



MEASURING PAVEMENT CONDITION IN DEVELOPING COUNTRIES: THE WORLD BANK'S EXPERIENCE

- Christopher R. Bennett •
- The World Bank •
- Senior Transport Specialist •
- cbennett2@worldbank.org •



Road Management Systems Require Data

Bridge Form	
Details 1	Details 2
Number	Unknown
Obstacle	Irrigation char
Obstacle (other)	None
Obstacle name	Unknown
Load	0 t
Height	0 m
Len	55
Carr W	4.1
Clear W	0
Inspection date	29/01/2004

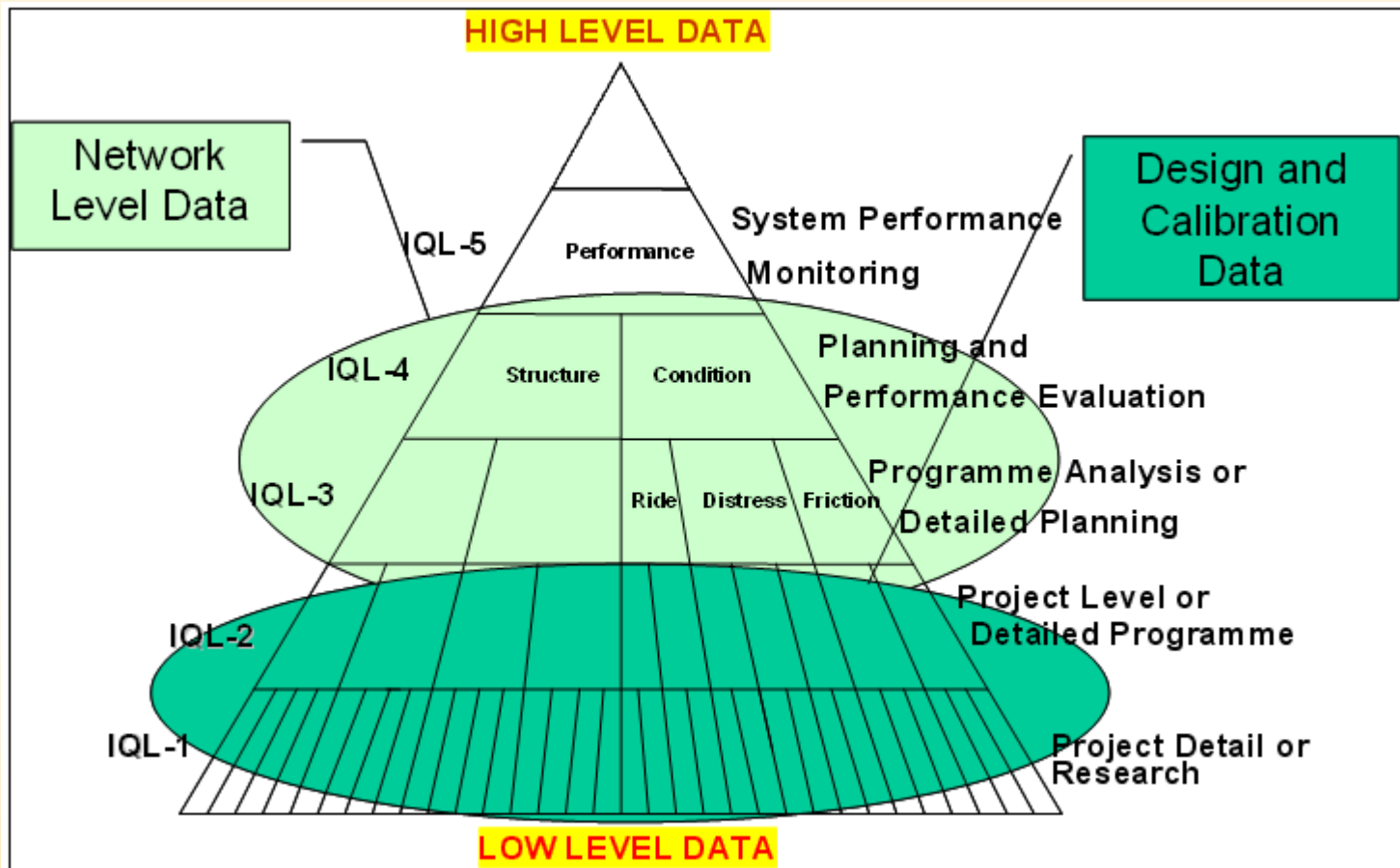
Bridge Form	
Details 1	Details 2
Superstructure material	Bailey
Other	None
Running surface	Steel
Other	None
No. spans	2
Services	No
Comments	None



What to Collect?

