47th ASECAP Study & Information Days

Tomorrow's Mobility….is here Today

House of Events, Westin Business Hotel, Costa Navarino, Greece

29-31 May 2019

PROTECTING THE WEALTH OF BRIDGES

(From a Bridge Engineer's perspective)

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PROTECTING THE WEALTH OF BRIDGES
(From a Bridge Engineer's perspective)

1. *Preamble*

Bridges constitute an asset of crucial importance in practically all transportation networks.

When bridges fail to satisfy the requirements of safe traffic the results have a considerable functional and economical impact on the network which at cases can turn into life losses and economic catastrophe.

As the average age of bridges in Greece is 35 to 40 years, the aging infrastructure is expected to deteriorate faster in the coming decades particularly under the increasing operational demands.

2. *What is threatening the performance of our bridges?*

Bridge performance is impaired by a number of factors of various nature:

- Design errors and omissions
- Construction flaws
- Misusage (e.g. allow overweighed trucks without special measures)
- Natural aging of materials due to environmental actions (corrosion, carbonation)
- Accidental actions (hydraulic erosions, collision, fire, earthquake)
- Inadequate or totally missing maintenance

Under the accumulation of so many adverse factors damages of varying extent and importance will eventually occur.

Safeguarding the performance of bridges against the above threats can be achieved by:

- Implementing **Life Cycle Planning** (LCP) and
- Employing an effective **Bridge Management System** (BMS)

