

# Risk - Based Infrastructure Asset Management System in Dominica



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# Motivation



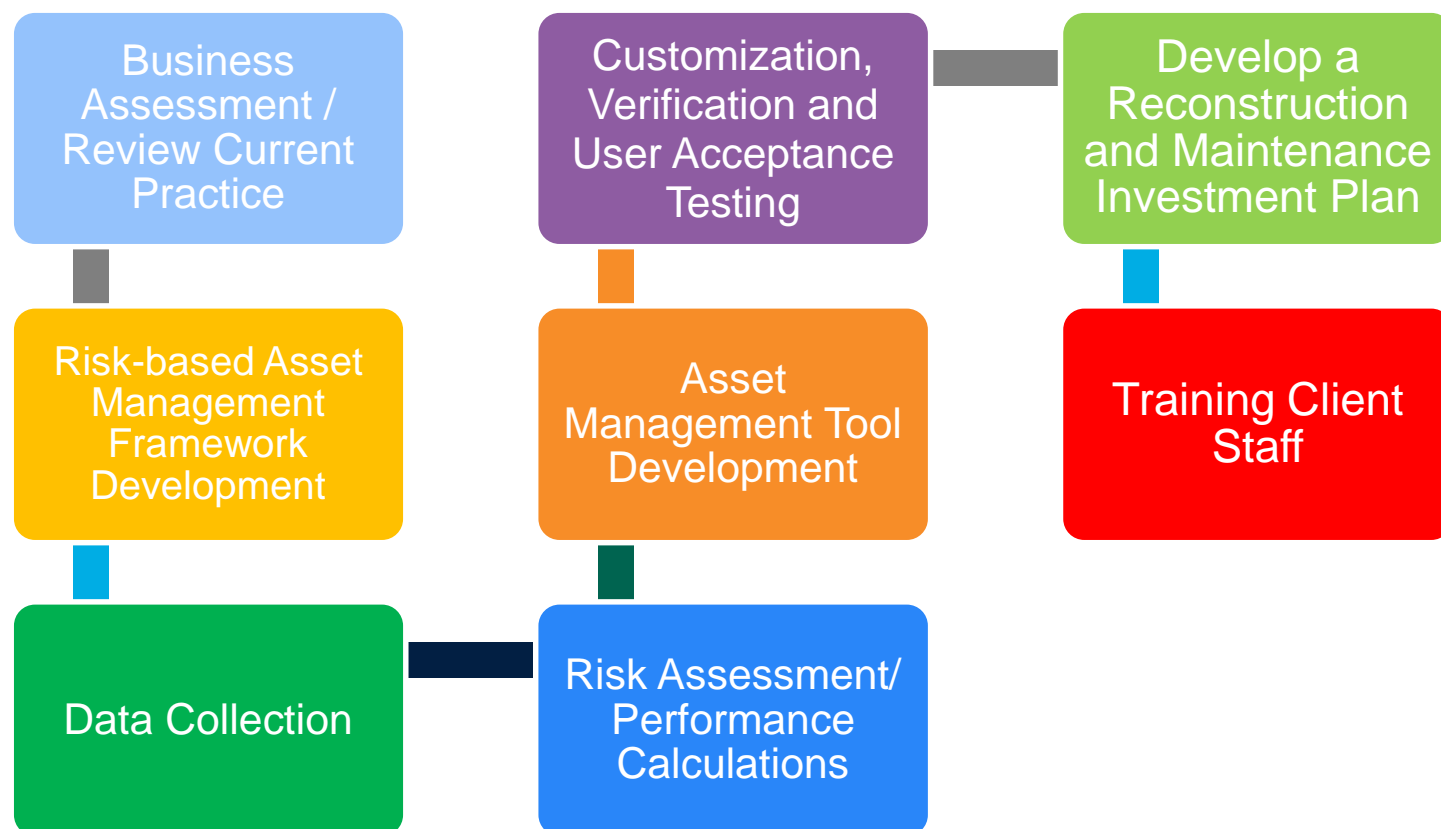


# Risk-based Asset Management Dimension and Complexity





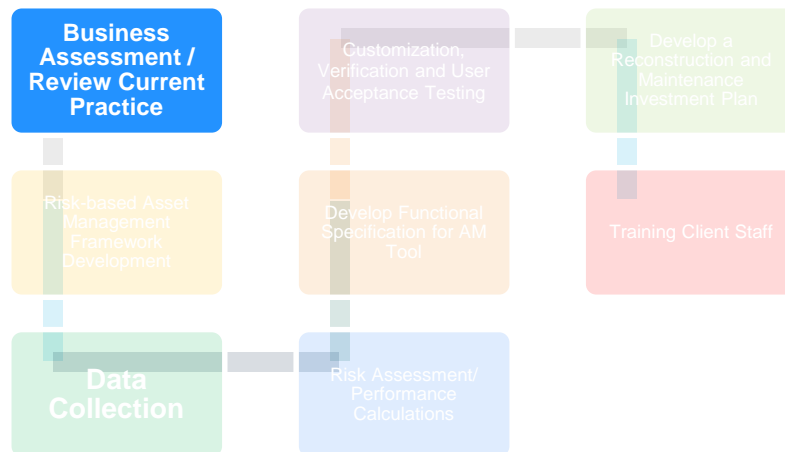
# Project Steps





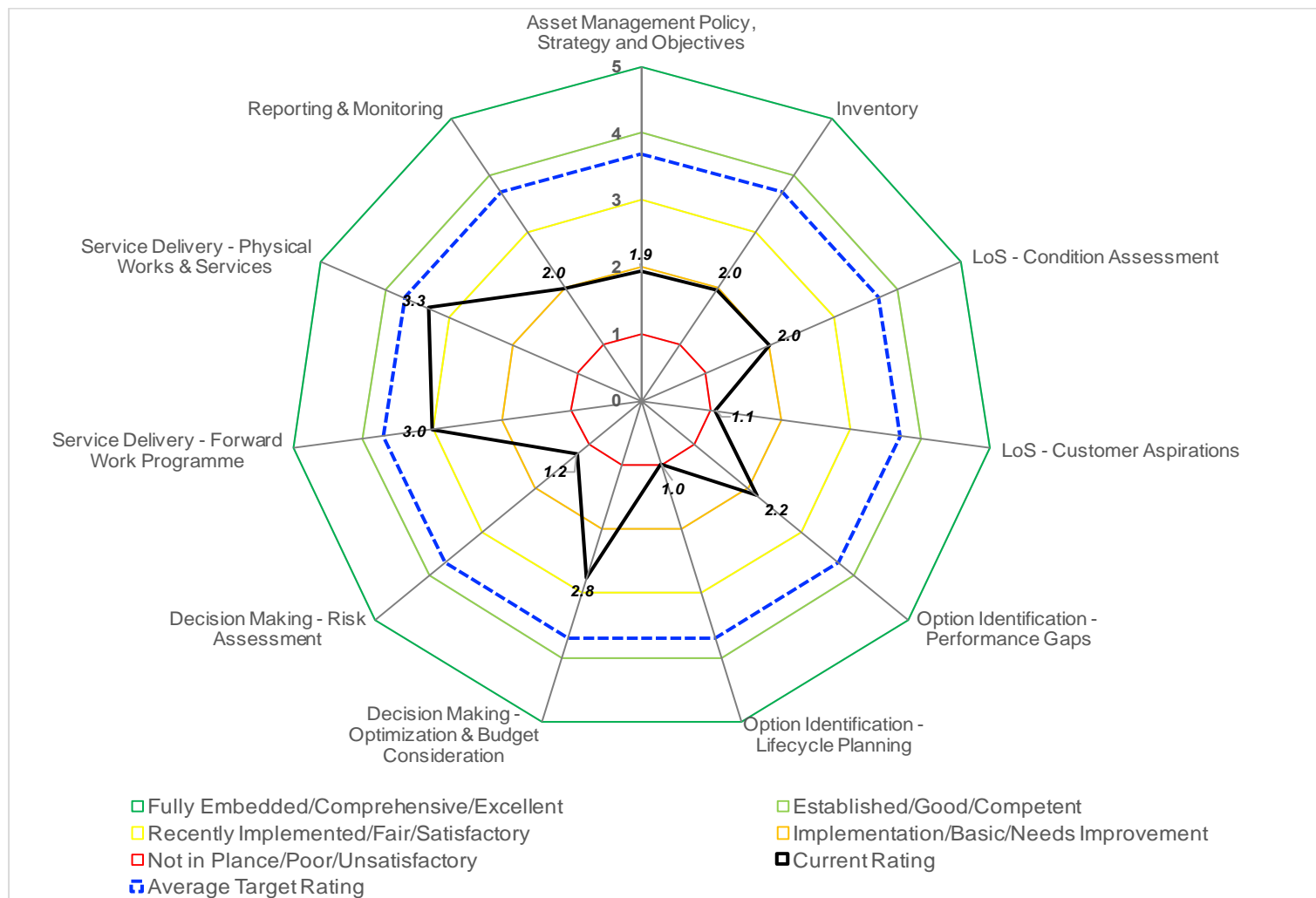
# Business Assessment

## CURRENT PRACTICE REVIEW AND GAP ASSESSMENT





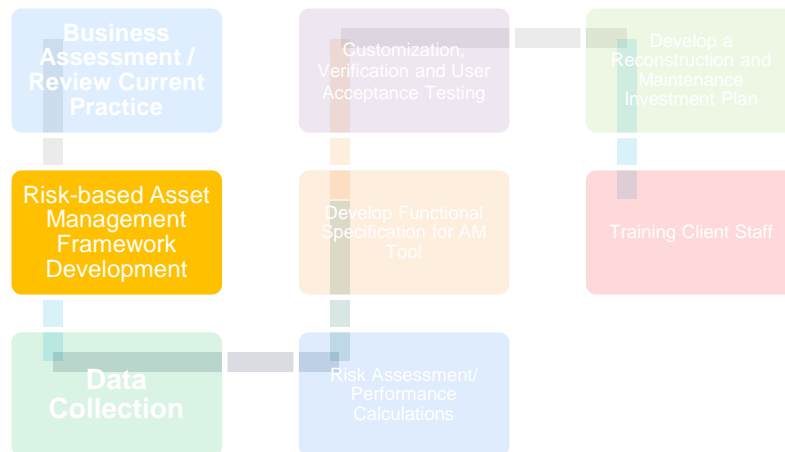