- **Collect only what you need**
- **Collect to the lowest level of detail sufficient to make appropriate decisions**
- **Collect data only when they are required**

To What Level of Detail?

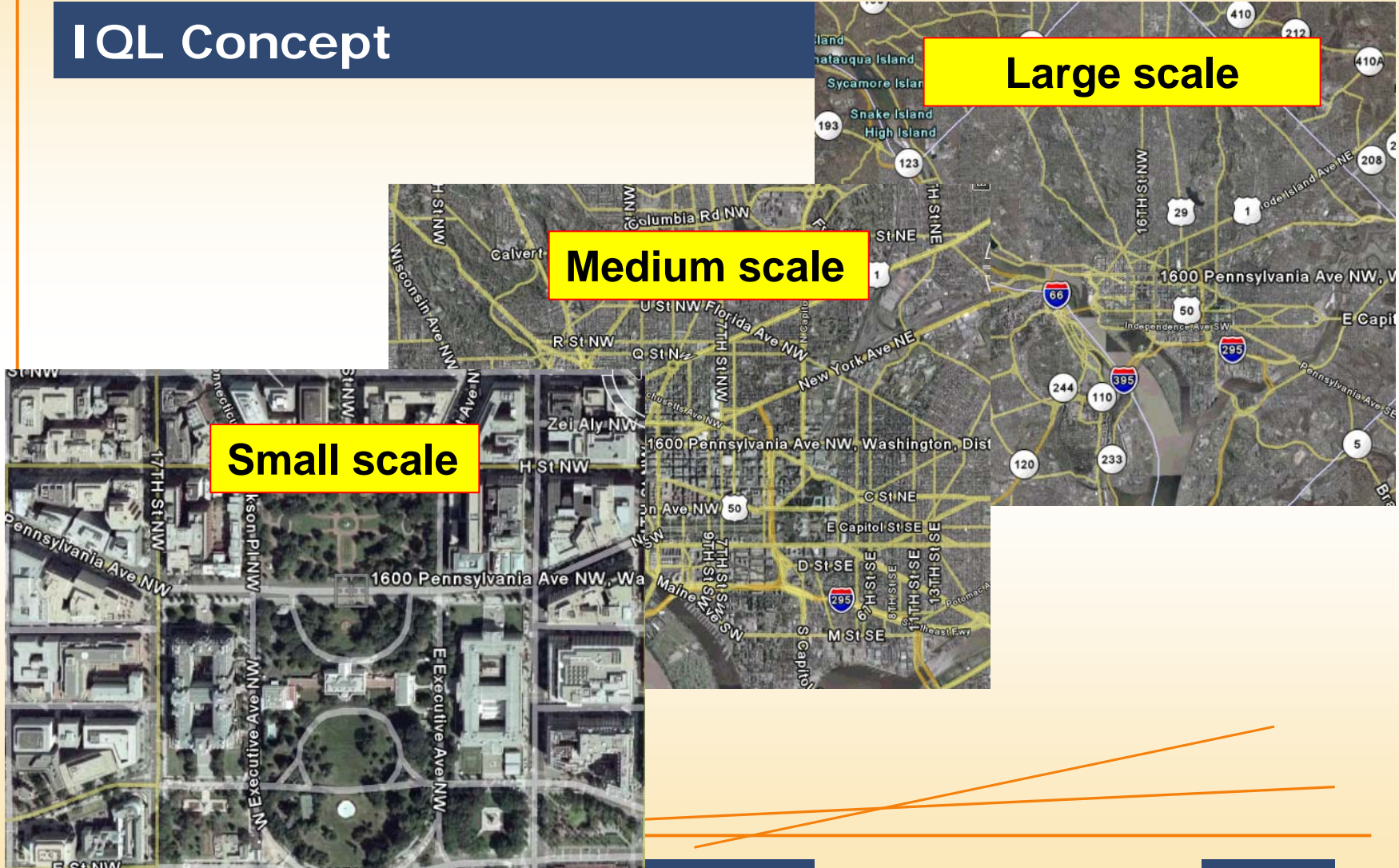


IQL Concept

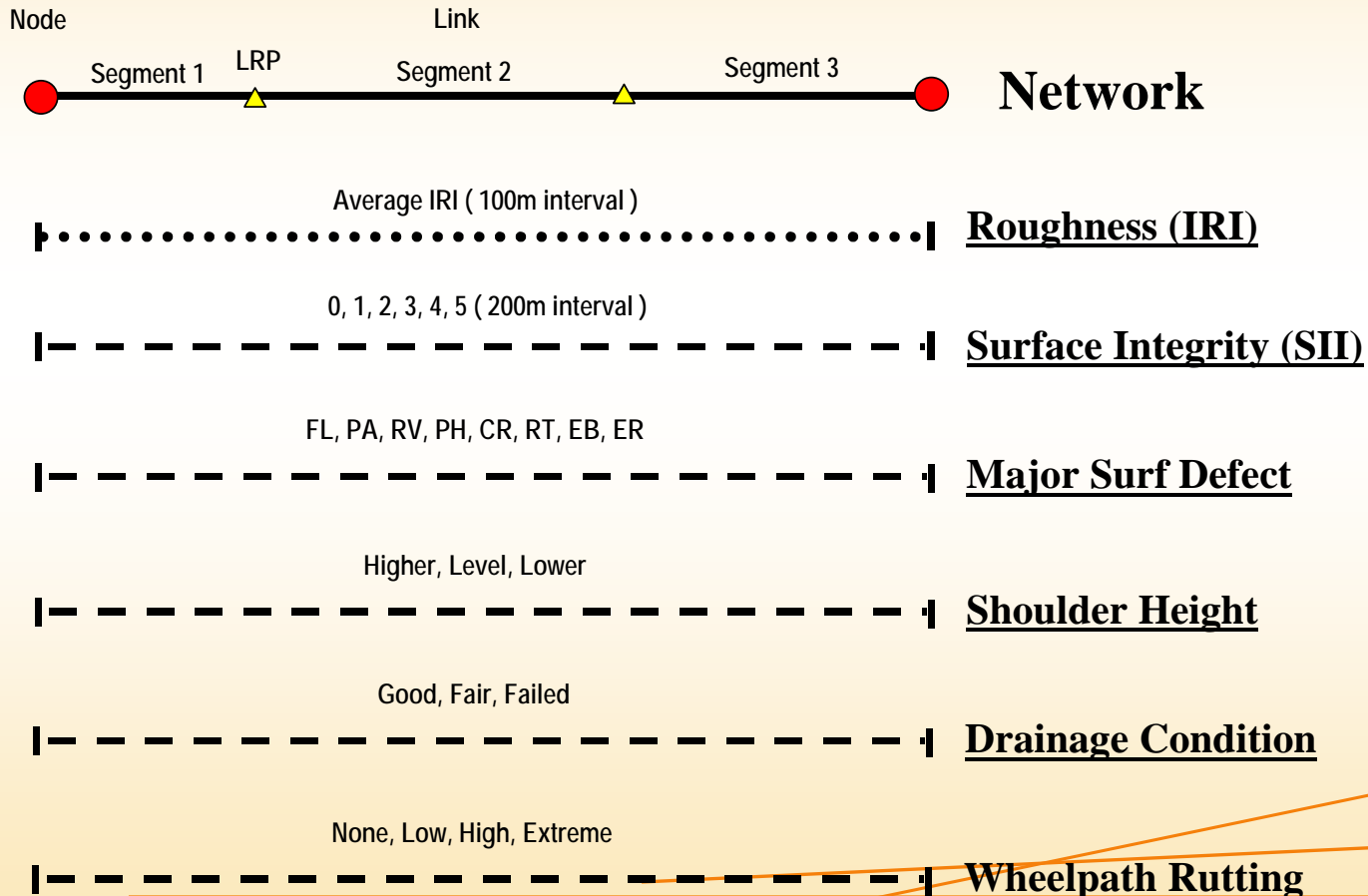
Large scale

Medium scale

