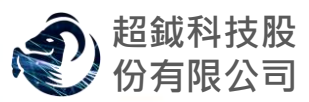




11<sup>th</sup> REAAA Business Forum



**REAAA Event Theme:**

**"AI Application in Road Engineering & Management-  
The Potentials, Challenges, and Future Directions"**

# Current Developments of AI Technology in Road Maintenance in Taiwan

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National Ilan University, Taiwan

Former President, Chinese Society of Pavement Engineering (CSPE)

Editor-in-Chief, International Journal of Pavement Research and Technology, Springer (ESCI)

**2024.09.04**



# CONTENTS



## 1 Taiwan Highway Bureau Project

Duration: February 2023 ~ December 2024

Amounts: USD 620,000

## 2 Taipei City Project

Duration: July 2022 ~ July 2025

Amounts: USD 70,000

(Professional Construction Management, PCM)

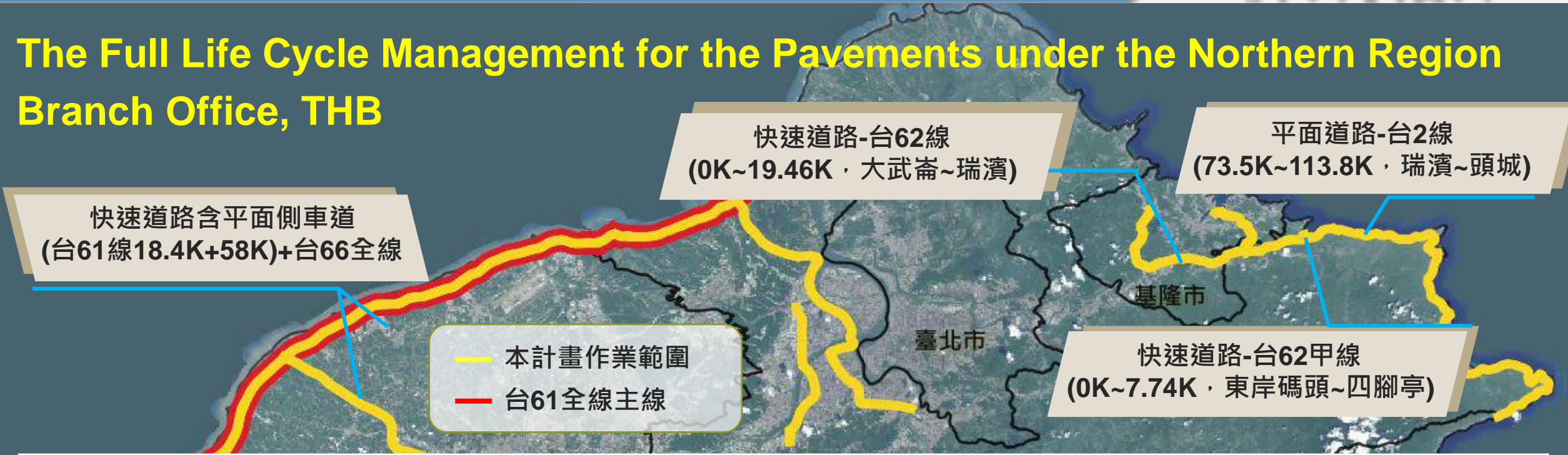
## 3 Applications of AI Technology

## 4 Remarks

# Taiwan Highway Bureau (THB) Project



## The Full Life Cycle Management for the Pavements under the Northern Region Branch Office, THB



No.	Road Numbers	Total Length (KM)	PCI	Road Surface Modeling (Digital Surface Model)
1	<b>Expressway</b> (ramp not included): Provincial Highway No. 61, 62, 62A, 64, 65, 66, 68, 68A	200	<input checked="" type="checkbox"/>	
2	<b>Surface Side Lane</b> : Provincial Highway No. 61 (18.4k ~ 58k), 66	67	<input checked="" type="checkbox"/>	Provincial Highway No. 61 (77 KM)
3	<b>Surface Road</b> : Provincial Highway No. 2 (73.5k ~ 113.8k)	40	<input checked="" type="checkbox"/>	

# Pavement Inspections



## Pavement Condition Index (PCI) Surveys: AI Technology

Five distress types: Longitudinal / transverse cracks, Alligator cracks, Potholes, Patching, Deformation  
→ PCI for each pavement unit

monthly

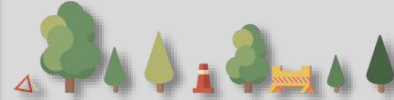
## Longitudinal (IRI) and Transverse (Rutting) Profiles: Road Surface Modeling (Digital Surface Model, DSM)

- Provincial Highway No. 61 (77 KM)
- 2 longitudinal and 5 transverse profiles for each pavement unit
- Comparisons of road surface changes based on the precise digital surface model (DSM)