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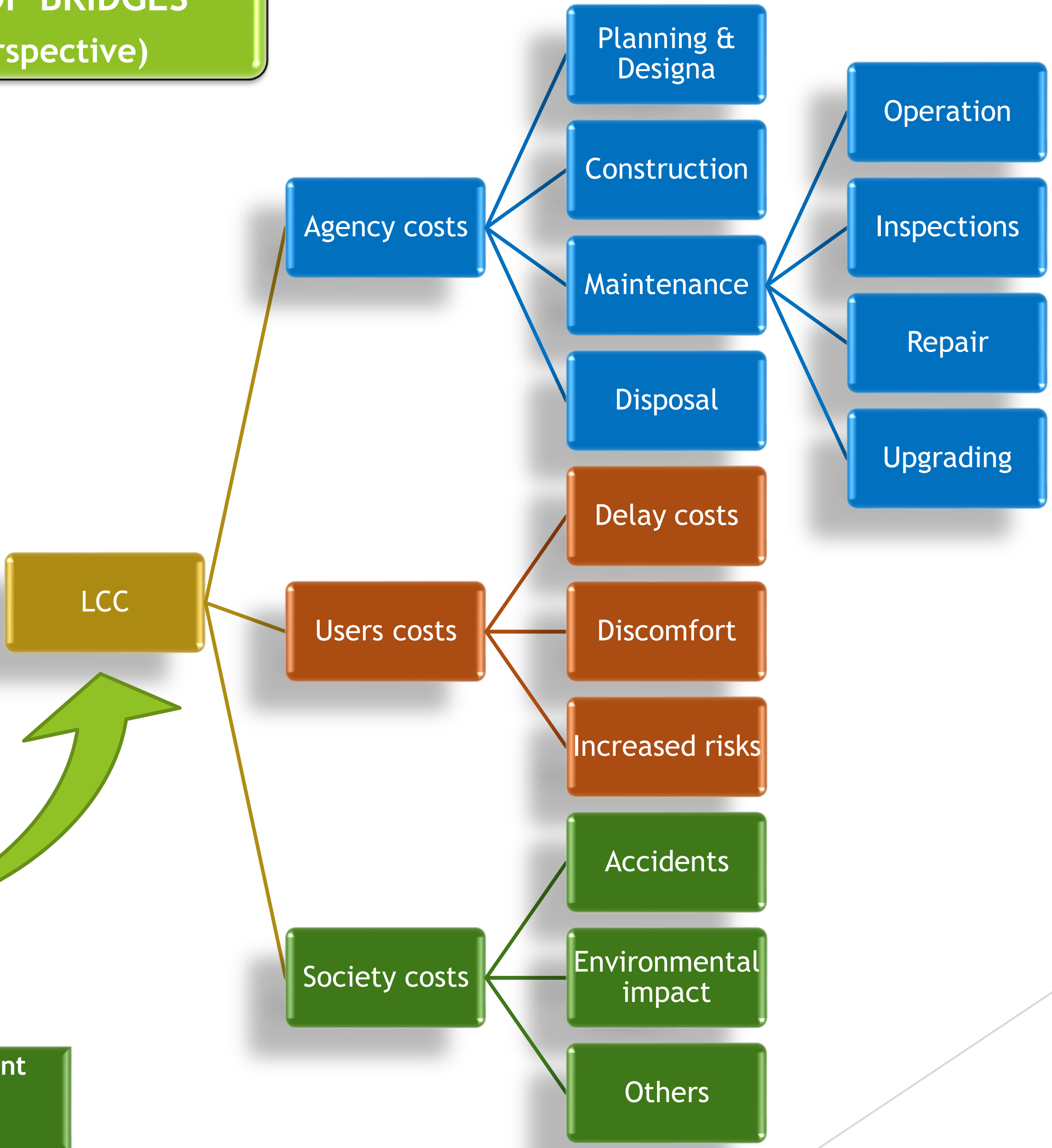
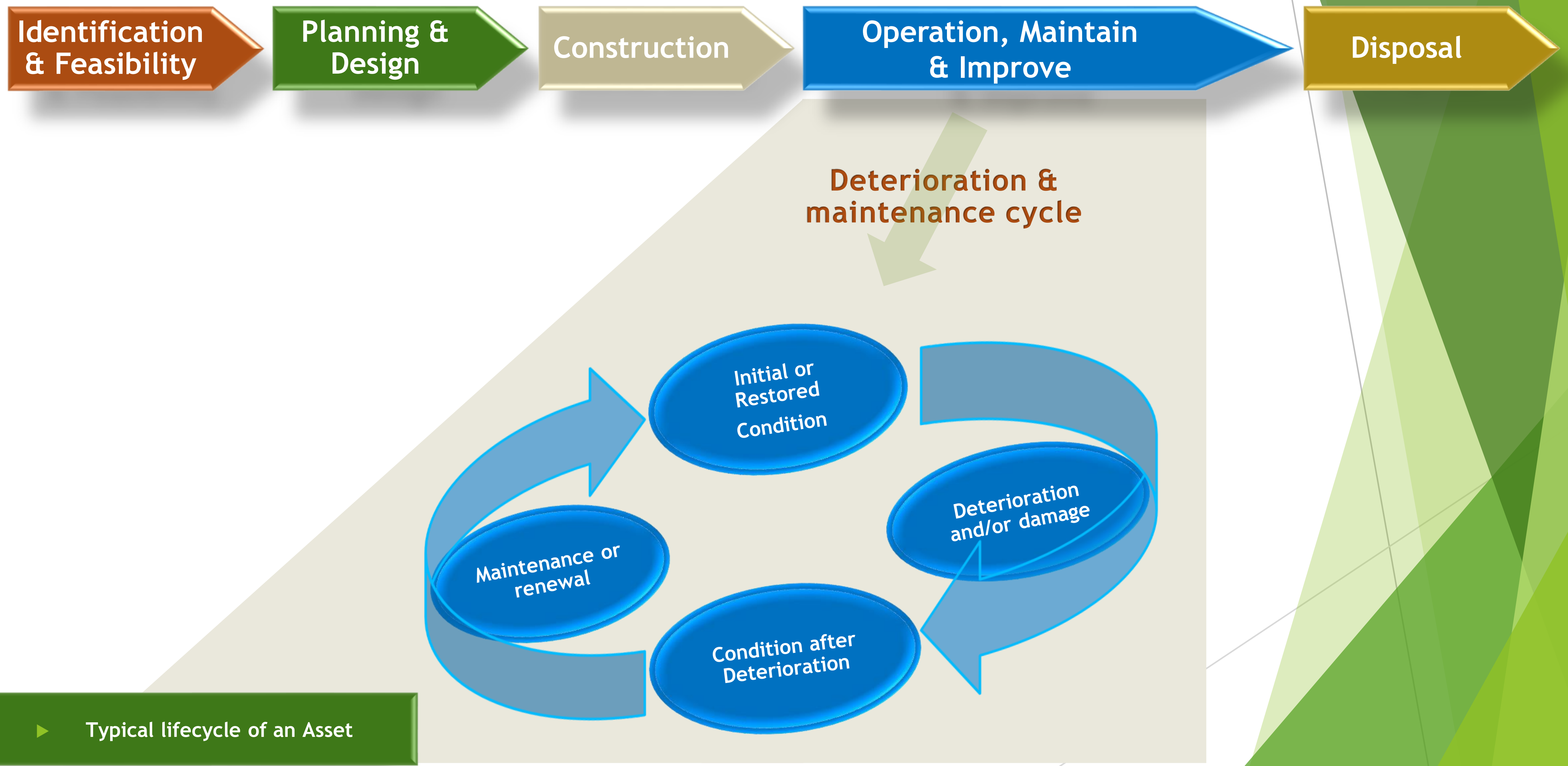
3. *Life cycle planning*