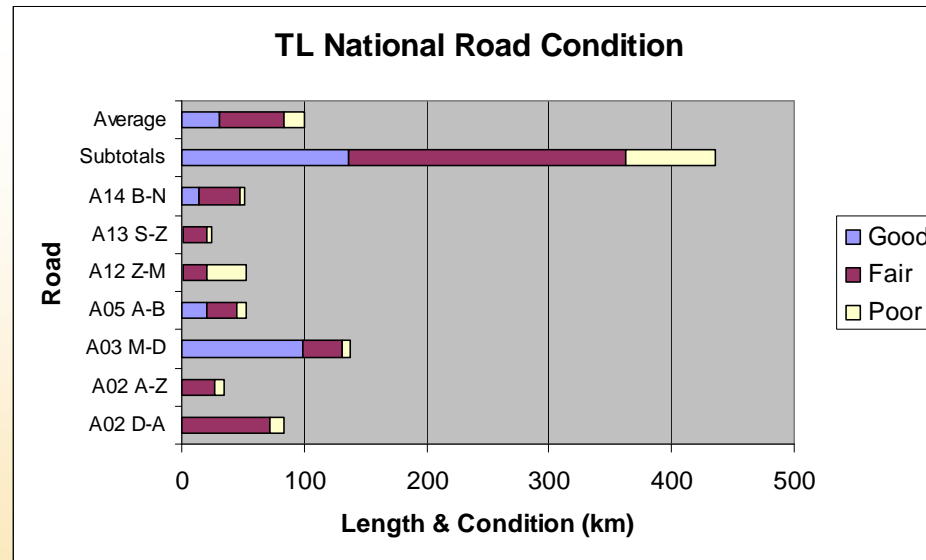
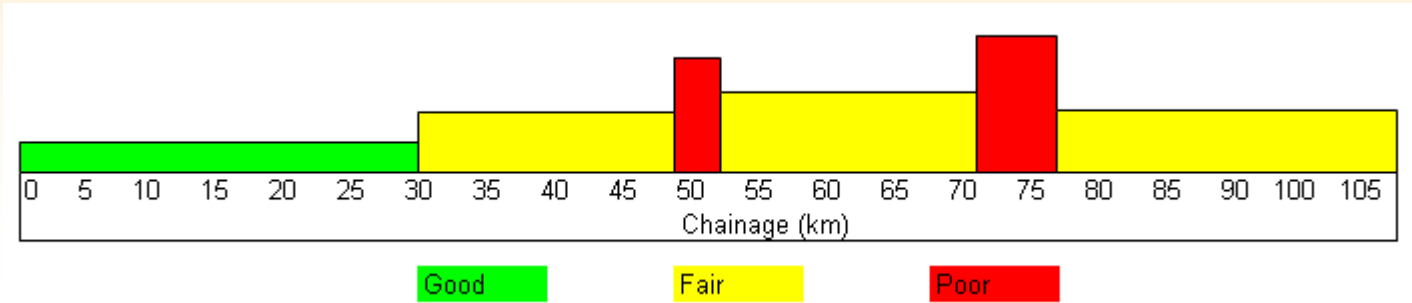
Small scale



Example – Cambodia IQL 3



Example Timor Leste – IQL 4



With the Right Technology ...

