction, must be considered to get the geographical coordinates driving on both directions.
    - Processing the data of each point to obtain progressive values in each road based on geographical projections

4.2 Inventory of Networks Elements

- Data gathering of elements of the road Inventory for the road segments included in the project. This includes the GPS location, inventory attributes, and condition of maintenance for each element.
- The following list shows the main attributes to obtain on data gathering to be realized on field using mobile devices.

  At the level of each segment to be surveyed, the information is as follows:
    - Identification of the route and segment.
    - Route code which the segment belongs.
    - Code of segment.
    - Description of the segment (the segment start point and end point of the segment).
    - Zone or District where the segment is located.
    - Department where the segment is located.

- Municipality where the segment is located.
- Segment length.
- Location of points of reference.
- Partial Distance
- Distance to route origin
- Width of Pavement (road).
- Road surface type (Asphalt Binder, Concrete, Surface treatment, etc)
- Number of lanes of driveway.
- Date of the inventory.

For each inventory element placed on each segment:

- Cross Drains
  - Location: Route, Section, Progressive, coordinates.
  - Type and Dimensions.
  - Maintenance condition
- Longitudinal Drains
  - Location: Route, Section, Progressive (from / to) coordinates.
  - Type and Dimensions.
  - Maintenance condition
- Bridges and other additional structures
  - Name of the bridge river or intersection
  - Location: Route, Section, Progressive, coordinates.
  - Condition
- Supplementary information and route issues
  - Location: Route, Section, Progressive, coordinates.
  - Intersections with other roads
  - Railways
  - Upper / Lower Steps
- Vertical Signage
  - Location: Route, Section, Progressive, coordinates.
  - Type and Dimensions.
  - Condition
- Horizontal Signs

        - Location: Route, Section, Progressive (from / to) coordinates.
        - Type and Dimensions.
        - Condition
    - Security Devices
        - Location: Route, Section, Progressive (from / to) coordinates.
        - Type and Dimensions.
        - Condition
    - Shoulders and Verges
        - Location: Route, Section, Progressive (from / to) coordinates.
        - Type and Dimensions.
        - Condition

4.3 Data Processing and System Implementation

- Processing of data gathering results to relate each item with its geographical location for determining position in each segment by progressive traces obtained previously.
- As part of the implementations it is included methodology and data gathering handbooks and also recommendations focused on human resources and characteristics of the department involved on the project.
- Installation and configuration of Maintenance System Core server application for both web enabled and client server platform.
- Data migration from previous systems if it is necessary
- Implementation of data synchronization software and procedures to integrate mobile devices with the core application.
- Installation and configuration of the Geographic Information System (GIS) with full integration with maintenance system core applications.
- Users training on system application and procedures
- Testing and Go Live

5. Typical Project Schedule

The following chart shows the schedule for a typical SIGMAVIAL project including from scoping and planning to inventory execution and system go live