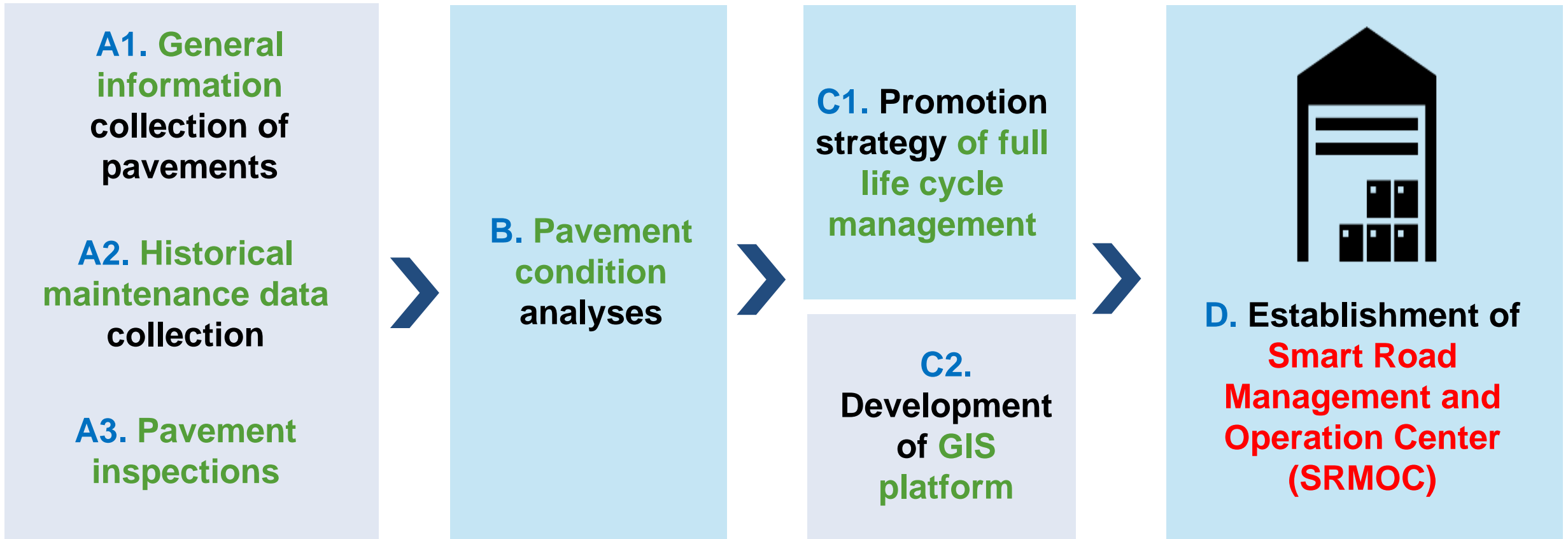
quarterly



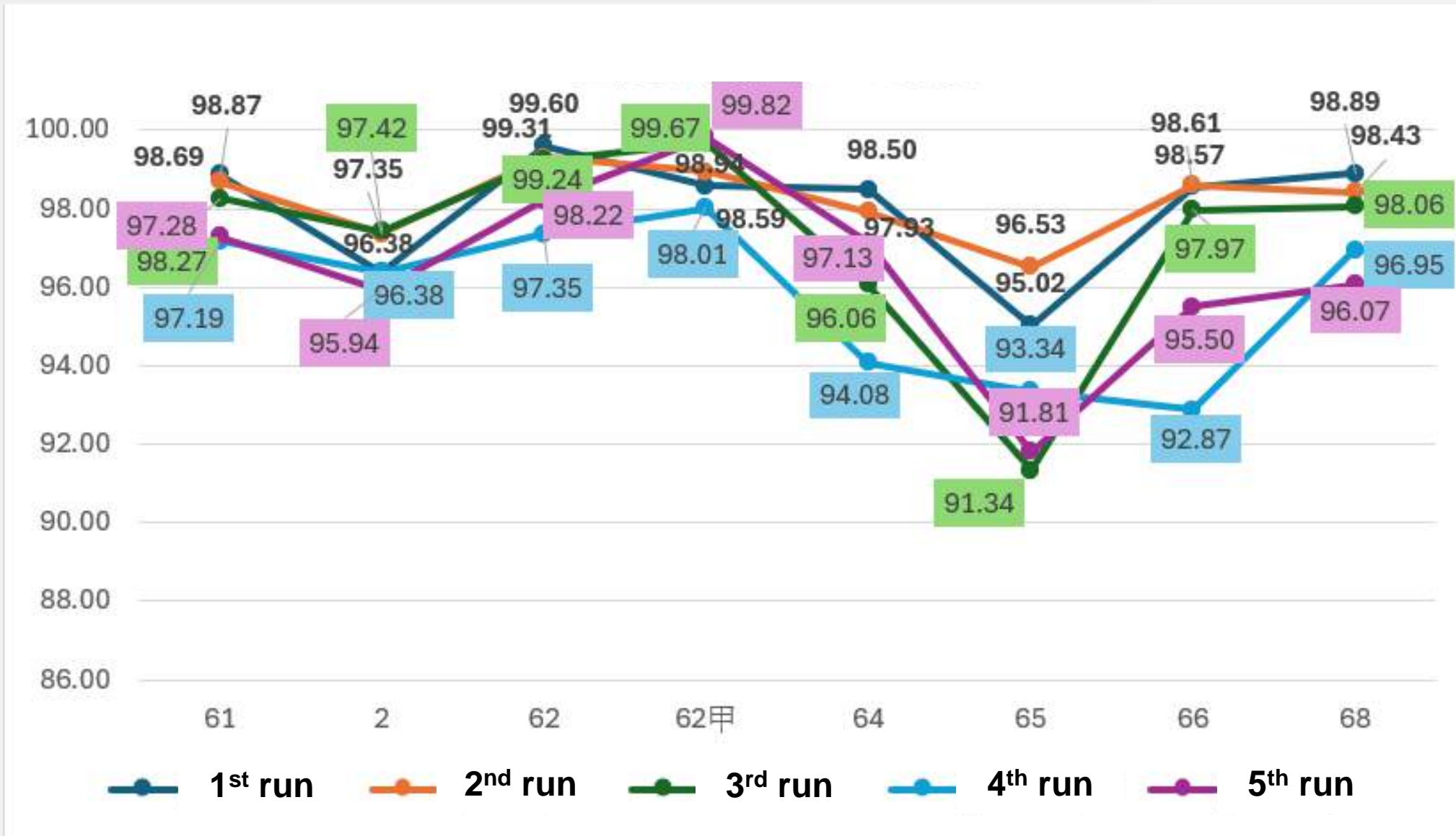
# Right place, Right time, Right method (3R)?