# Assessment of Current Capabilities





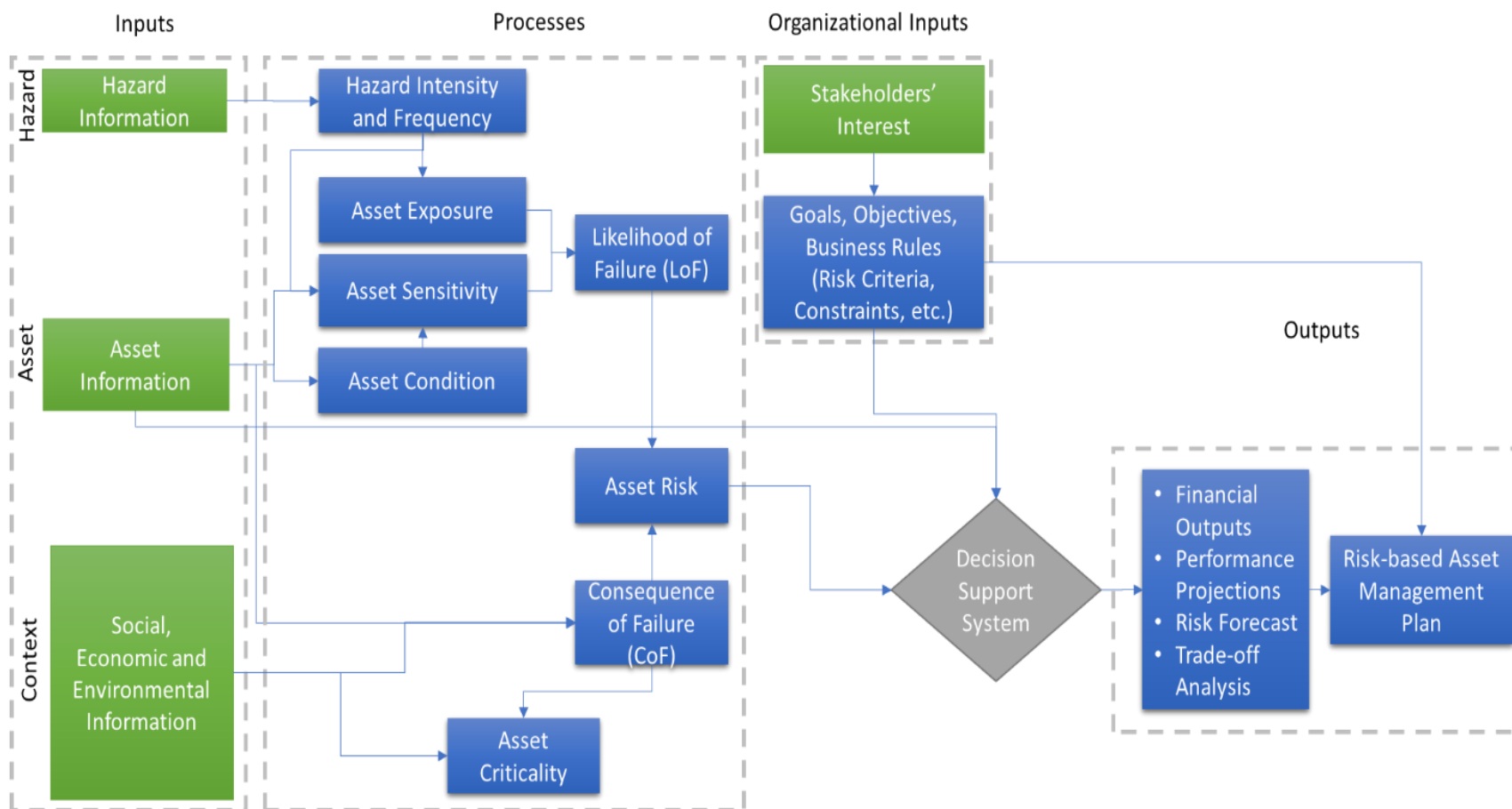
# Asset Management Framework Development

## RISK-BASED AM METHODOLOGY





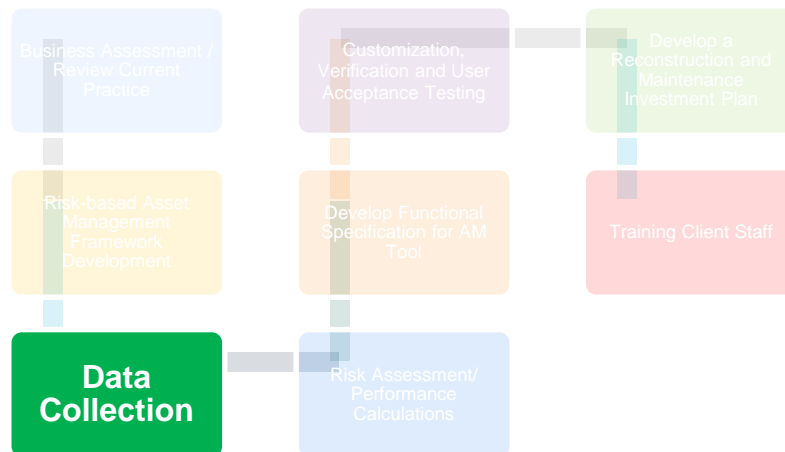
# Risk-based Asset Management Methodology Overview





# HAZARDS

## DATA COLLECTION AND ANALYSIS





# Flood Hazard Map

## Design Rainfall Characteristics

	1:5 year	1:10 year	1:20 year	1.50 year
Depth (mm)	163.9	204.4	244.9	299.8
Max Intensity (mm/h)	237.8	232	216.6	187.4
Length Duration (min)	165	265	300	375