Long term strategy and systematic process of operating, maintaining and improving the asset of bridges planned to achieve and sustain a desired level of performance over the life cycle of the asset while minimizing the whole Life Cycle Costs (LCC).



Schematic presentation of the different items in a complete LCC analysis

In-depth understanding how a bridge is likely to behave/deteriorate is fundamental to bridge management. The typical lifecycle of a bridge is as shown below:



- Typical lifecycle of an Asset

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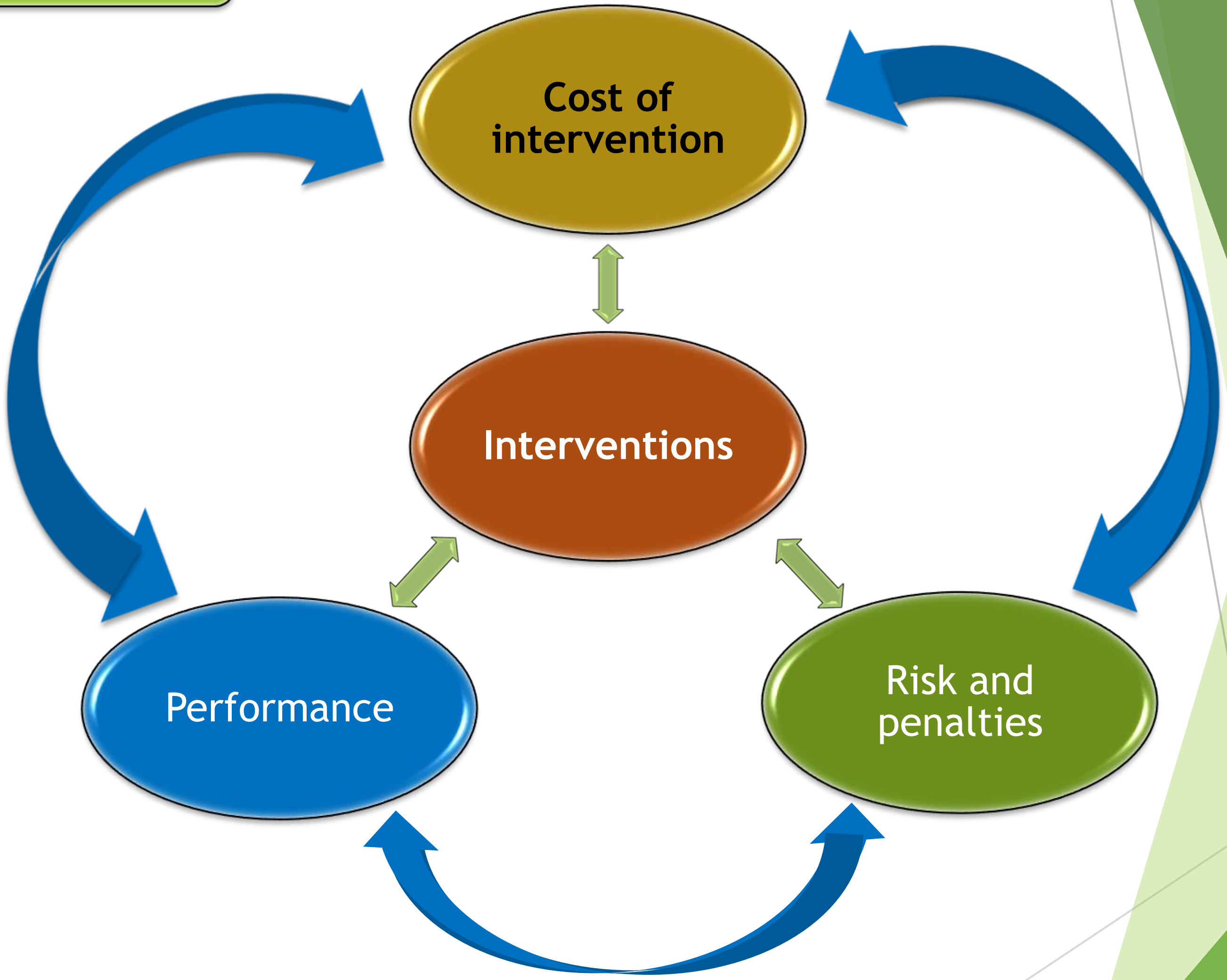
For already in service bridges the deterioration-maintenance part of the cycle is of outmost importance.