## Project Flowchart



# PCI Comparisons



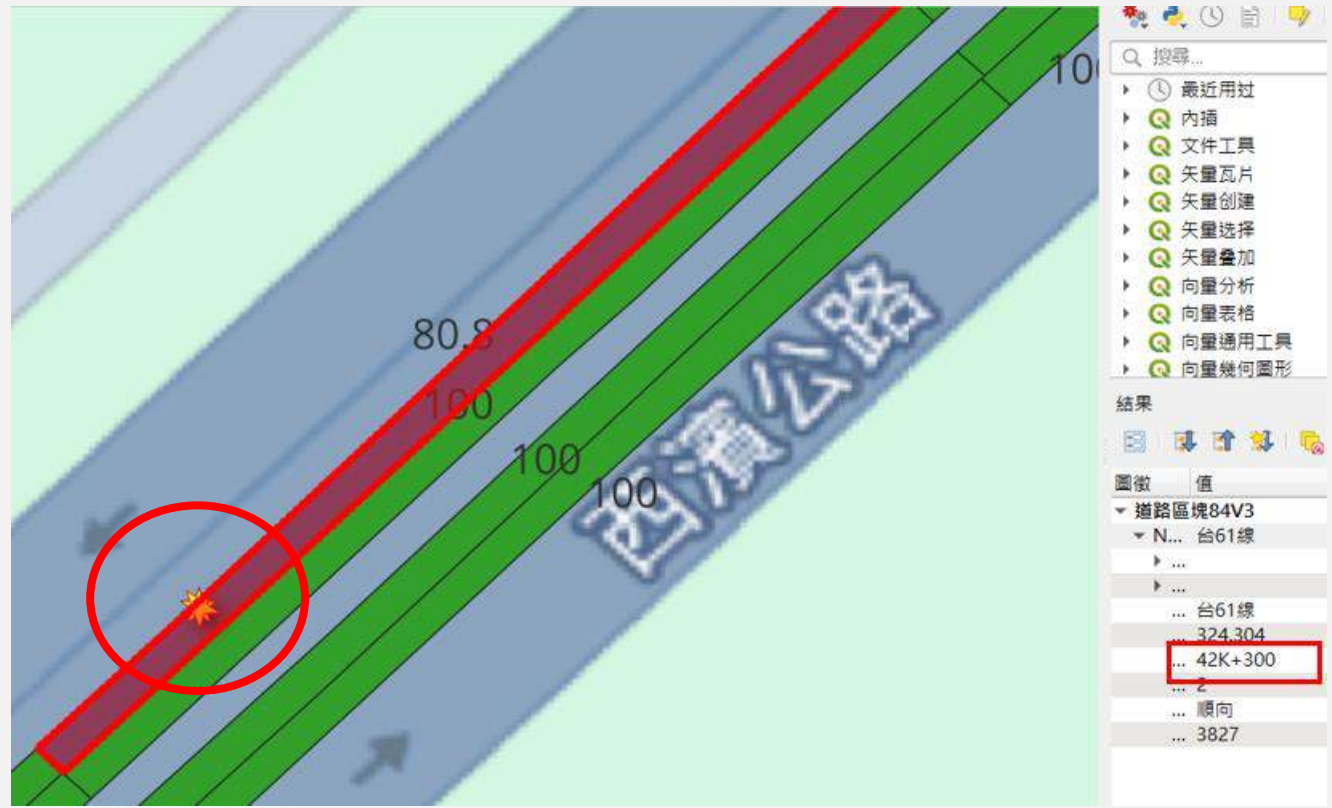
# Provincial Highway No. 61 - Pothole



**42K+300  
forward direction  
outside lane**



**AI recognition**



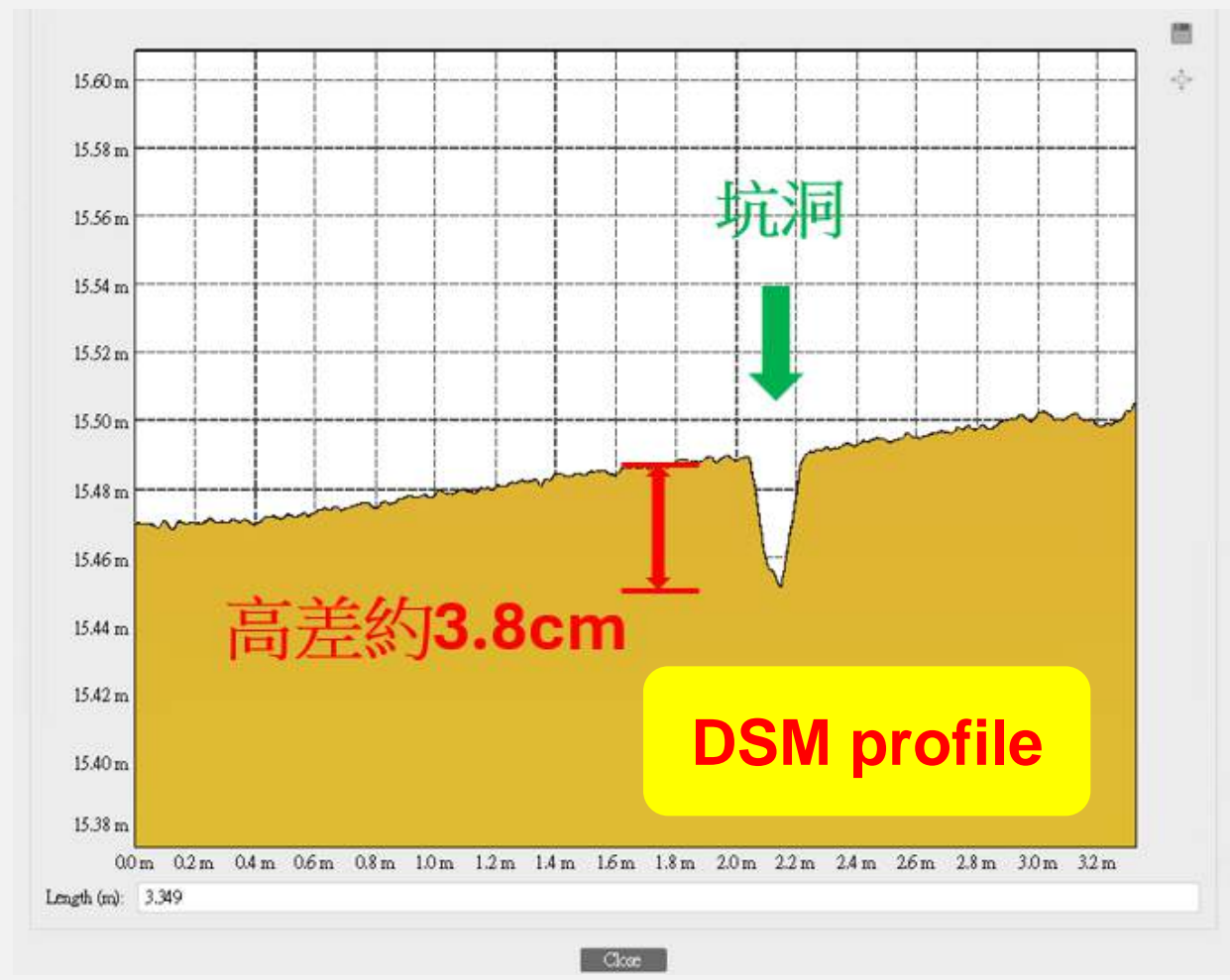
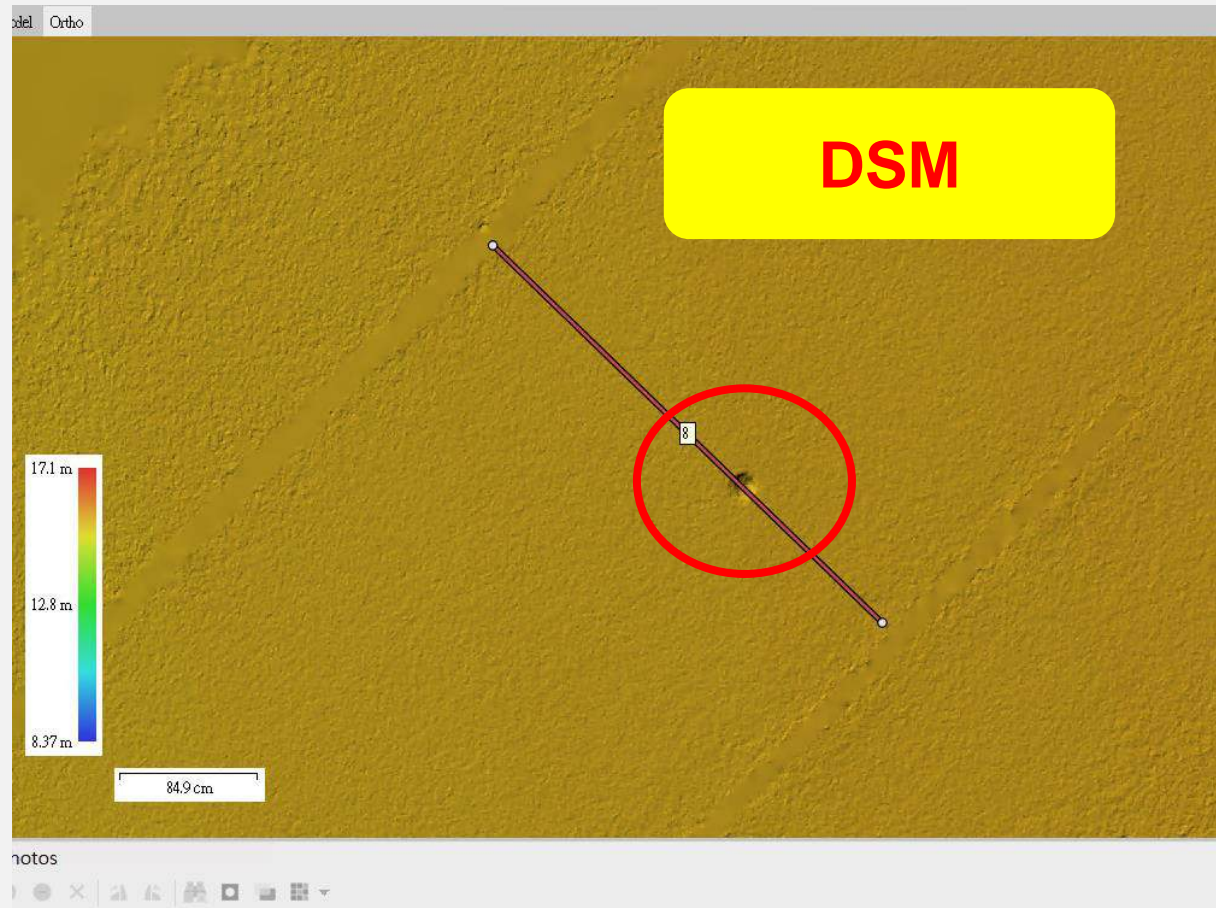
搜索...