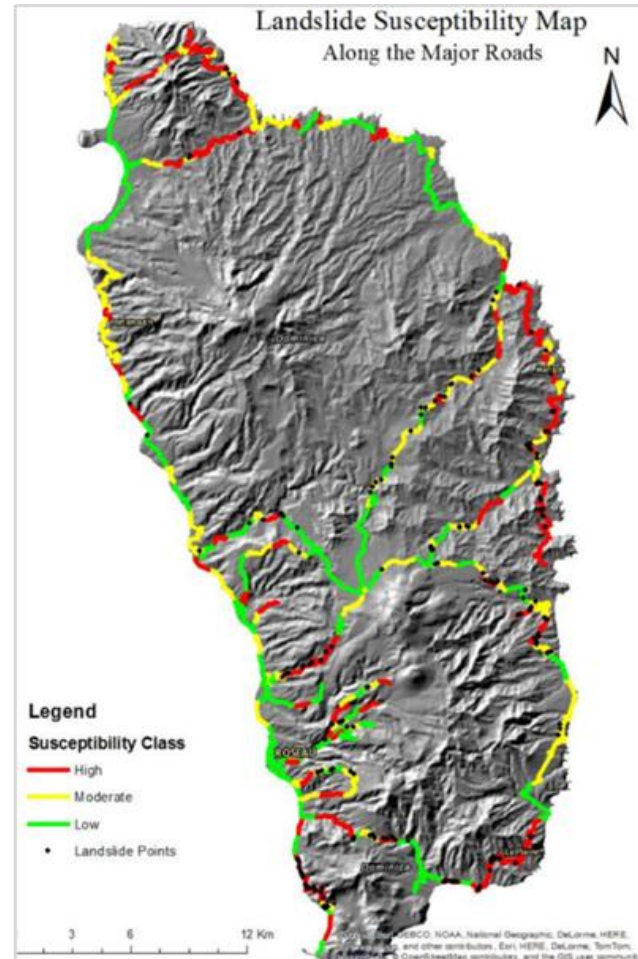
Dominica Flash Flood Map  
(Source: CHARIM)



# Landslide Hazards Map



Dominica Landslide  
Susceptibility



Dominica Landslide Susceptibility  
along Major Roads



# Debris Flow Risk



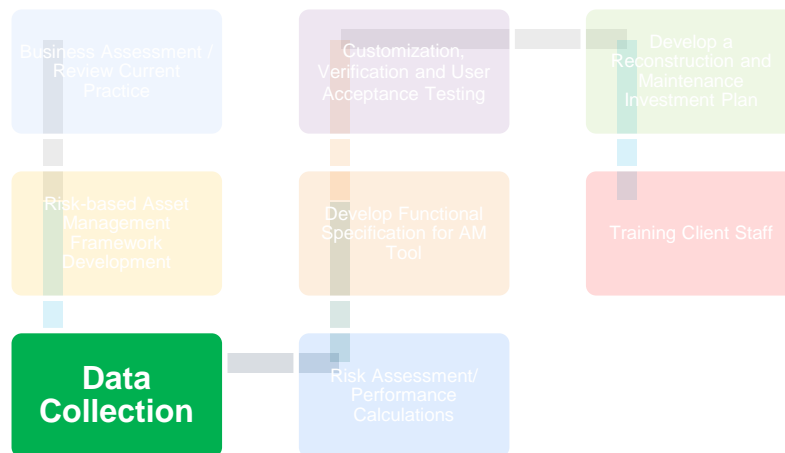
Evidence of:

1. Bypass flow over bridge
2. Large quantity of floating debris
3. Large volumes of sediment deposited during event modifying channel geometry





# Asset DATA COLLECTION







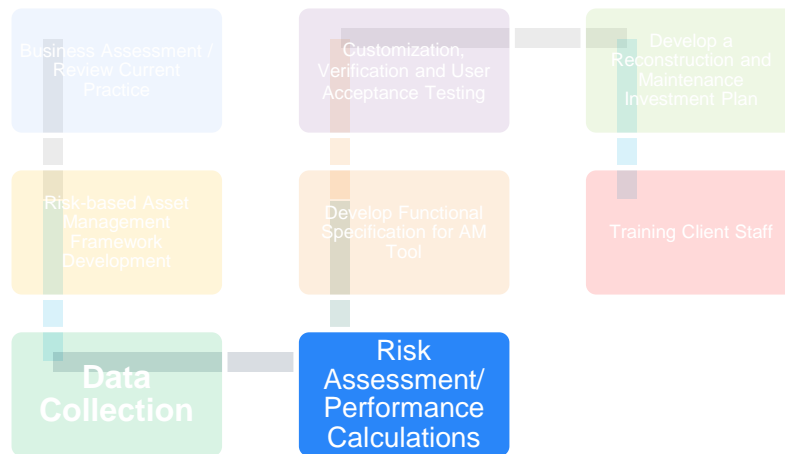
General Data	Operational Data	Financial Data
Geometry Location Material Configuration	Maintenance History Traffic Physical condition Protections	Maintenance and Rehab Cost





# Performance Assessment

## RISK AND CONDITION ASSESSMENT





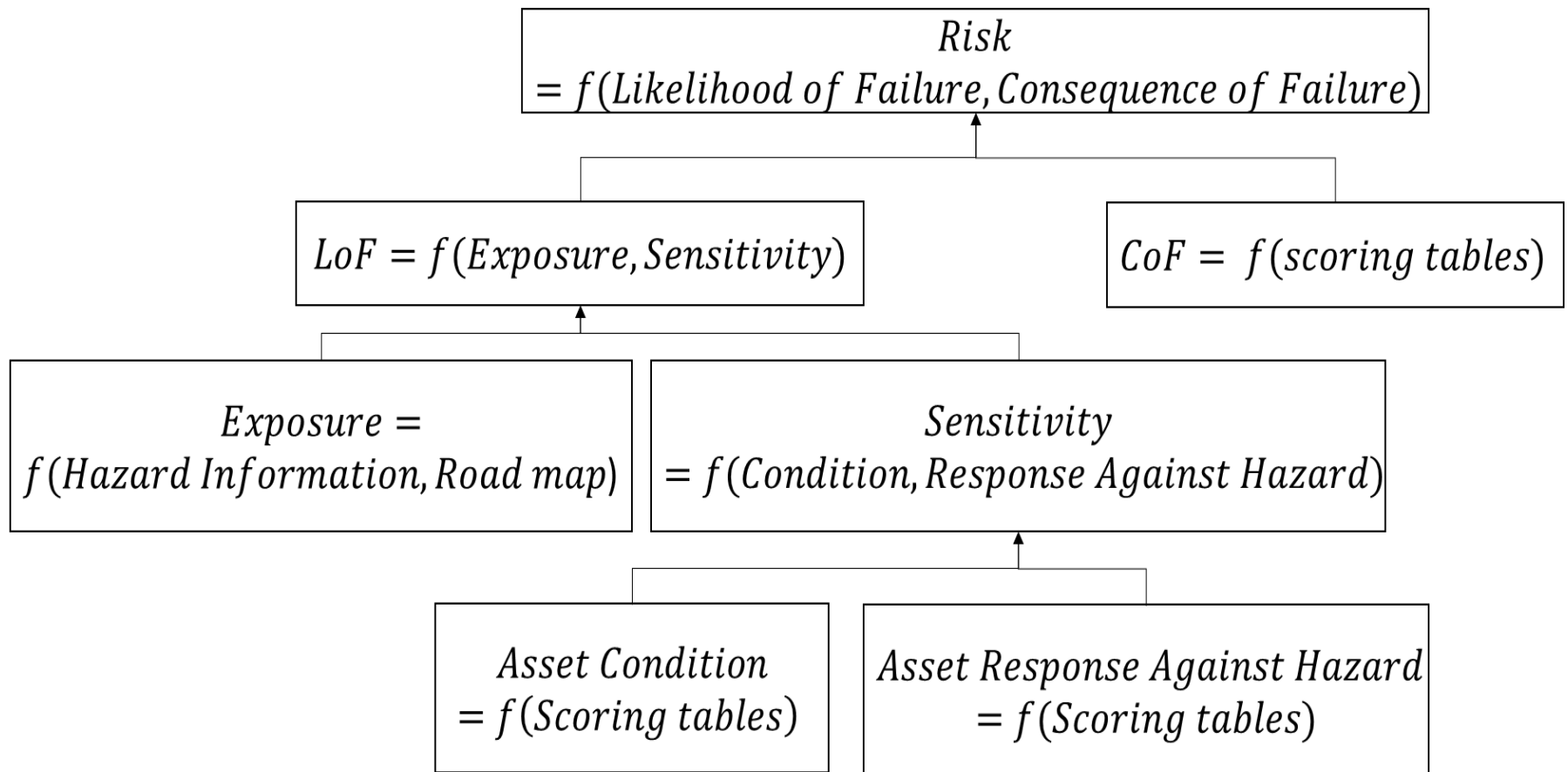
# Condition

- Directly relates to the likelihood of asset failure
- Two Condition Assessment Methods:
  - Visual Condition assessment
  - Analytical Assessment (algorithms and criteria)