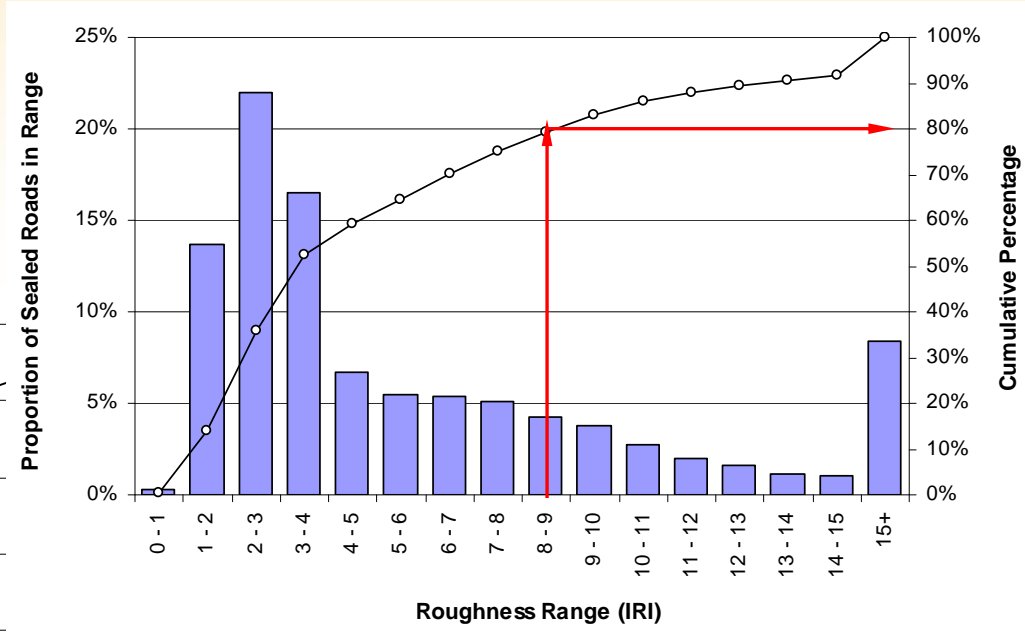
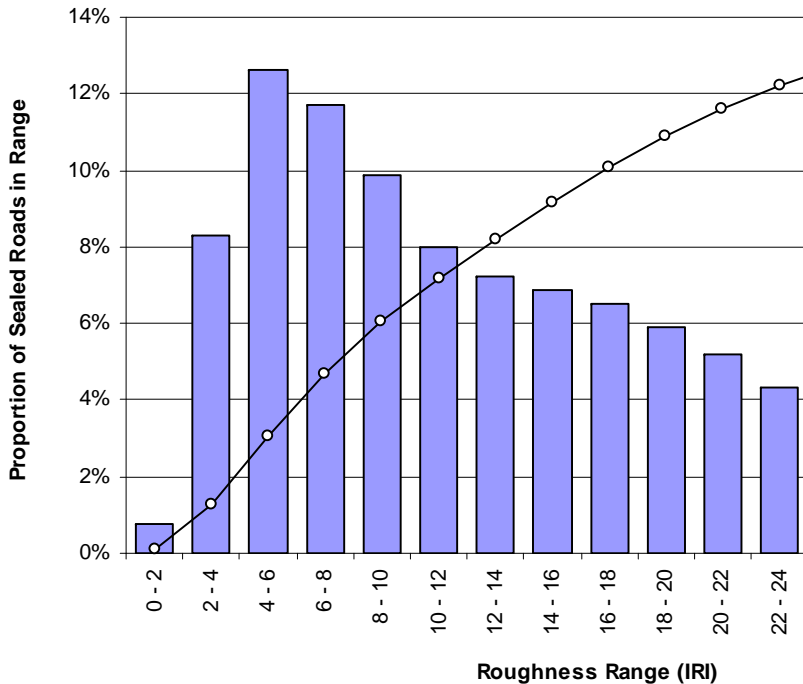
Designed for this



Not this ...

Technology Implications: Cambodia Roughness

Paved



Unpaved



The World Bank's Experiences

- **Bank finances**
 - Procurement of equipment
 - Data collection services
- **Mixed results**
 - Some clients use equipment effectively
 - Many do not
 - Many data collection services are successful
 - Some are not

Equipment Procurement Problems

- **Vendors convince agencies to procure unsuitable technology**
- **Data do not meet the agency's needs**
- **Equipment not appropriate for local conditions**
- **Ongoing maintenance and calibration not sustainable**
- **Inadequate local support**
- **Inadequate training**

Consider Cost Against Performance

		Operational Performance					
		Scale	1 (Low performance)	2	3	4	5 (High performance)
Equipment Global Cost	1 (High cost)				<ul style="list-style-type: none"> • Skid Resistance Dynamic - Vehicle 	<ul style="list-style-type: none"> • Imaging for Surface Distress 	
	2				<ul style="list-style-type: none"> • Ground Penetrating Radar - Dynamic • FWD - Trailer 	<ul style="list-style-type: none"> • Macrotexture - Dynamic High Speed • Precision INU for Geometry • Roughness - Class I (Laser) 	
	3				<ul style="list-style-type: none"> • Deflection Beams • FWD - Portable • Ground Penetrating Radar - Static • Skid Resistance - Dynamic Trailer 	<ul style="list-style-type: none"> • GPS with INU • Macrotexture - Dynamic Low Speed • Rut Depth Profilers • Roughness - Class II 	
	4		<ul style="list-style-type: none"> • Roughness - Class IV 	<ul style="list-style-type: none"> • Roughness - Class I (Manual) • Skid Resistance - Static 	<ul style="list-style-type: none"> • Video Logging • Roughness - Class III 	<ul style="list-style-type: none"> • GPS 	
	5 (Low cost)			<ul style="list-style-type: none"> • Macrotexture - Static 		<ul style="list-style-type: none"> • Digital DMI 	