Issues to be considered:

- Expected deterioration mechanisms and rates
- Intended service life and required performance levels
- Type timing and intervals of maintenance activities
- Cost of maintenance activities and service disruption
- Safety of maintenance crew and public in general
- Impacts on the wider social community

Understanding the relationship between the lifecycle planning components "Risk – Cost – Performance – Intervention" is of crucial importance.



- Balancing Risk, Performance, Cost and Interventions

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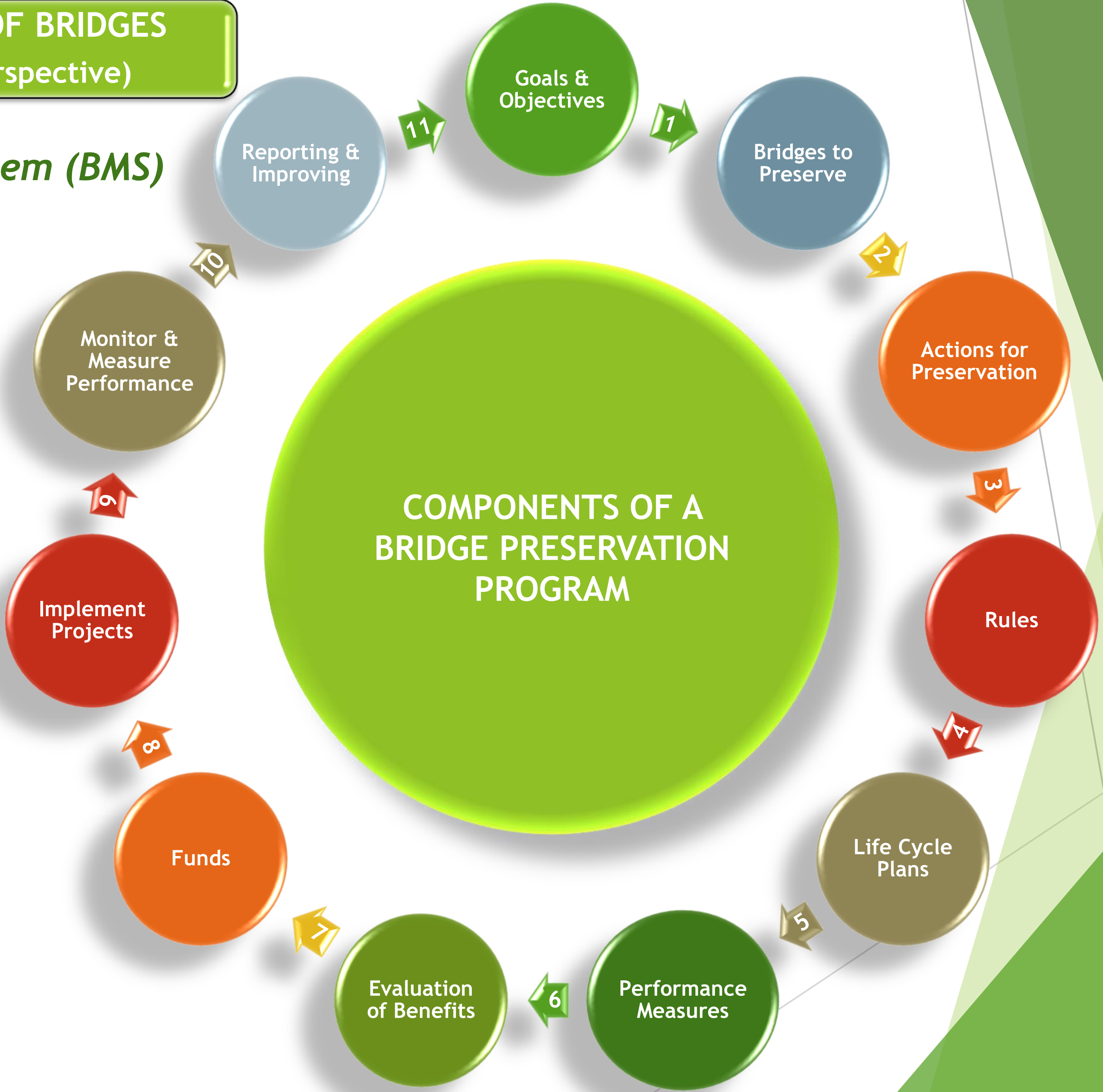
4. *Bridge Management System (BMS)*