Rating			Drainage	Geotechnical Assets	Pavement	Structures
A	5	Excellent	Newly installed or nearly new condition, correct size, free flowing.	New or nearly new condition with no obvious visual defects.	IRI < 5. Smooth with few bumps or depressions.	Bridge in excellent condition, or presenting minor and isolated durable damages.
B	4	Good	Structurally sound, correct size, free flowing.	No visual defects and with few visible signs of surface deterioration. No evidence of previous failures.		Bridge presenting extended minor durable damages.
C	3	Fair	Structurally sound, slight siltation and likely to cause drainage problems during times of heavy rains.	Evidence of initial deterioration and minor previous failures. Minor tension cracks, minor ravines, or evidence of minor slippages/falls are visible.	IRI = 5 - 8. Comfortable with intermittent bumps or depressions.	Bridge presenting medium extended durable damages. Functional damages affecting non-structural elements of the bridge.
D	2	Poor	Signs of deterioration of structure, evidence of silting and likely to cause drainage problems with medium to heavy rains.	Evidence of slippages of embankment or cutting slopes and previous slides that do not interfere with carriageway; tension cracks or ravines in a soil slope. Similar areas of material around current location have already failed.	IRI = 8 - 11. Uncomfortable with frequent bumps or depressions.	Bridge presenting severe durable or functional damages, affecting structural elements. Medium bearing damages.
E	1	Very poor	Severe structural damage, blocked with silt, vegetation or other material, inadequate in size and likely to cause flooding even in light rainfall.	Deep seated soil slippage, normally indicated by slip circle. Rock slides resulting in danger to road users or damage to highway condition. Settlement causing damage to the carriageway or safety fence. Foundation failures of retaining structures. Visual evidence that possible slides may occur.	IRI > 11. Uncomfortable with constant bumps or depressions.	Collapsed bridge or presenting severe bearing damages.