- 最近用过
- 内插
- 文件工具
- 矢量瓦片
- 矢量创建
- 矢量选择
- 矢量叠加
- 向量分析
- 向量表格
- 向量通用工具
- 向量几何圆形

结果

图徵	值
道路区块84V3	
N...	台61线
...	
...	台61线
...	324.304
...	<b>42K+300</b>
...	2
...	顺向
...	3827

# Provincial Highway No. 61 - Pothole





# Provincial Highway No. 61 - Rutting



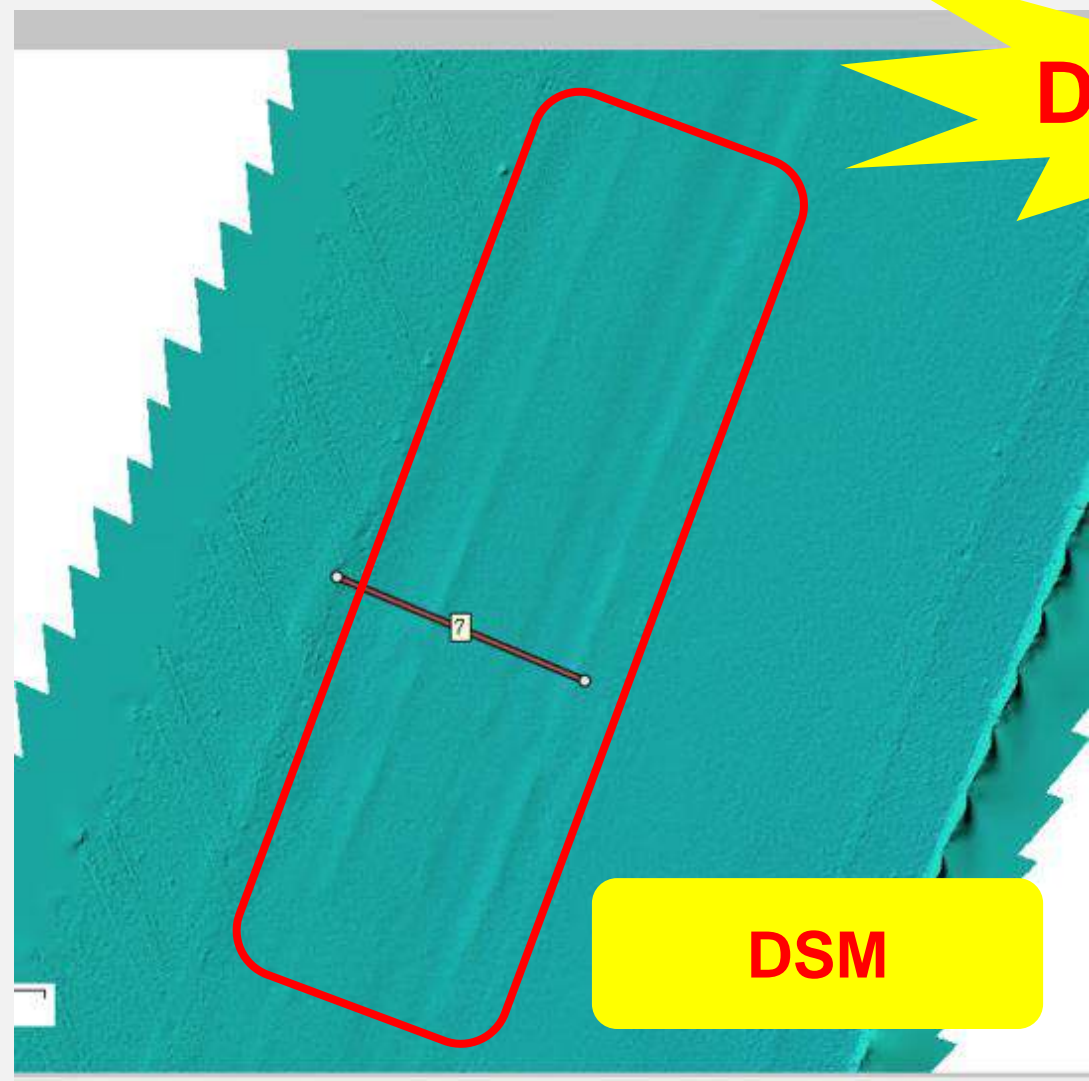
**46K+200  
forward direction  
outside lane**