A multi component data basis which (in simple words) enables the bridge Manager:

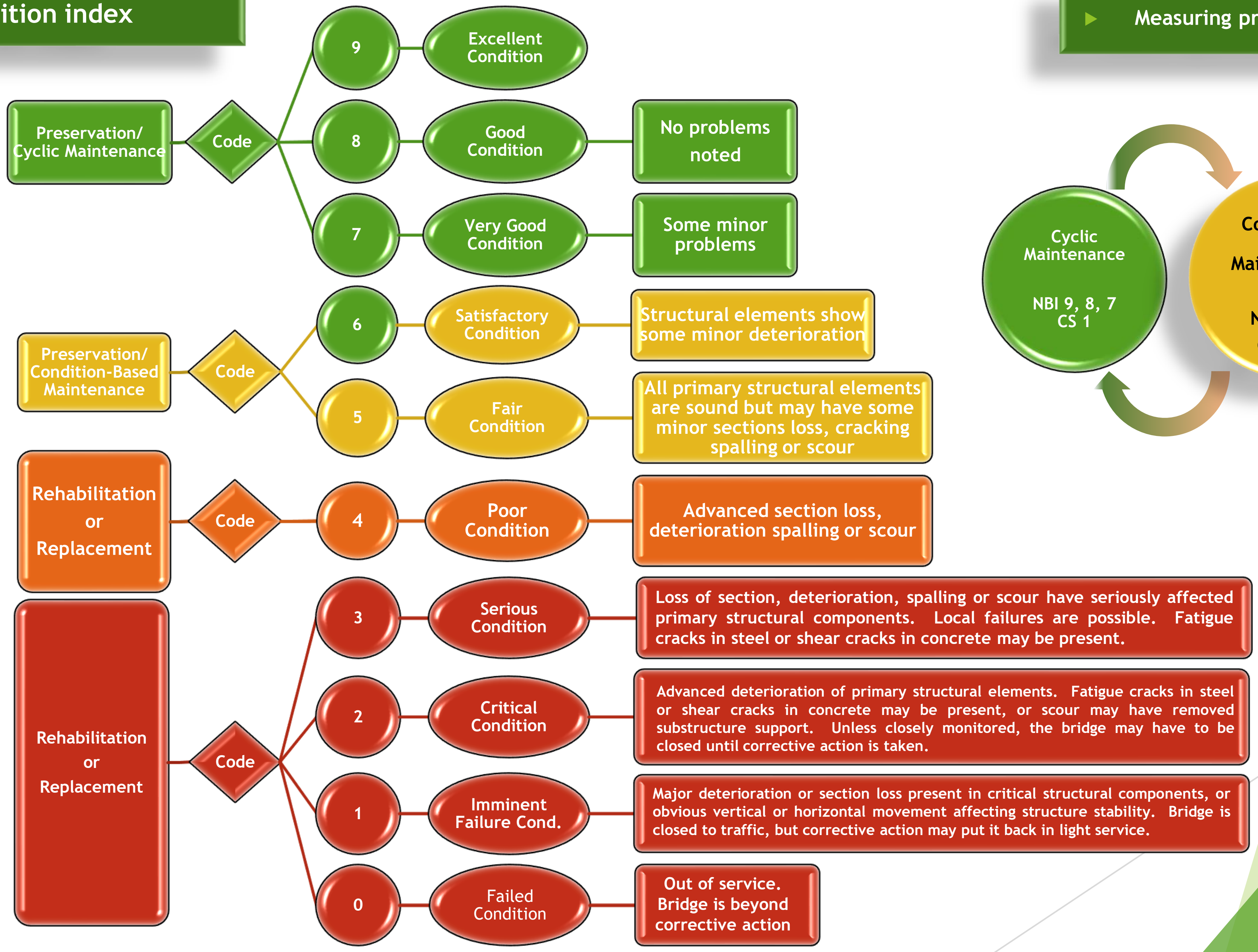
a. be fully informed of the health of "his" bridges