Specifications

- Prepared by agencies
- Often limited understanding of technologies
- Vendors may influence process
- Risk of omissions with agency

**World Bank Generic Specifications
from www.road-management.info**



Multifunction Vehicles



WIM and Volume



FWD

Principles

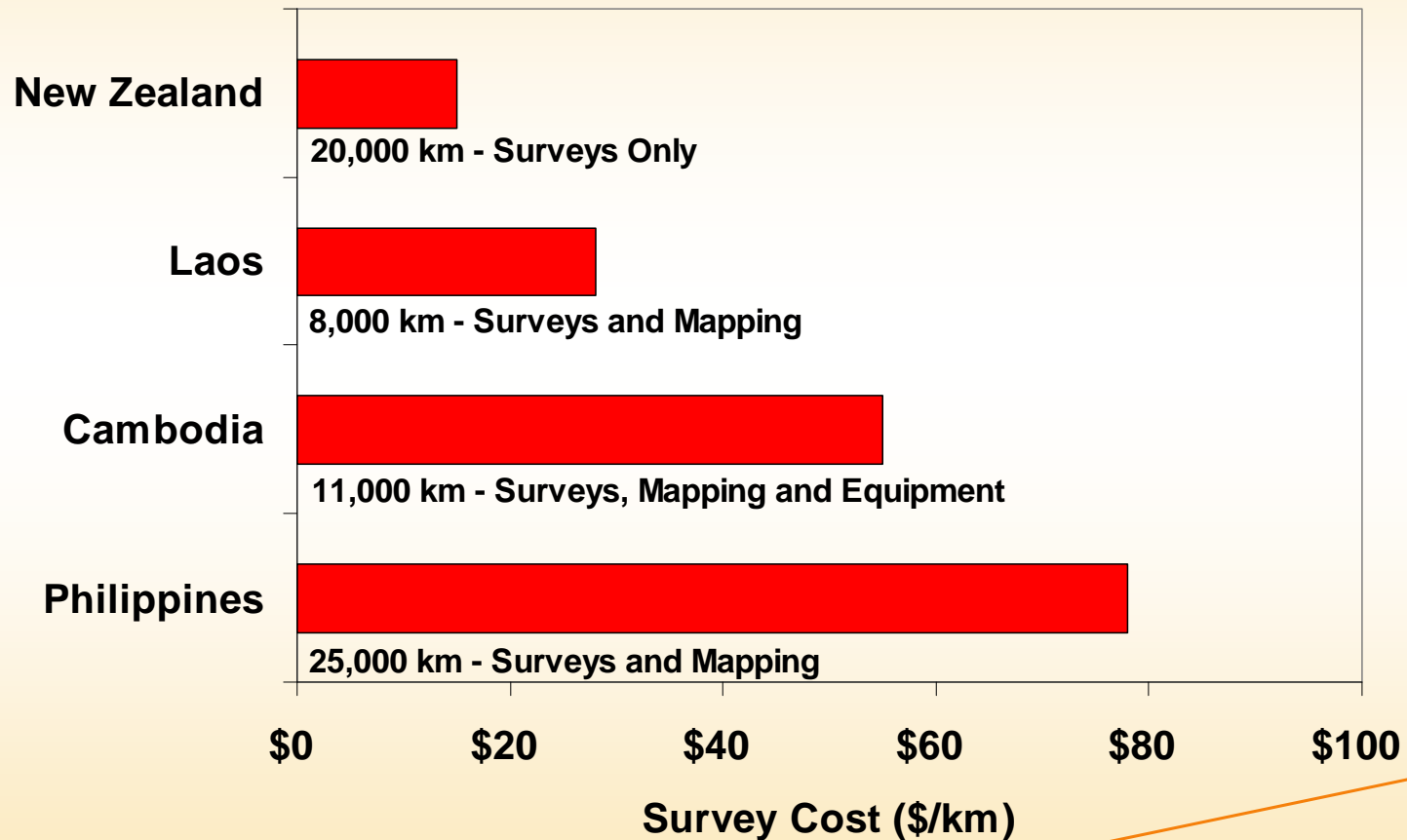


- **Validation**
 - Calibrate to confirm measurements
 - Validate to show works locally
- **100 km sample survey**
- **Load data into agency's road management system**
- **Issue acceptance certificate**