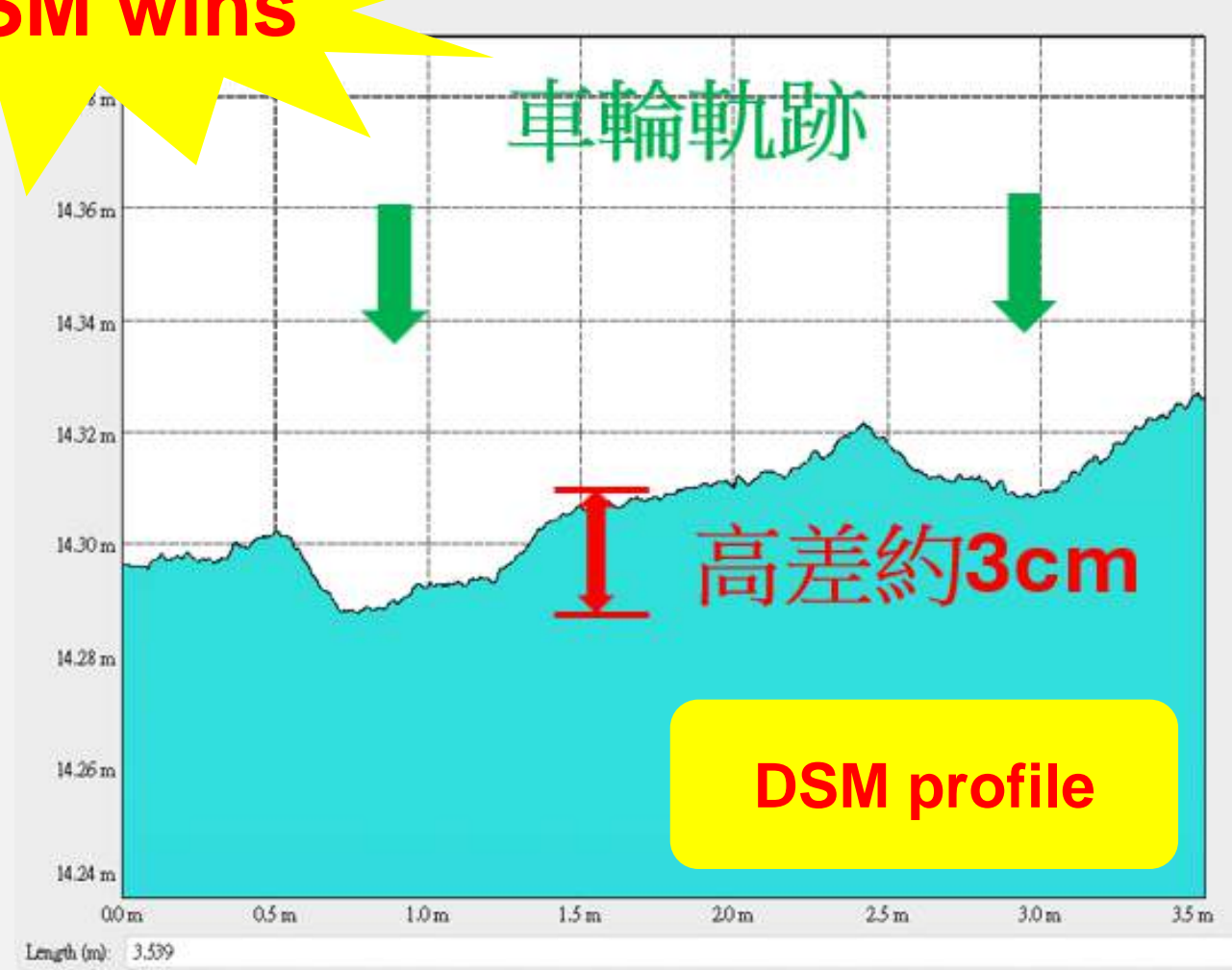
**AI recognition**



# Provincial Highway No. 61 - Rutting



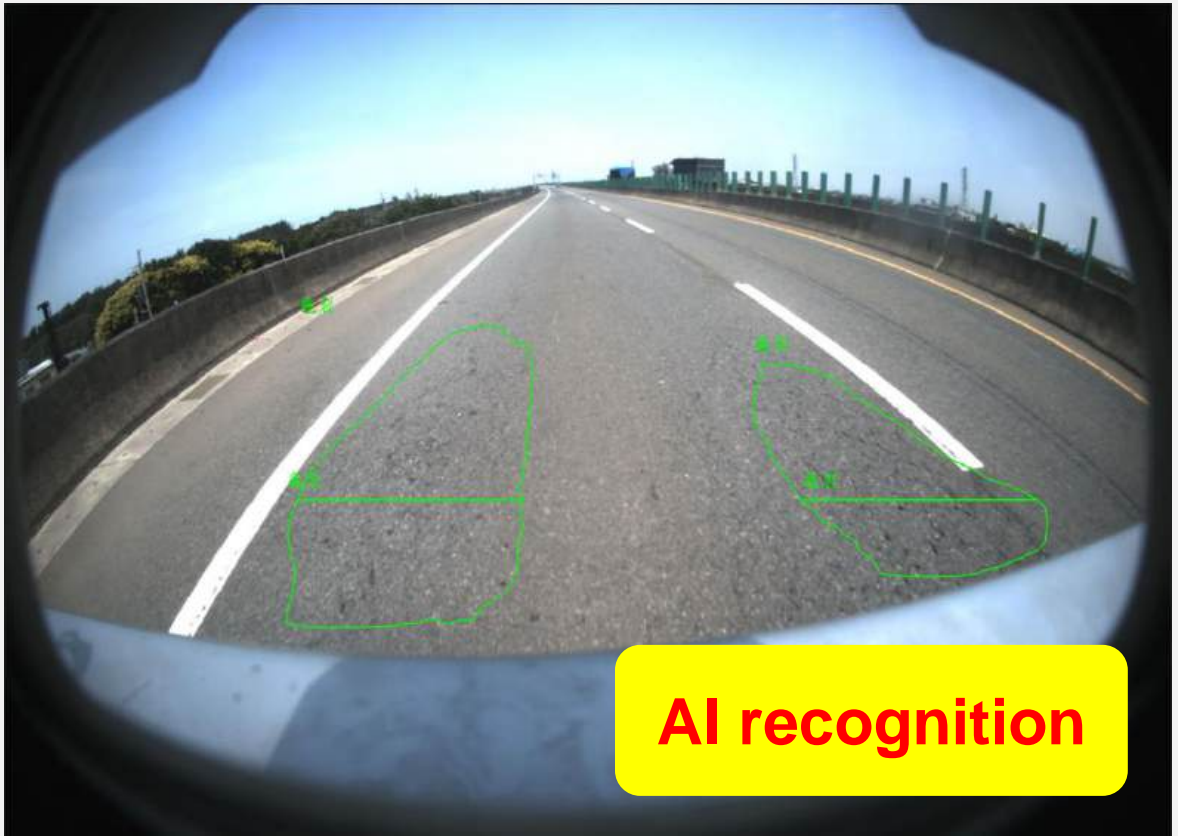
**DSM wins**



# Provincial Highway No. 61 - Cracks



**48K+800**  
**forward direction**  
**outside lane**



**AI recognition**

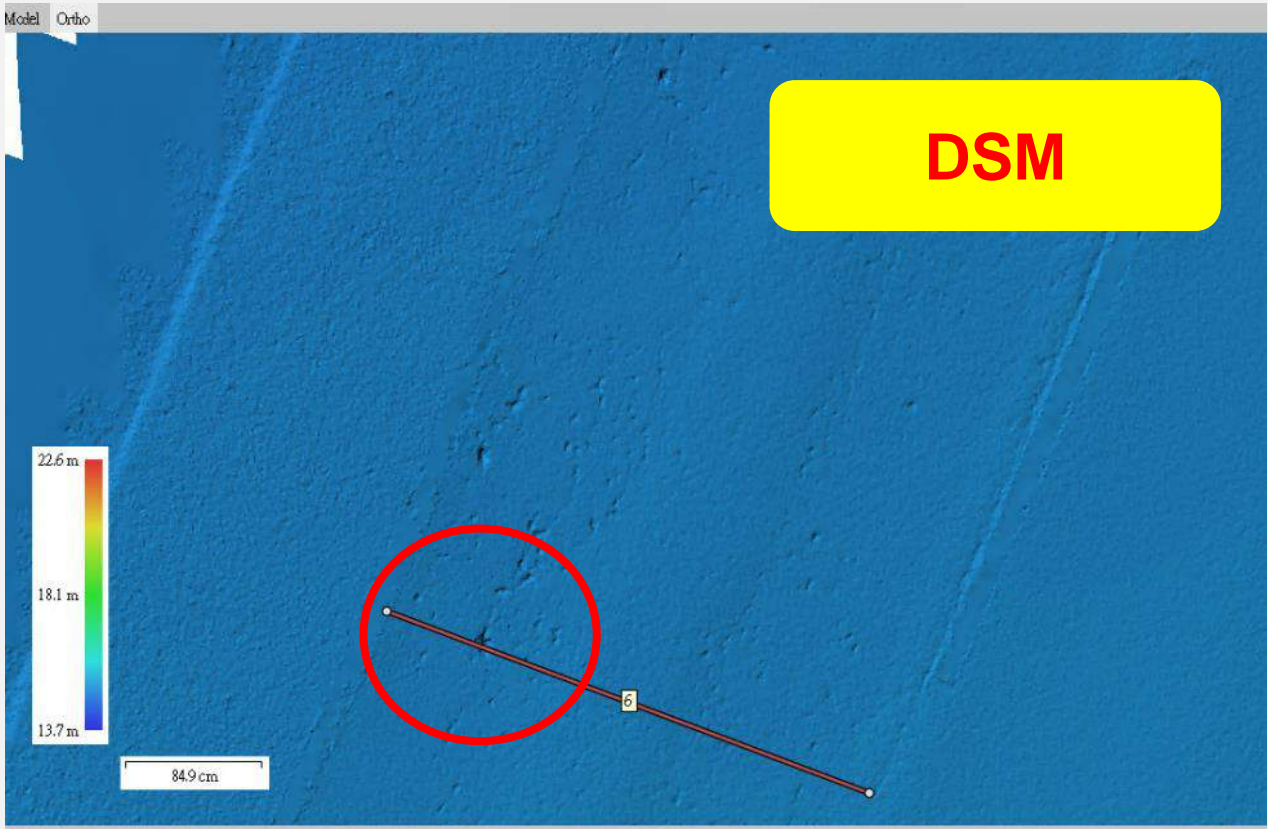
基礎 73.55  
程機 95.21

100  
100

圖徵 值

圖徵	值
道路區塊	
Name	台61線
(資訊)	