b. be able to decide where to spend "his" funds in the most efficient way

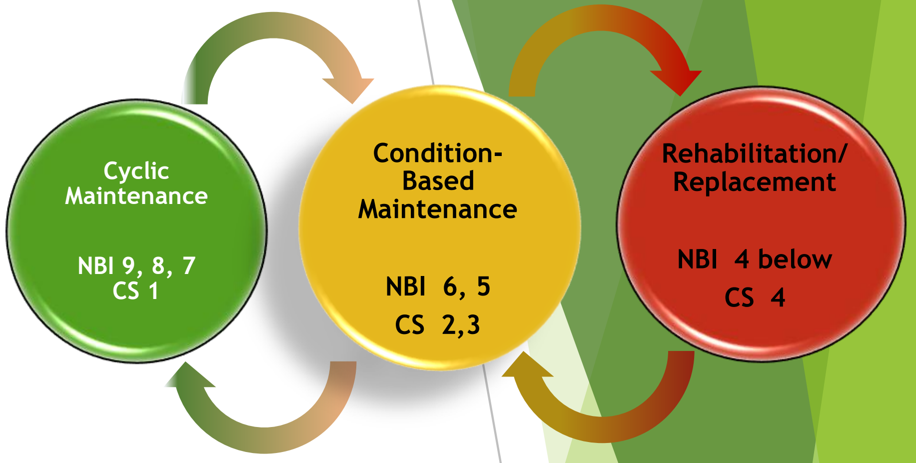


- Steps for establishing a bridge preservation program

Condition index



Measuring preservation performance



5. *Proactive bridge maintenance*

Typically comprises a combination of:

a. Bridge inspections

Provide a snapshot of the bridge condition at a certain point in time

b. Static loading tests

Normally not exceeding SLS

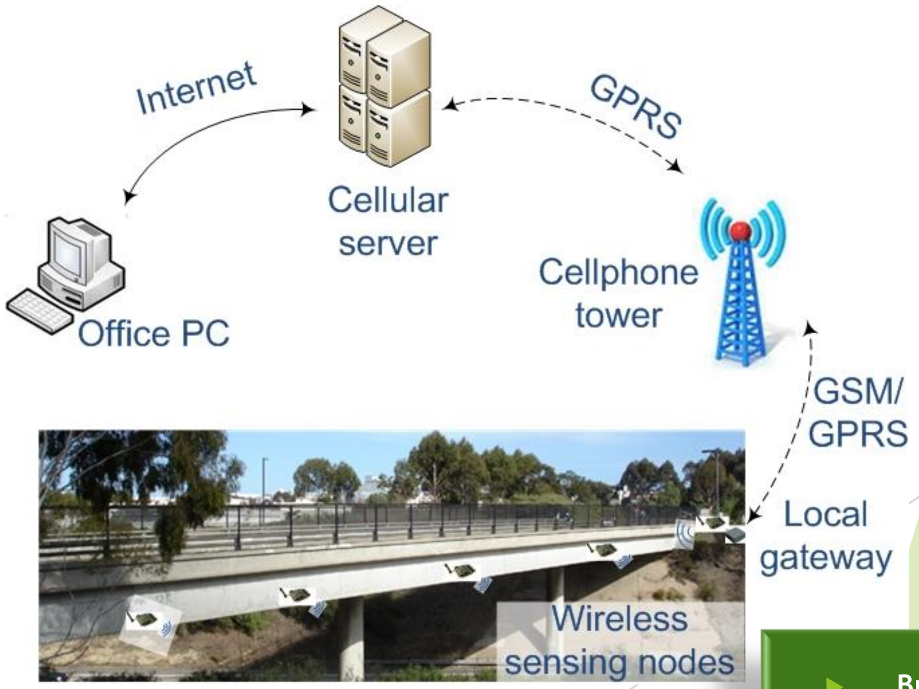
c. Structural Health Monitoring (SHM)

Continuous monitoring helps to gauge the performance and acts as a warning device in case an unusual behavior is recorded.