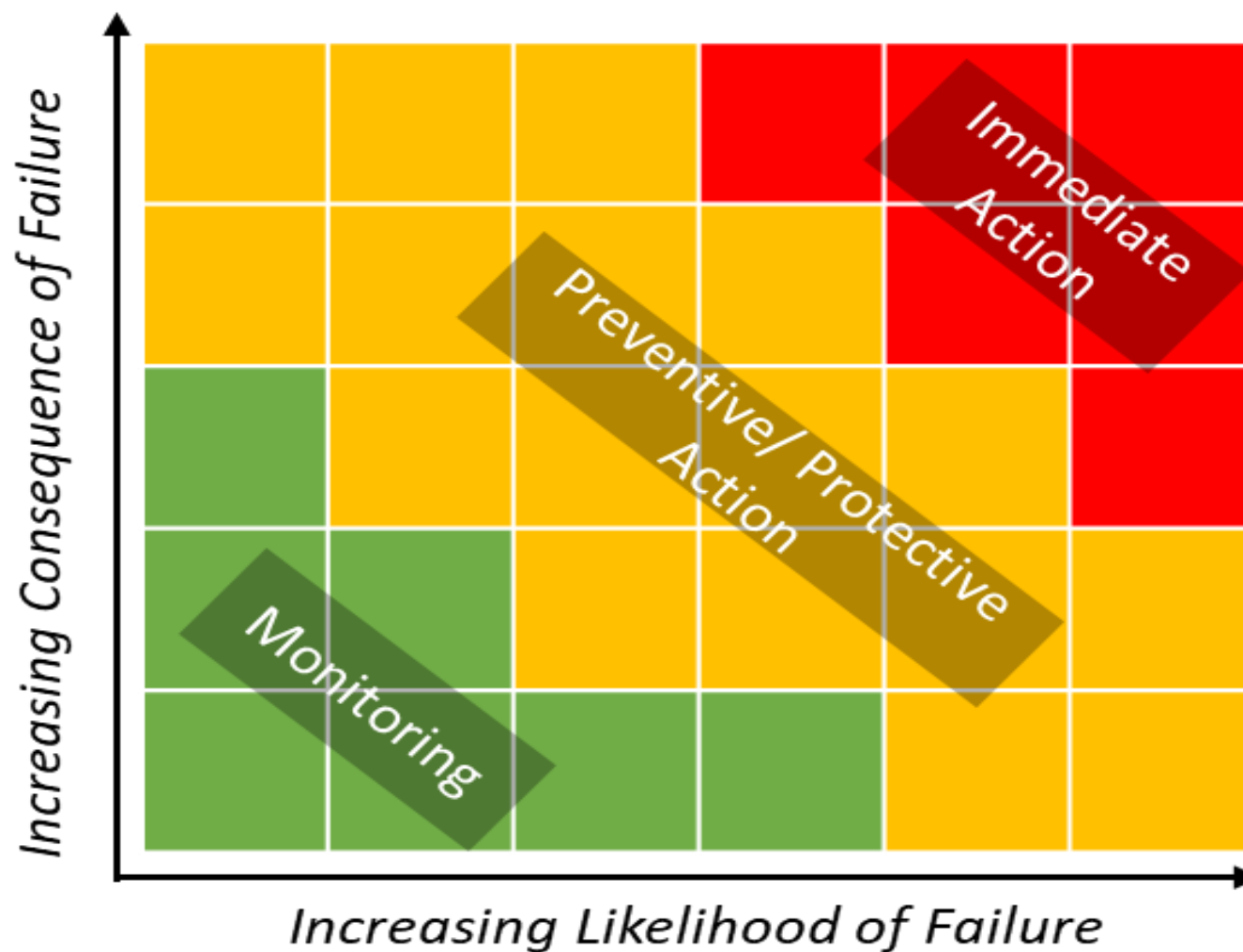


# Risk



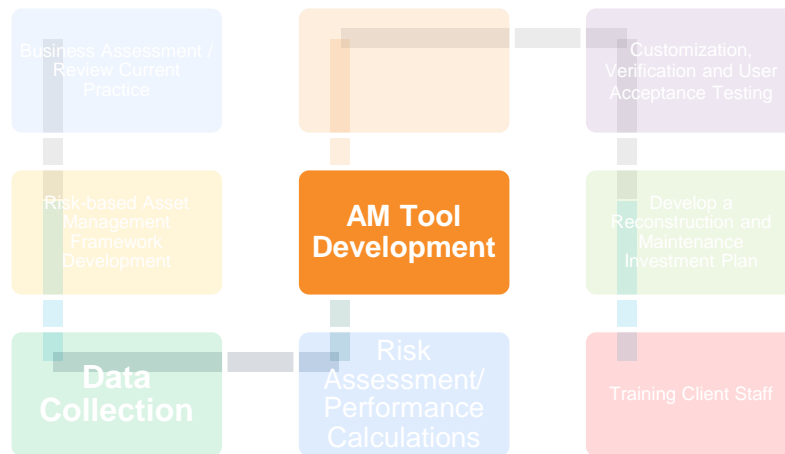


# Risk Management





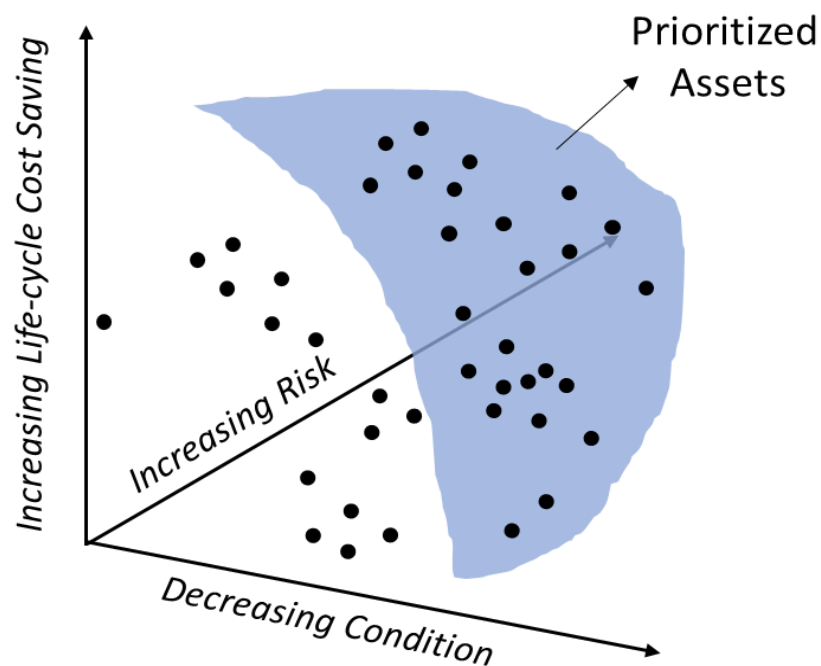
# Asset Management Tool Development





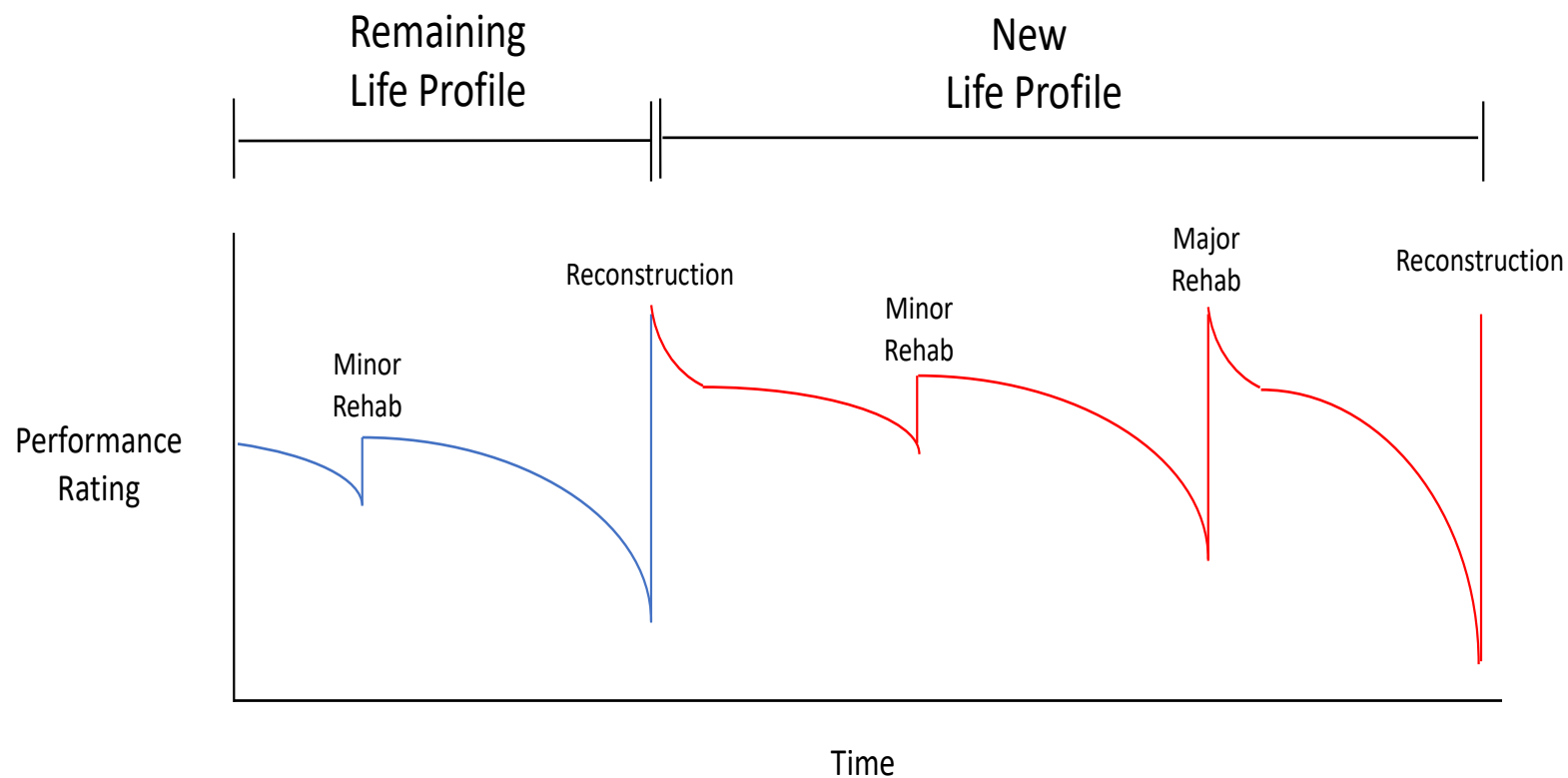
# Integration of risk and condition into decision making

- **Unconstrained** needs assessment: Determines the financial needs to maintain assets in an acceptable performance level (assuming there is no budgetary constraints).
- **Constrained** needs assessment: determines the optimal financial strategies to maintain assets at an acceptable performance level considering annual budget limitations.