Data Collection Services

- **Most agencies had data collection problems**
 - In-house and contracted data collection problematic
- **Contracting data difficult**
 - Requires good contract management
 - Data quality control checks
 - Liquidated damages for poor performance

Services: Comparative Costs



Costs Affected By

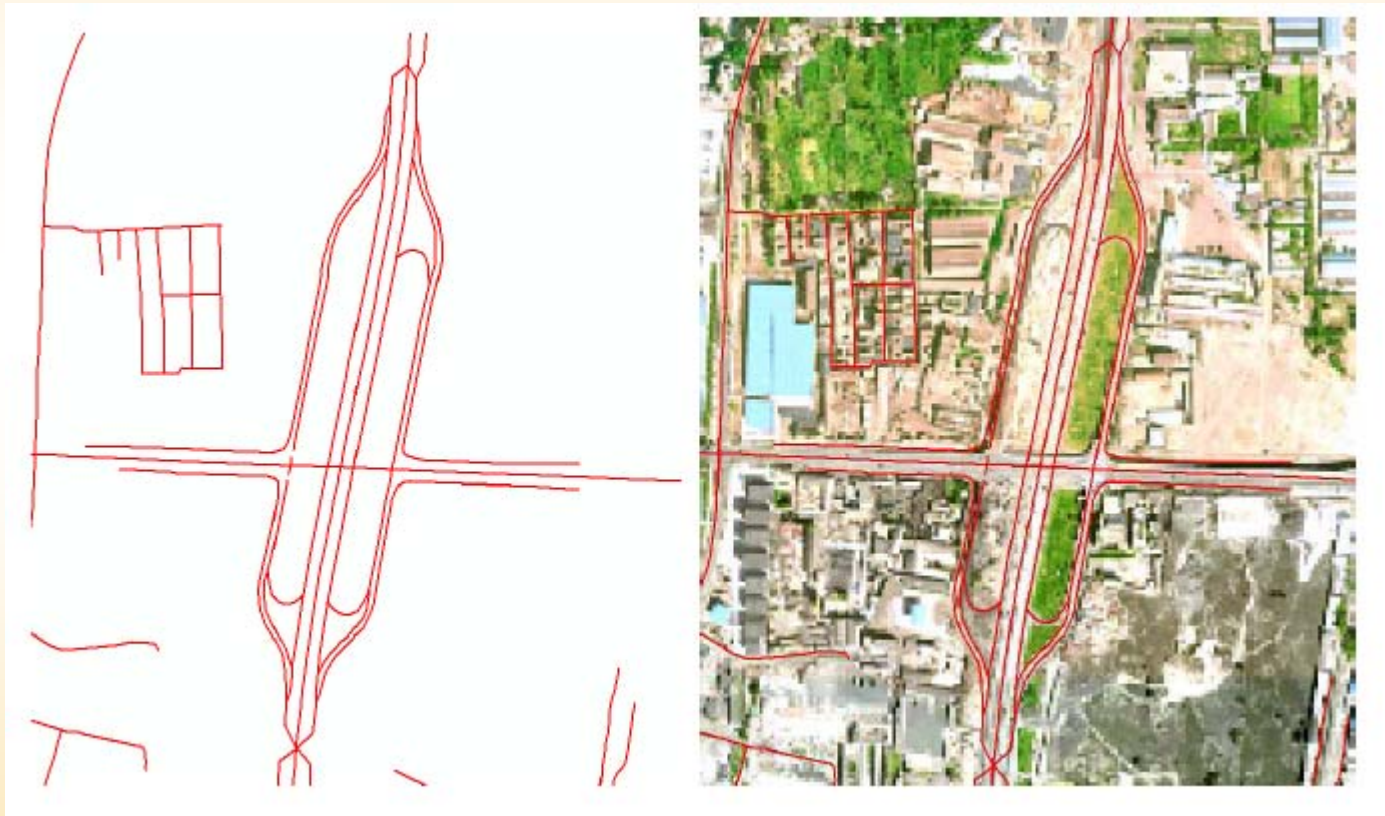
- Challenging network to drive
- No pre-defined network
- No previous data on inventory or condition
- Missing links / broken bridges
- Mines and unexploded ordinance (UXOs) within the right way
- Equipment breakdowns and difficulties getting spares
- Wildlife
- Banditry
- Weather



Challenges to Contracting Data Collection

- **Surveys result in a large amount of data**
- **Unless processing is done during survey significant delays**
 - Contracts should require data submission within 30 days of survey
- **Quality assurance is challenging but essential**
 - Philippines: some data returned 4 times to contractor for correction
- **ALL projects have underestimated difficulties in data processing**

The need for Quality Control



Generic TOR for Data Collection Services

www.road-management.info

Generic Terms of Reference
Pavement Data Collection Services

Version 1.0 – April 23, 2007



East Asia Pacific Transport Unit
The World Bank
Washington, D.C.