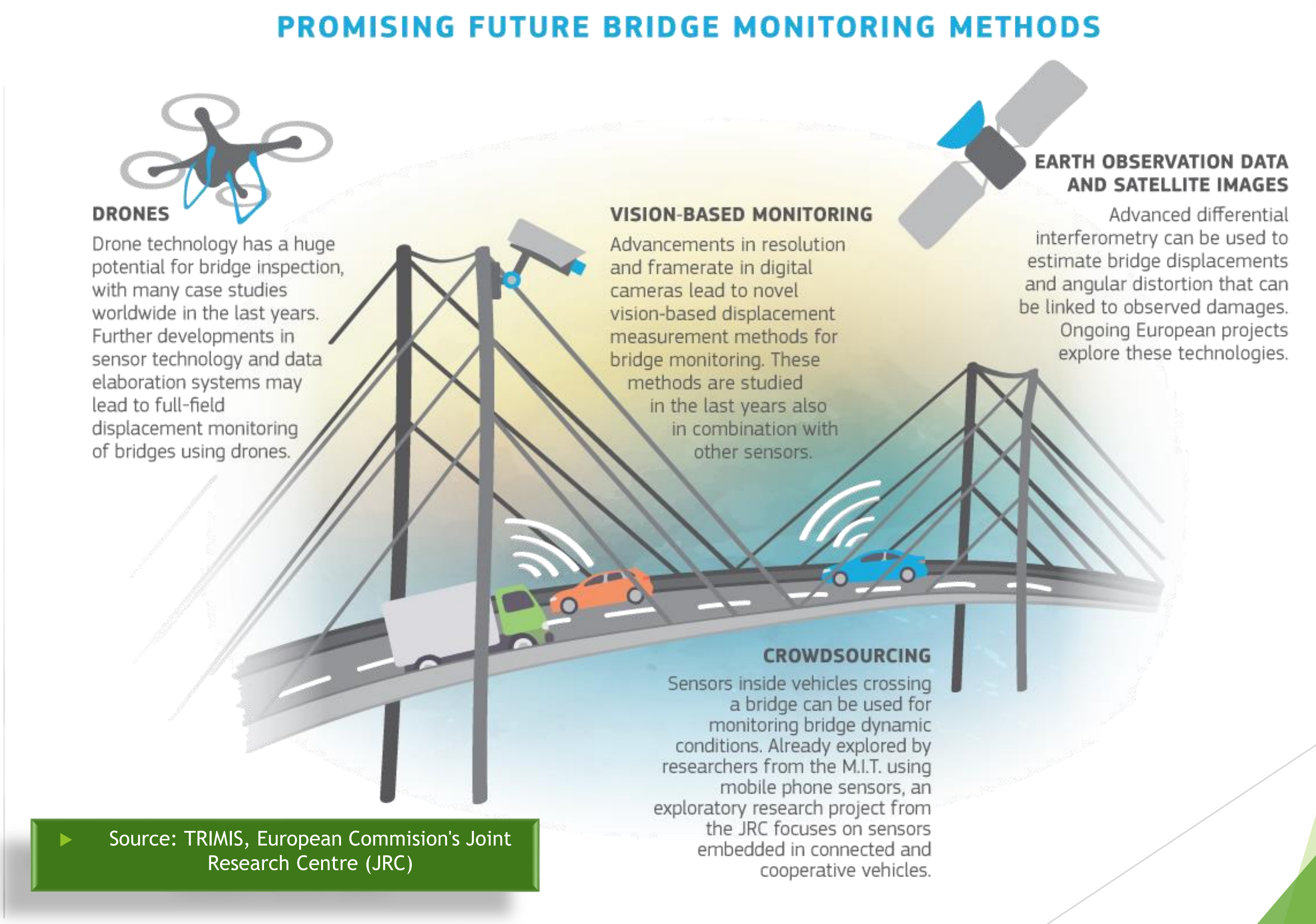
Information can be obtained under service include loading and/or ambient vibrations :

- Deck deflection
- Stress levels and variation
- Change of level (settlement)
- Dynamic characteristics
- Corrosion rates and crack widths