(動作)	
Name	台61線
area	322 700
chainage	48K+800
lanes	2
direction	順向
ogr_fid	3893
補滿100後...	台61線
補滿100後...	322.7
補滿100後...	48K+800
補滿100後...	2
補滿100後...	順向
補滿100後...	186
補滿100後...	台61線
補滿100後...	73.55

# Provincial Highway No. 61 - Cracks



# Provincial Highway No. 61 - Patching



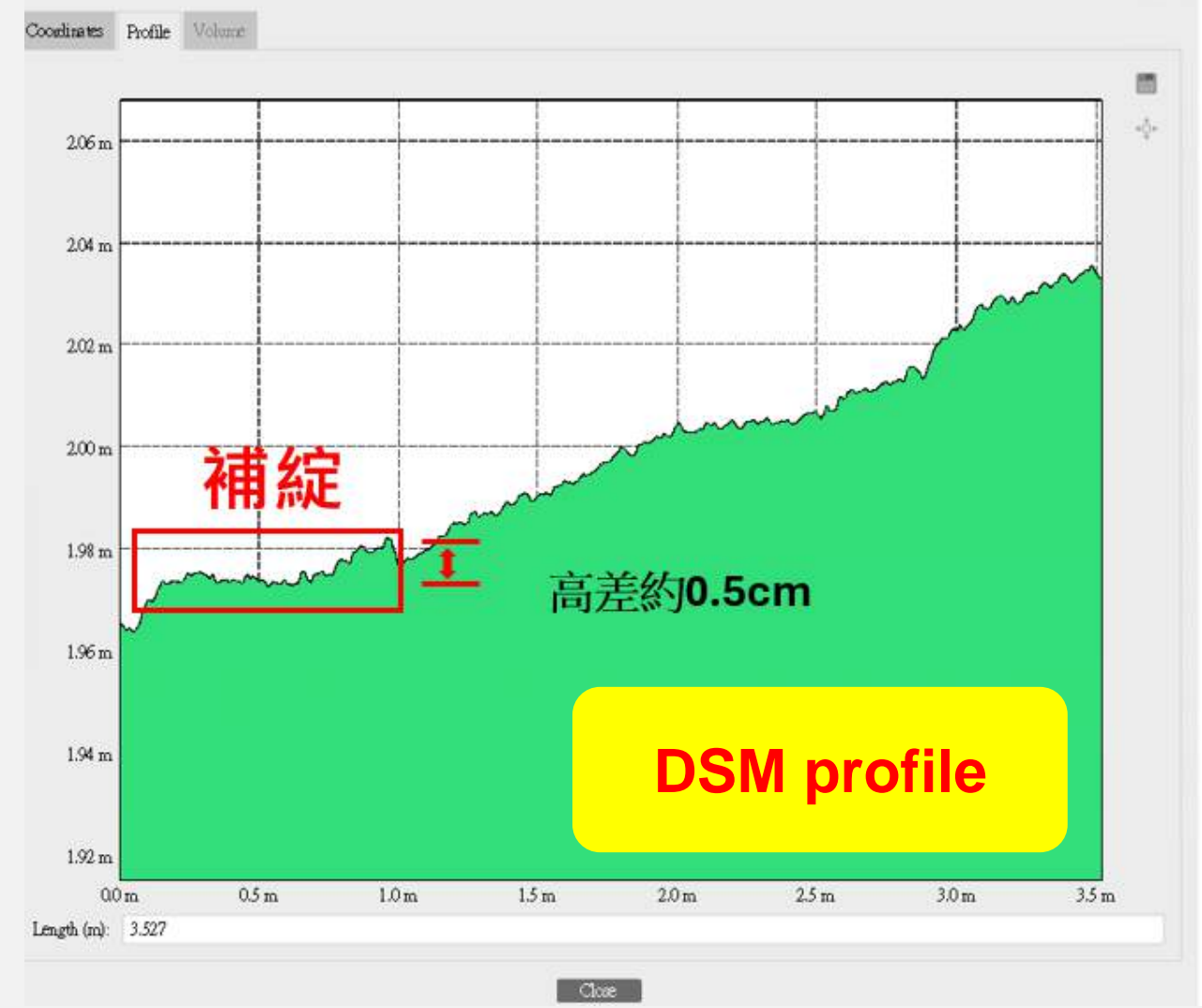
**69K+500**  
**forward direction**  
**outside lane**