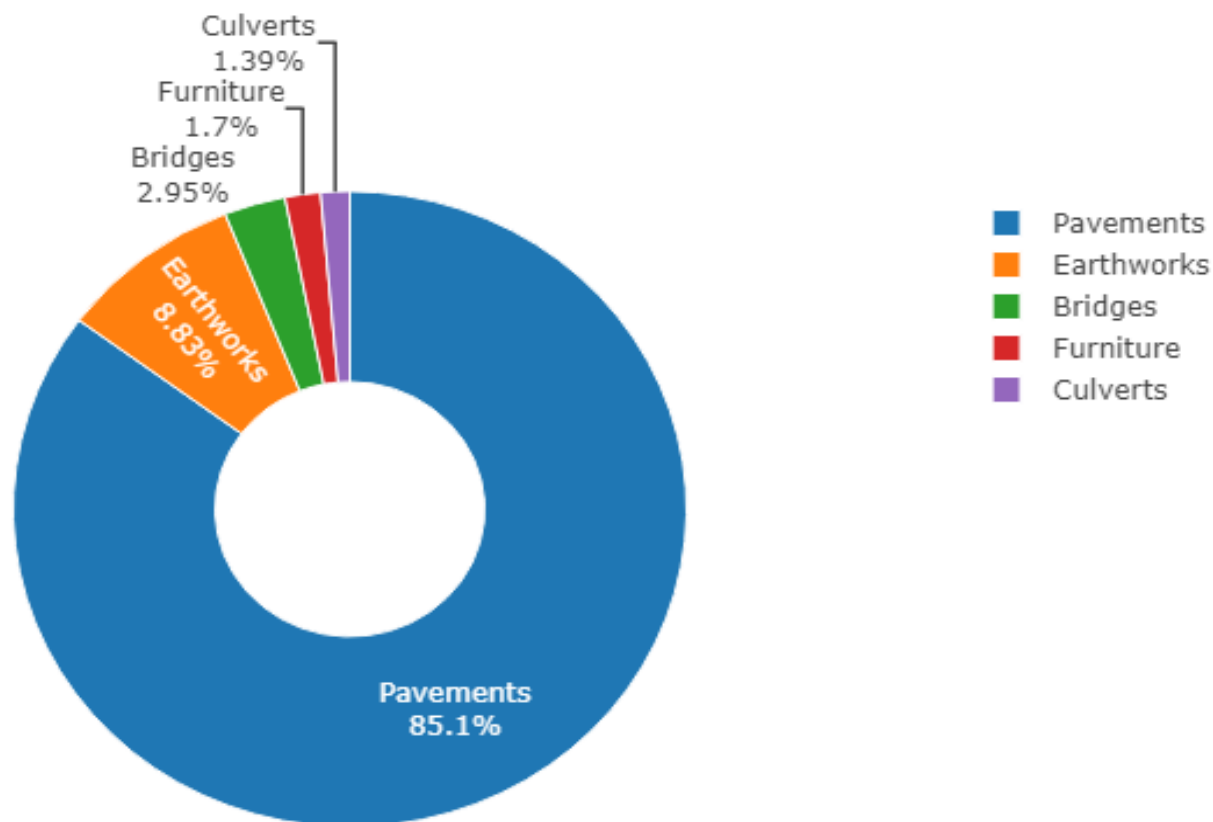


# Optimal life-cycle activity profile



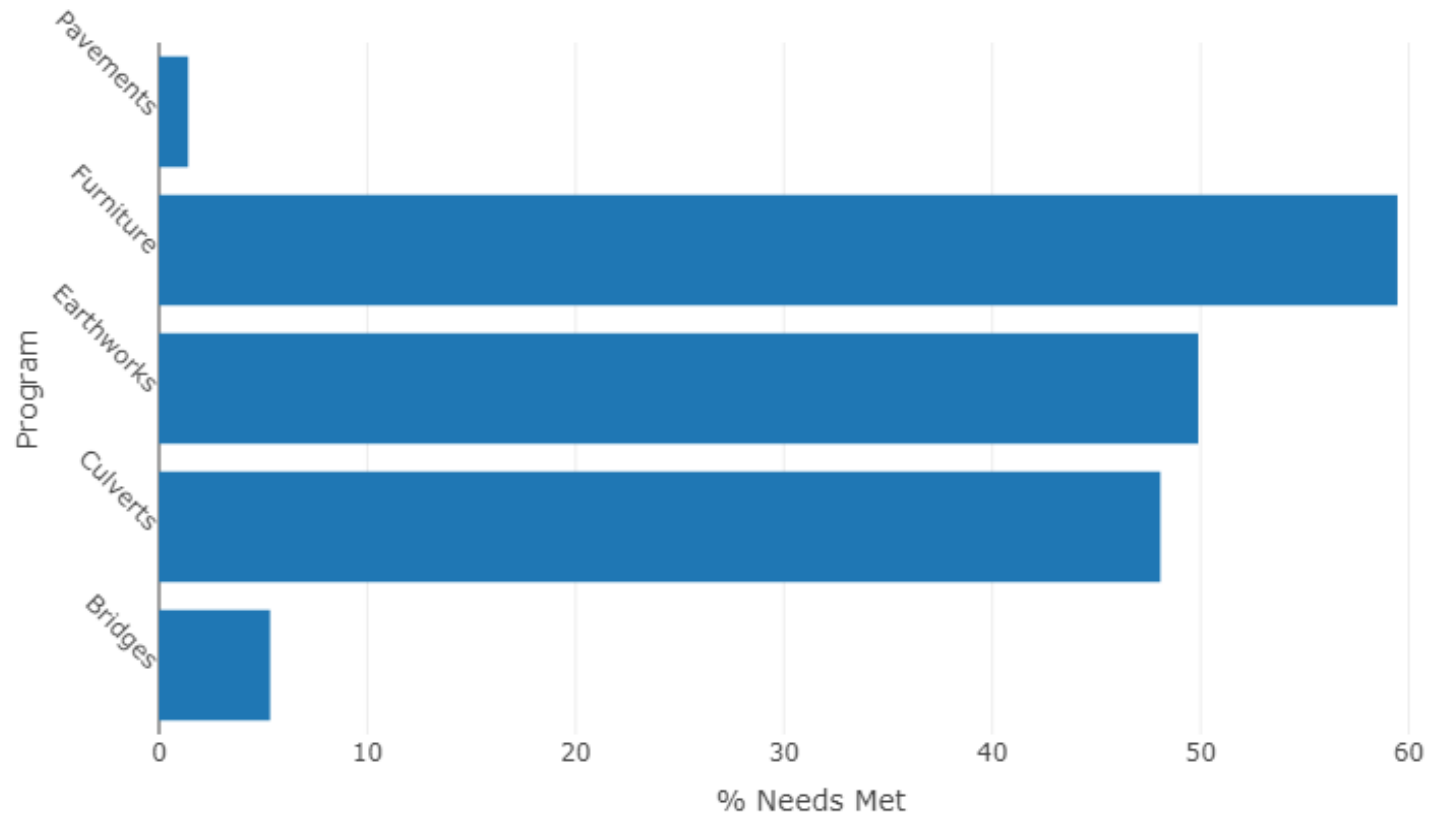


# Resource allocation across various asset classes



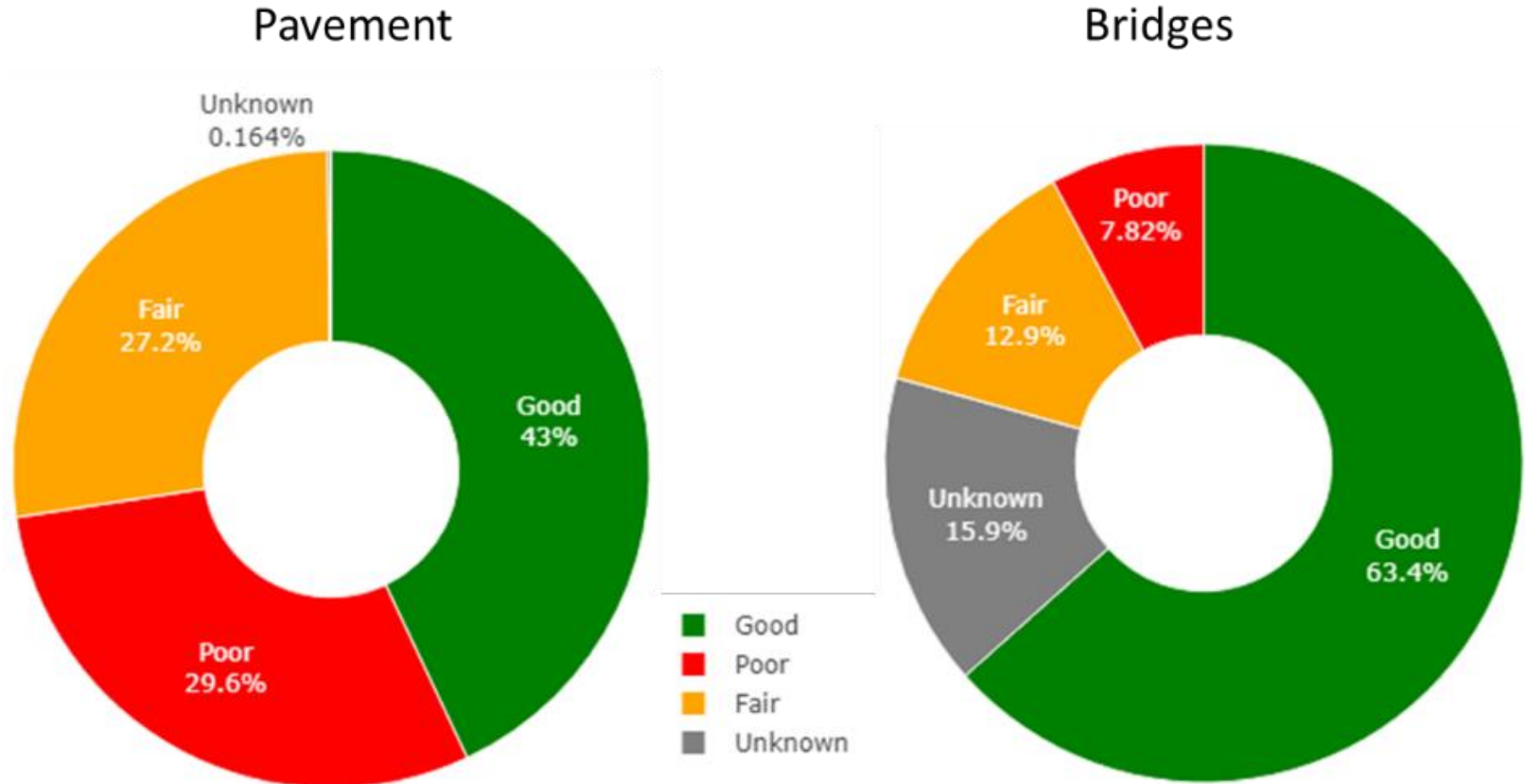


## Percent needs met over a planning period of 10 years



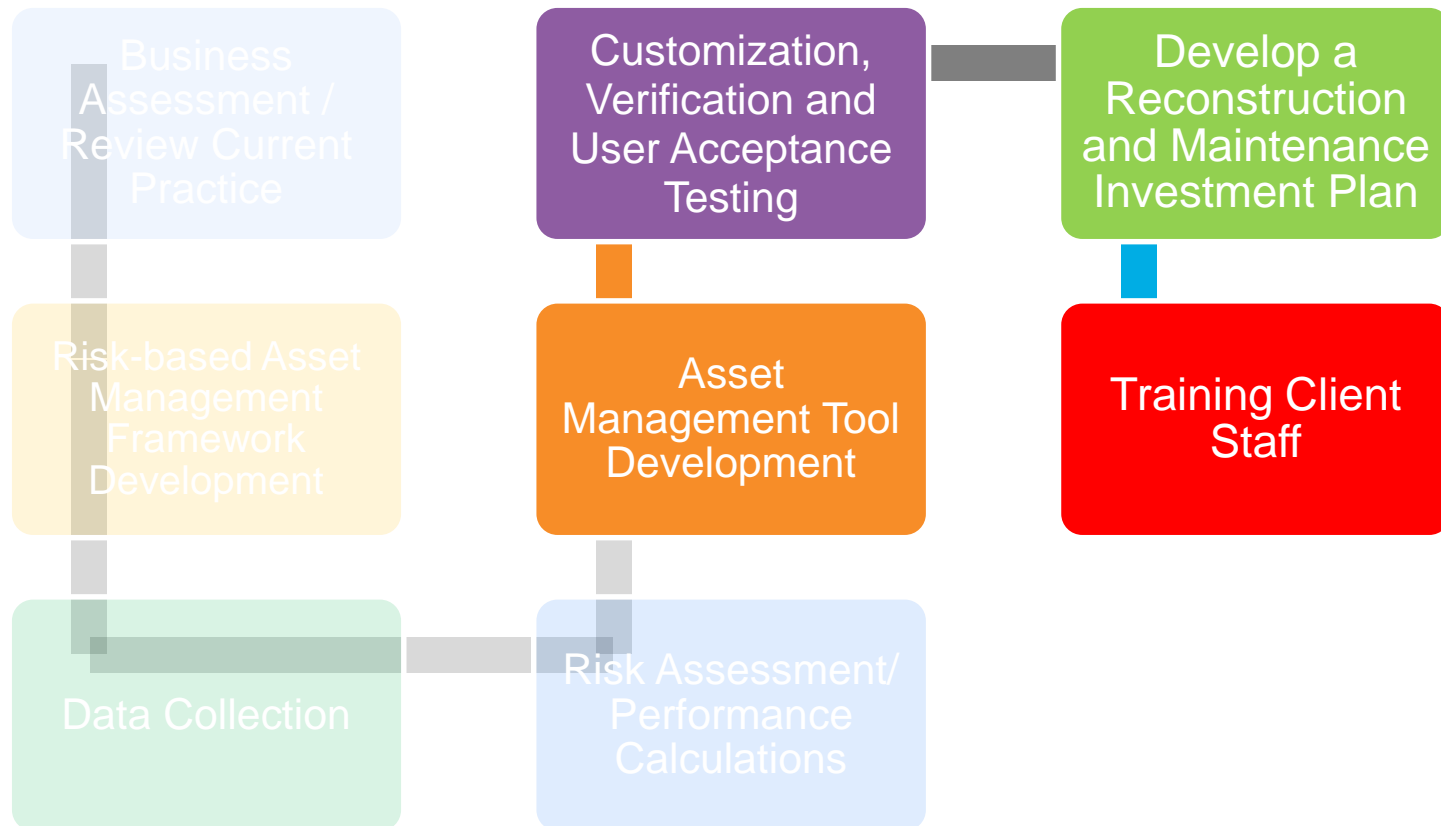


# Forecasted pavement and bridge State of repair at the end of program





# Tool and training





## GIS based Inventory database

The screenshot displays the 'W-GIS' application interface. On the left is a sidebar menu with options: W-GIS (selected), Data Sheet, Database, Queries, Budgeting and Investment, Schedule, Reports, and Administration. The main panel shows search and filter tools. Under 'Road Network', 'Main Roads' is checked. Under 'Assets', 'Pavements' and 'Bridge' are checked. Under 'Risk Assessment', 'Asset Criticality' and 'Asset Condition' are selected. The map shows the island of Dominica with a network of roads and numerous blue circular markers indicating asset locations. Key geographical features like Northern Forest Reserve and Morne Trois Pitons National Park are labeled.



# Data base

## Risk-Based Asset Management and Strategic Investment Planning Tool

dlc Logout



W-GIS

Data Sheet

Database

Queries