- Designed to guide agencies through procurement
- Address key issues to ensure success
- Minimum specifications for data appropriateness
- Quality assurance requirements

Key Principles

- **Output based contract**
 - Paid only for data delivered and accepted
 - All equipment procured by contractor
 - Payments based on pro-rata basis
 - Not a consulting time-writing contract
 - Contract: two years with option for extending
- **Example of payment schedule**

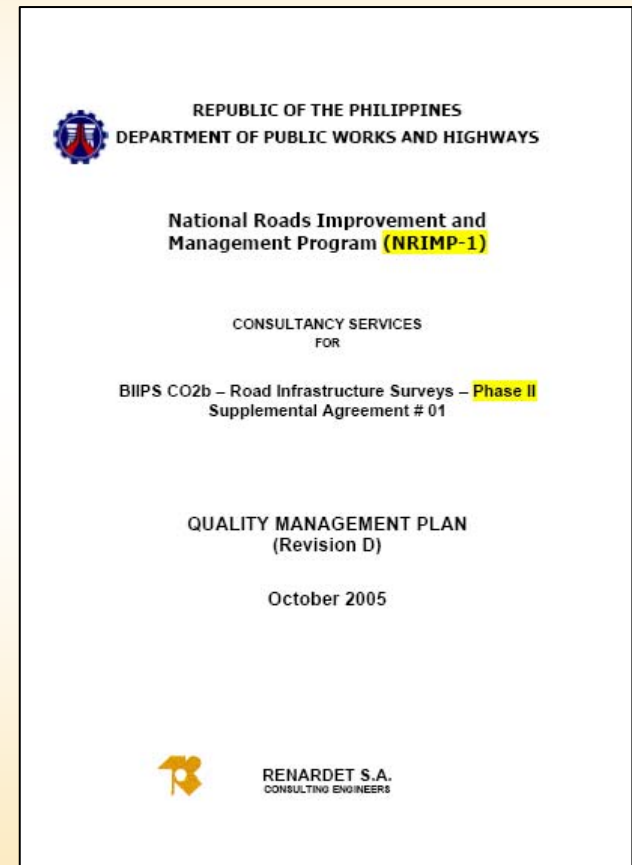
Activity	Payment Type	Basis
Acceptance for survey certificate	lump-sum	10%
Data collection	pro rata	per km or number
Data processing	pro rata	per km or number
Acceptance of final report	lump-sum	15%

Data Expectations

Data Item	Units	Reporting Interval	Min Accuracy Level	Paved	Unpaved
Location Referencing					
Location referencing (linear)	-		0.1%	M/O/NR	M/O/NR
GPS Centreline coordinates	-	5/10/20m	5/10m - horizontal	M/O/NR	M/O/NR
Inventory					
Road Inventory					
• Road Type	-	at change	IQL 2/3/4	M/O/NR	M/O/NR
• Pavement Surface Type	-	at change	IQL 2/3/4	M/O/NR	M/O/NR
• Pavement Width	m	at change	IQL 2/3/4	M/O/NR	M/O/NR
• Shoulder Width	m	at change	IQL 2/3/4	M/O/NR	M/O/NR
• Shoulder Type	-	at change	IQL 2/3/4	M/O/NR	M/O/NR
• Shoulder Elevation	cm	at change	IQL 2/3/4	M/O/NR	M/O/NR
• Median Width	m	at change	IQL 2/3/4	M/O/NR	M/O/NR

Quality Assurance

- **Vital for contractor and agency to have QA plan**
- **Proper adherence will improve results**
 - Continuous checks
 - Repeat surveys
 - Revalidation
- **Need sufficient staff and resources to implement**



The Final Word: Success Depends on Convergence of People, Processes and Technology