**AI recognition**



# Provincial Highway No. 61 - Patching



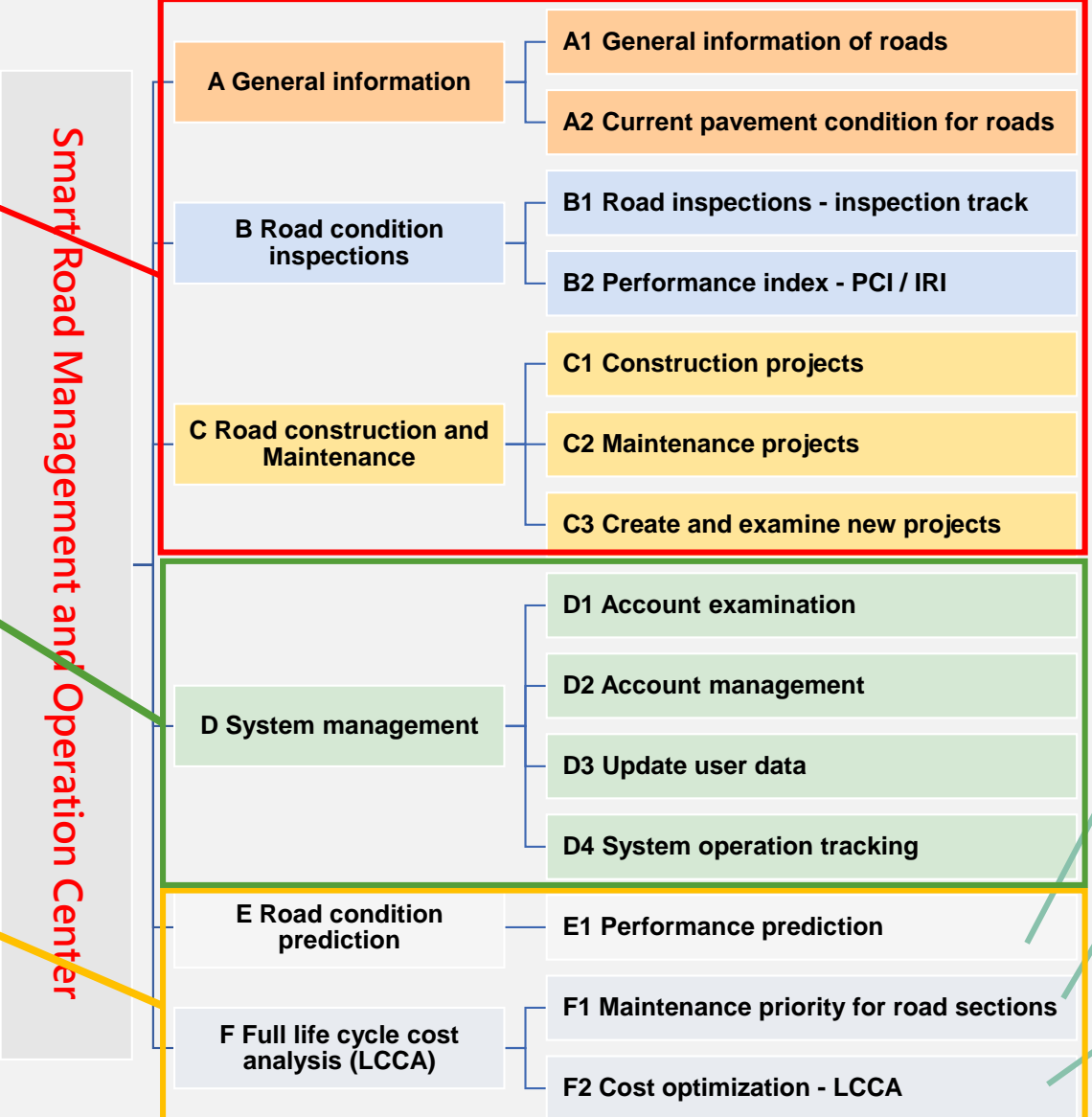
# Smart Road Management and Operation Platform



**General information**

**System management**

**Full life cycle management and analysis**



**E1 Road condition prediction**

**F1 Maintenance priority**

**F2 Cost optimization**



A1 General information of roads



A2 Current pavement condition for roads



B1 Road inspections - inspection track



B2 Performance index - PCI / IRI



C1 Construction projects



C2 Maintenance projects



C3 Create and examine new projects



D System management



F Full life cycle cost analysis (LCCA)



# Taipei City Project



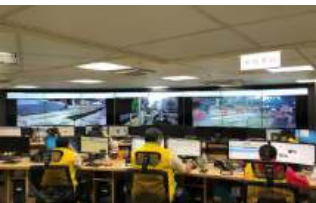
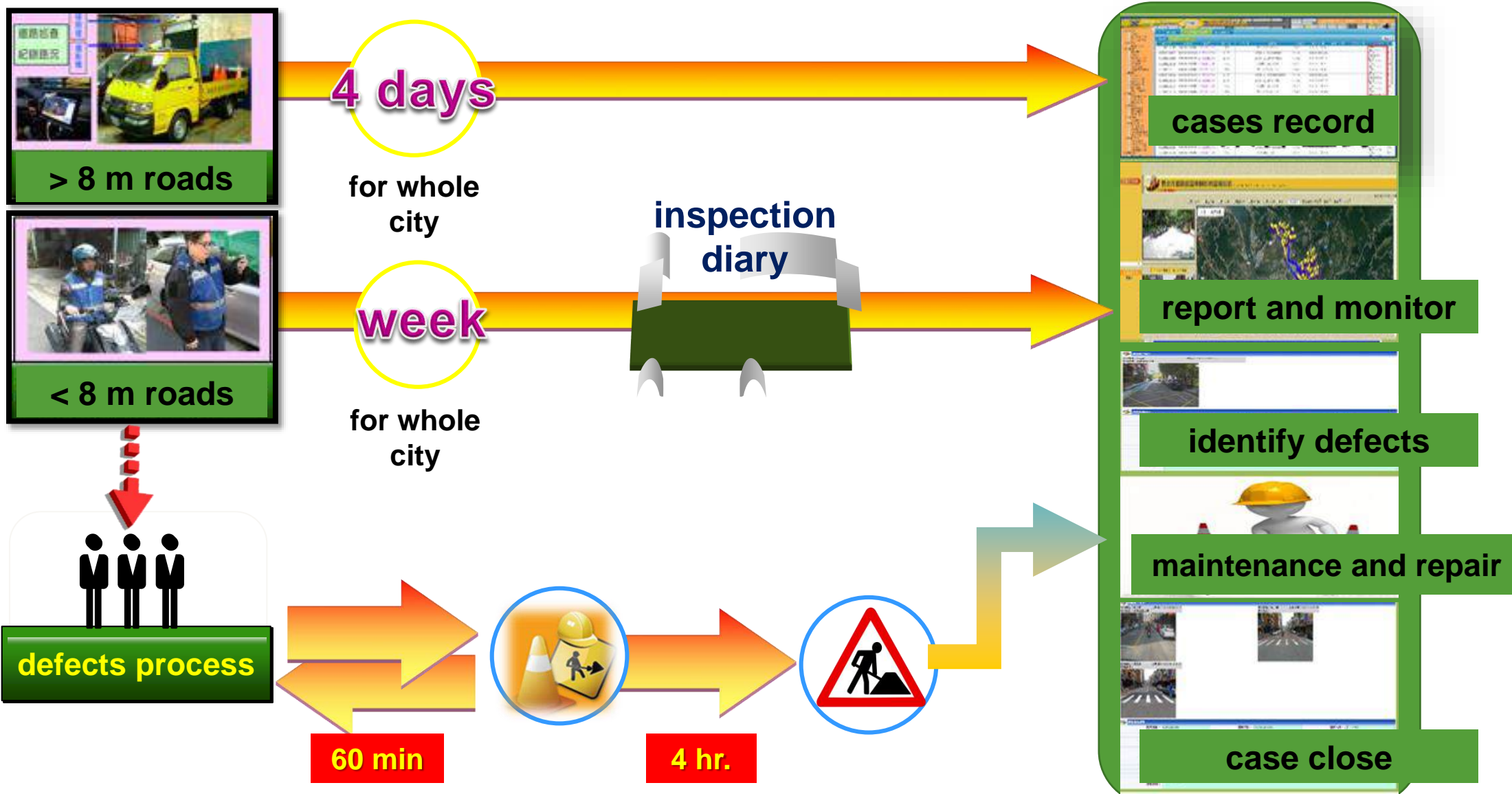
## Performance-Based Contract (PBC) for Road Inspection, Maintenance and Repair in Zhongshan District, Taipei City