Budgeting and Investment

Schedule

Reports

Administration

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### > Data Sheet

#### > Asset code

M1-SPR-B-2811

Asset Type: BRIDGE

#### > Data information

- ☒ General Data
- ☒ Inventory Data
- ☒ Operation and Maintenance Data
- ☒ Indexes and risk analysis

#### > File upload

File Upload



#### General Data

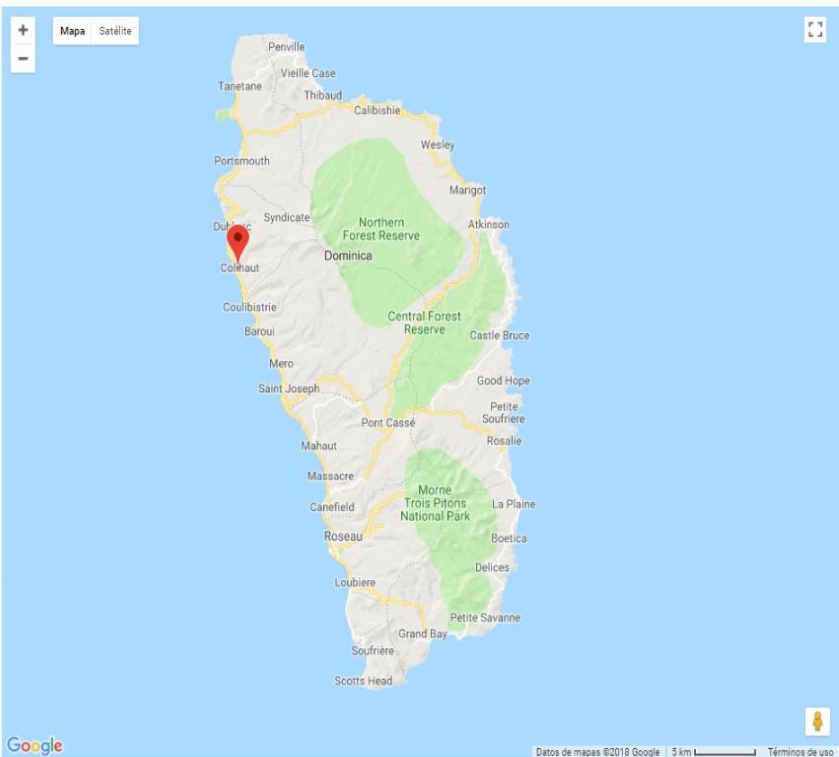
Asset Code	M1-SPR-B-2811
Structural Typology	Girder
Environment	Urban
Obstacle overpassed	River/water stream

#### Inventory Data

Material - Deck	Concrete
Material - Girders	Steel
Material - Abutments	Concrete
Bridge alignment	Straight
Single or multiple span?	Single
Total length (m)	15
Maximum span (m)	12.0
Total width (m)	10
Free height (m)	3.3
Foundations typology	Shallow foundations
Protection of abutments /nearby areas	Abutments protected

#### Operation Data


Existence of alternative itinerary	NO
Current visual condition	D
Consequences of failure on LOS	High
Damages on foundations	Damages on foundations





# Queries

### Risk-Based Asset Management and Strategic Investment Planning Tool



W-GIS

Data Sheet

Database

Queries

Budgeting and Investment

Schedule

Reports

Administration

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#### > Queries Control Panel