SHM is presently an expensive methods and usually confined to large important bridges



- Bridge performance surveillance



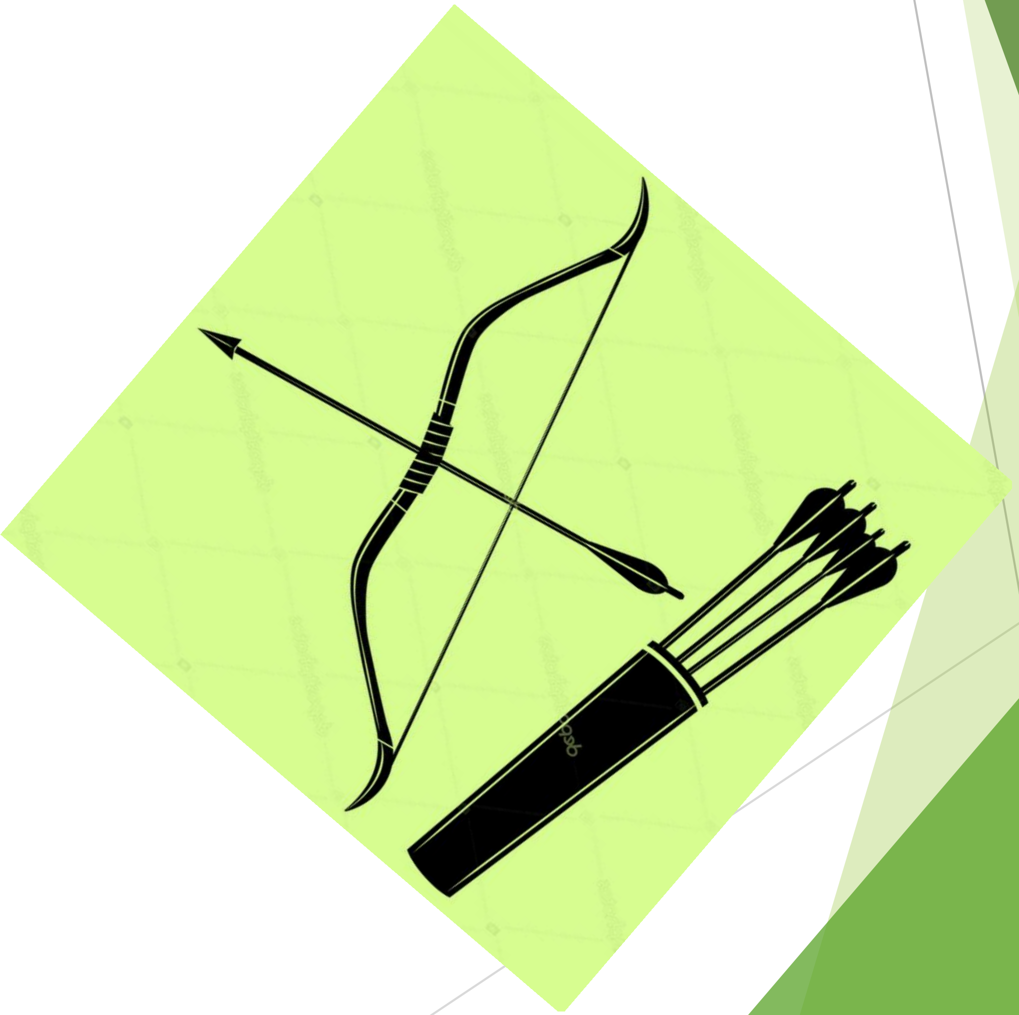
- Source: TRIMIS, European Commision's Joint Research Centre (JRC)

6. Reactive maintenance

In striving to achieve sustainable bridges great help is offered by:

a. Code compliant (EN 1504) and certified materials
   - Repair grouts
   - Corrosion prohibitors/inhibitors
   - Penetration reducing admixtures (PRA) and
   - Protective painting

b. Performance proven methods
   - Use of UHPC
   - Jacketing (concrete or FRP)
   - External posttensioning
     - **standard tendons**
     - **non-metallic tendons**
   - Cathodic protection
   - Seismic isolation



THANK YOU
FOR
CHERISHING BRIDGES

This presentation is associated with the cluster of actions
currently underway in Greece to establish the State Authority for Bridges