- **Public sector:** Reduce regulatory pressure, improve governance quality, provide quality roads
  - **Contractor:** Loosen traditional technical (specification-based) contracts, provide with flexible execution, independently introduce new materials and new construction methods, develop new equipment and new achievements
  - **The public:** The public and contractors become partners and serve as the backing of contractors
- ➔ Public-Private Partnership: Win-Win-Win**



# Road Maintenance Operations in Taipei City



**report to Taipei Road Excavation Management Center (REMC) 10 min**



**> 8 m roads**



**< 8 m roads**

**4 days**

for whole city

**week**

for whole city

**inspection diary**

**defects process**

**60 min**

**4 hr.**

**cases record**

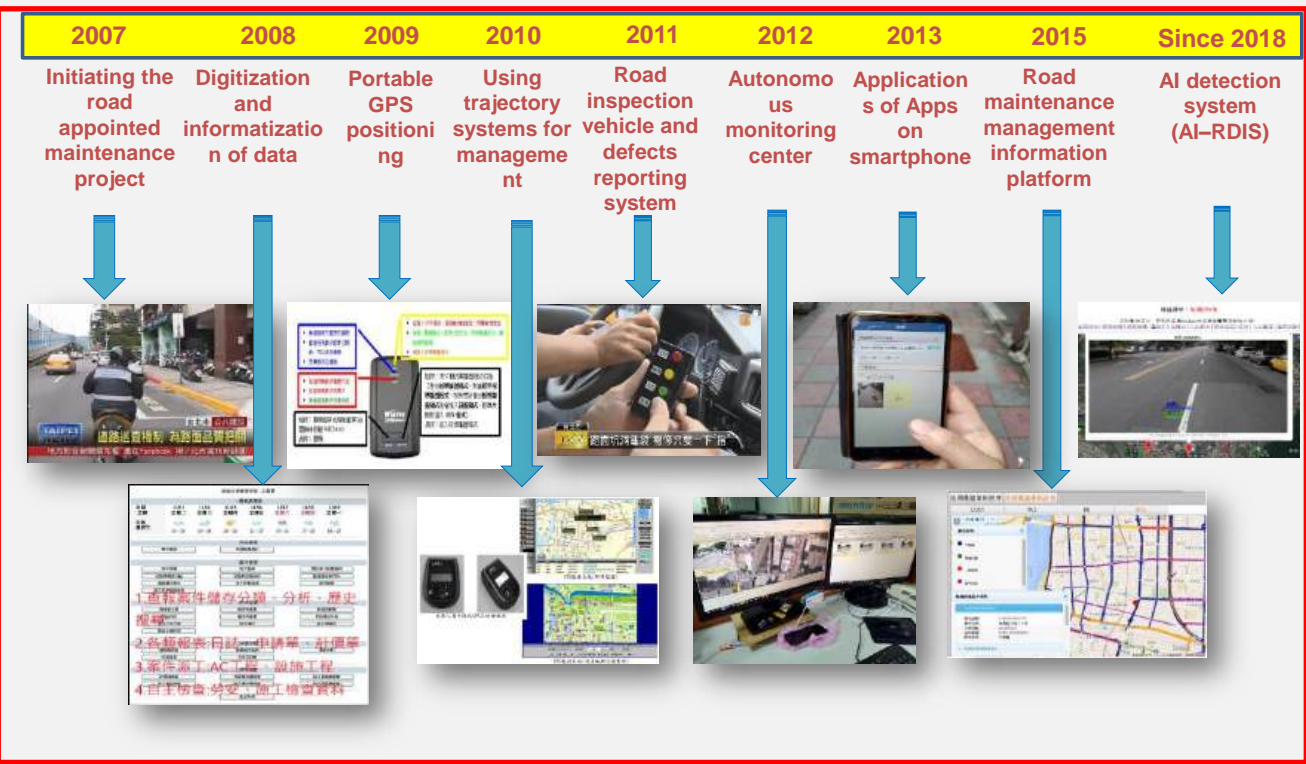
**report and monitor**

**identify defects**

**maintenance and repair**

**case close**

# Evolution of Road Inspection Equipment



数值地形模型 正射影像  
 微小坑洞检测  
 深度2公分  
 六公分高差  
 32 m, 8.6 m, 26 m, 11.5 m, 30.90, 30.82, 30.84, 30.90



# AI Technology to recognize distresses



# Visualization of Road Conditions



地圖
衛星檢視

- Potholes
- Cracks
- Alligator cracks
- Potholes
- Planned inspection routes
- Actual inspection routes

案件編號：1569927

報案種類：車巡查報

案件類別：縱橫裂縫

地址：0

查報時間：2019/06/14






**臺北市視覺化管理平台**



此路段資料

編號	017856
經度	121.56814
緯度	25.038197
類別	路障
報案時間	2019/06/14
狀態	待處理

路段改善進度統計

10%	20%	30%
-----	-----	-----

路段改善進度

10%	20%	70%
-----	-----	-----

路段改善進度

200W	210W	218W
------	------	------

**臺北市視覺化管理平台**



此路段資料

編號	COM23-05-02-5
類別	路面裂縫
面積	38.02m²
長度	26.1m

路段改善進度統計

8%	3.2%	1.8%
----	------	------

路段改善進度

7%	4.3%	2%
----	------	----



# Thank you for your attention



社團法人中華鋪面工程學會  
Chinese Society of Pavement Engineering



聖東營造股  
份有限公司



日陞空間資訊  
股份有限公司  
SUNRISE GEOMATICS CO.,LTD.



超鉞科技股  
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