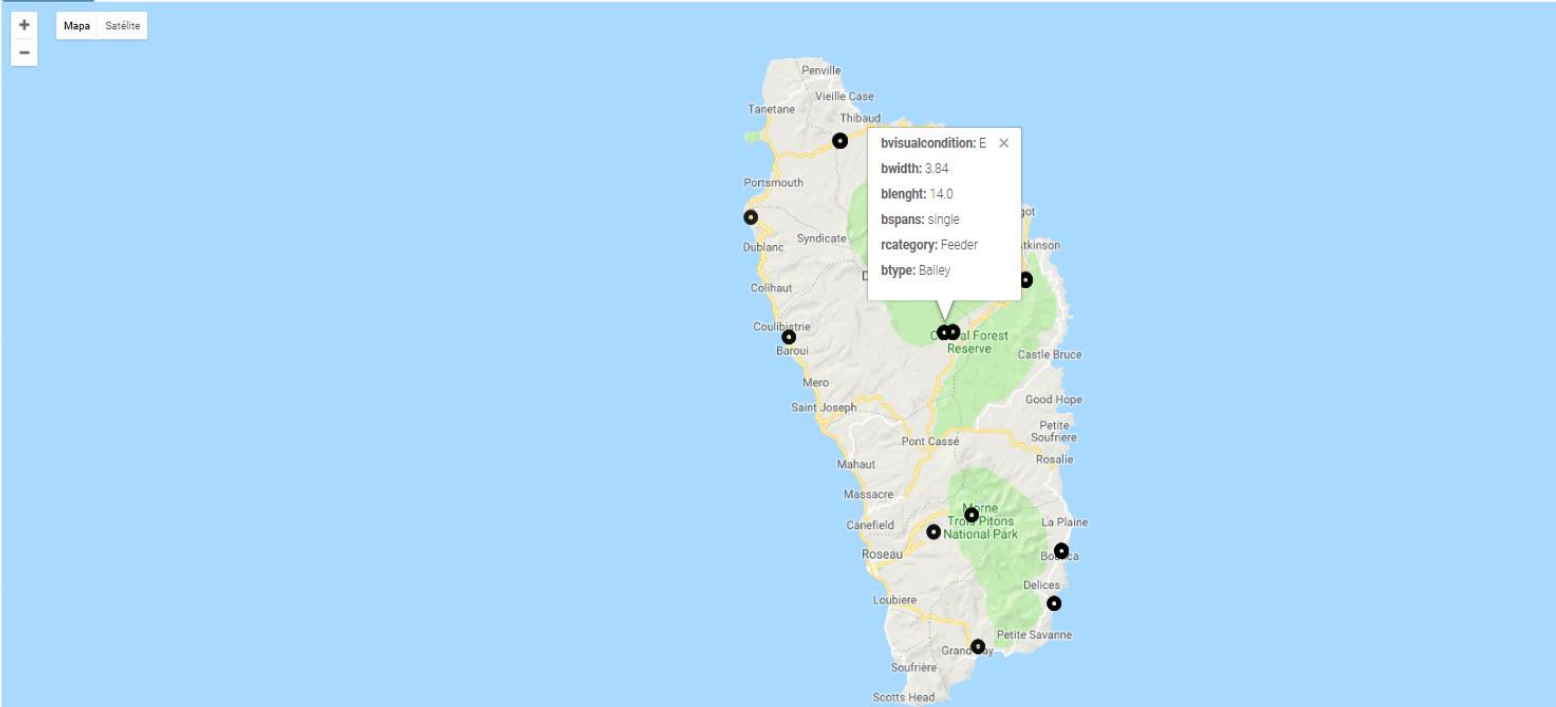
LOCATION

+

 Mapa 

Satellite

-



Map of Haiti showing various locations and a tooltip for 'Feeder' category.

Locations: Penville, Vielle Case, Thibaud, Tanetane, Portsmouth, Dublanc, Syndicate, Colihaut, Coulbatrie, Baroui, Mero, Saint Joseph, Pont Cassé, Mahaut, Massacre, Canefield, Roseau, Loubiere, Soufrière, Scotts Head, Castle Bruce, Good Hope, Petite Soufrière, Rosalie, La Plaine, Boussa, Delices, Petite Savanne, Grand Cay, Morne Trois Pitons National Park, Morne Forest Reserve.


Tooltip:

- bvisualcondition: E
- bwidth: 3.84
- blenght: 14.0
- bspans: single
- rcategory: Feeder
- btype: Bailey

Datos de mapas ©2018 Go



# Reports



W-GIS

Data Sheet

Database


Queries

Budgeting and Investment

Schedule

Reports

Administration



Reports Creation

Search tool

S8-SG-01-B-15

Generating...

BRIDGE INVENTORY SHEET


EARTHWORKS INVENTORY SHEET

RETAINING WALLS INVENTORY SHEET

CULVERTS


PAVEMENTS INVENTORY SHEET

Report



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BRIDGE INVENTORY SHEET



IDENTIFICATION

Asset code	S8-SG-01-B-15	Road code	S8-SG-01
Asset name		Road name	KP
Structural typology	Girder		

GENERAL DATA


Year of construction	
Environment / surroundings	Rural
Obstacle overpassed	River/Water stream
Existence of alternative	NO


DESIGN PARAMETERS


Design flood scenario	
Load capacity	


INVENTORY DATA

Geometry		Road characteristics	
Alignment	Straight	Pavement material	Asphalt
N° of spans	2	Road width	3.5
Total Length (m)	30.0	Road furniture	
Maximum Span (m)	17.5	Barriers	
Width (m)	5.58	Existence	No
Free height (m)	7.2	Typology	
Materials		Typology of safety fences	
Deck	Concrete	Signposting and road signs	
Girders	Steel	Existence	No
Piers	Concrete	Typology	
Piers	Masonry	Typology of vertical signaling	
Foundations		Street lighting	
Type of foundations	Shallow foundations	Existence	No
Response parameters		Typology	
Existence of piers over riverbed	No piers over riverbed		
Protection of abutments and nearby areas	Abutments protected		





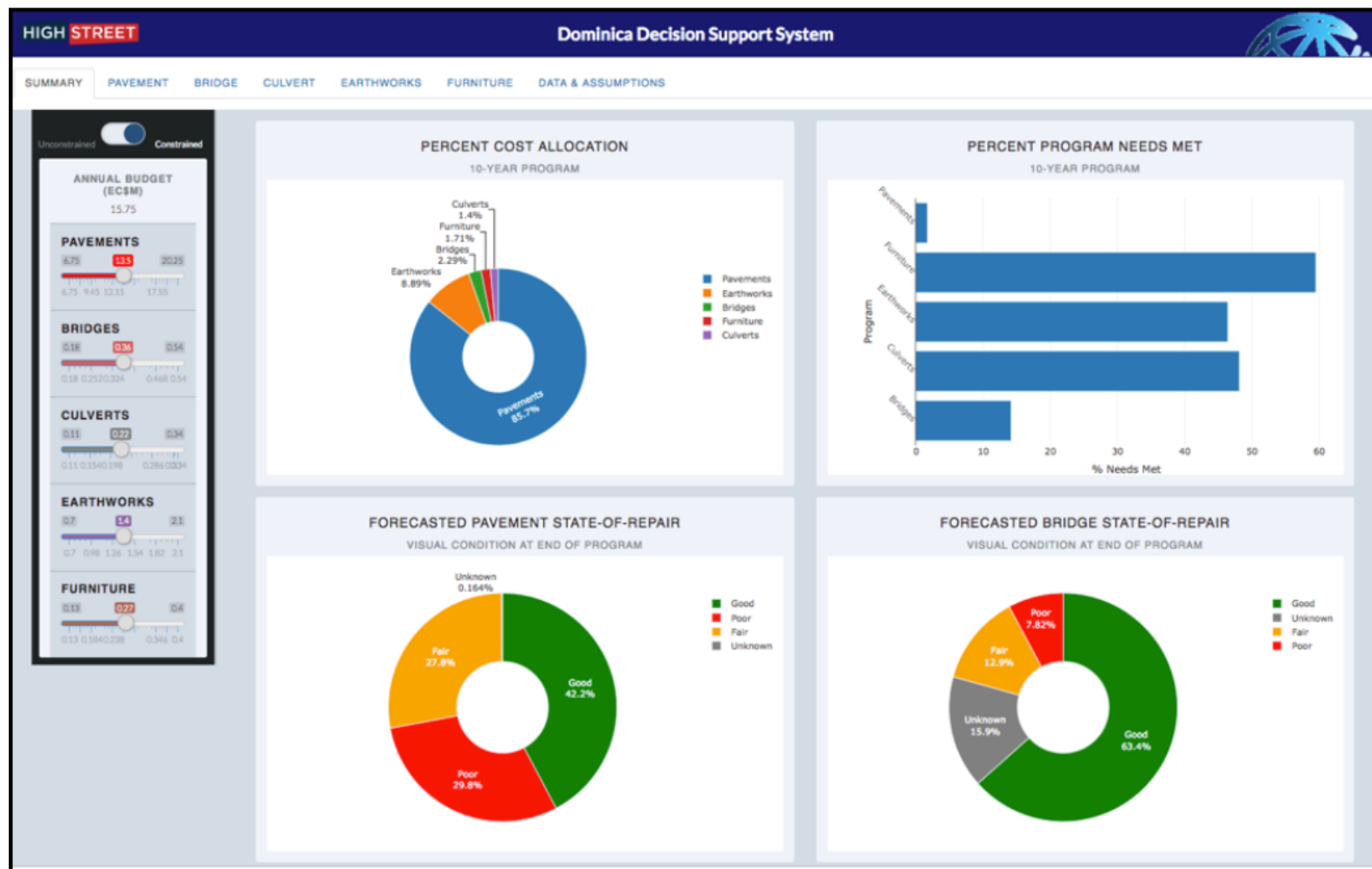




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# Decision support tool





# Summary

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- **A practical guideline on**
  - **what type of data can be collected**
  - **how data can be processed,**
  - **how risk is calculated and**
  - **how risk and other measures are used in prioritization and optimal resource allocation.**
- **Low-cost easy-to-use methods for data collection, performance assessment (e.g. criticality and condition) which can be used in many countries**
- **A multi-objective resource allocation optimization model to develop multi-year maintenance and investment plans**



# Thank you!

