TRANSPORT INFRASTRUCTURE IRELAND

Circular Economy

and Application to IAPDM Pavement Design

Local Authorities Seminar
TII Network Management January 2021

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The Importance of the Circular Economy

To Ireland and the EU

European Union

- 90% of biodiversity loss and 50% carbon emissions are associated with resource extraction and production.
- A **climate law** committing the EU to net-zero emissions by 2050.
- Finance for a **'Just transition'.**
- **Empower consumers** – a true 'right to repair'.
- **Focus** on the sectors that use the most resources and where the potential for circularity is high, which **include construction and buildings.**

Ireland

- Implementation of the Waste Action Plan for a Circular Economy.
- Ensure that public procurement leads the transition to the Circular Economy through an evidence-based approach such as relying on Environmental Product Declarations.
- There is a need to plan for C&D materials management at the earliest possible stage in a construction project, ideally at concept stage.

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What is the Circular Economy?

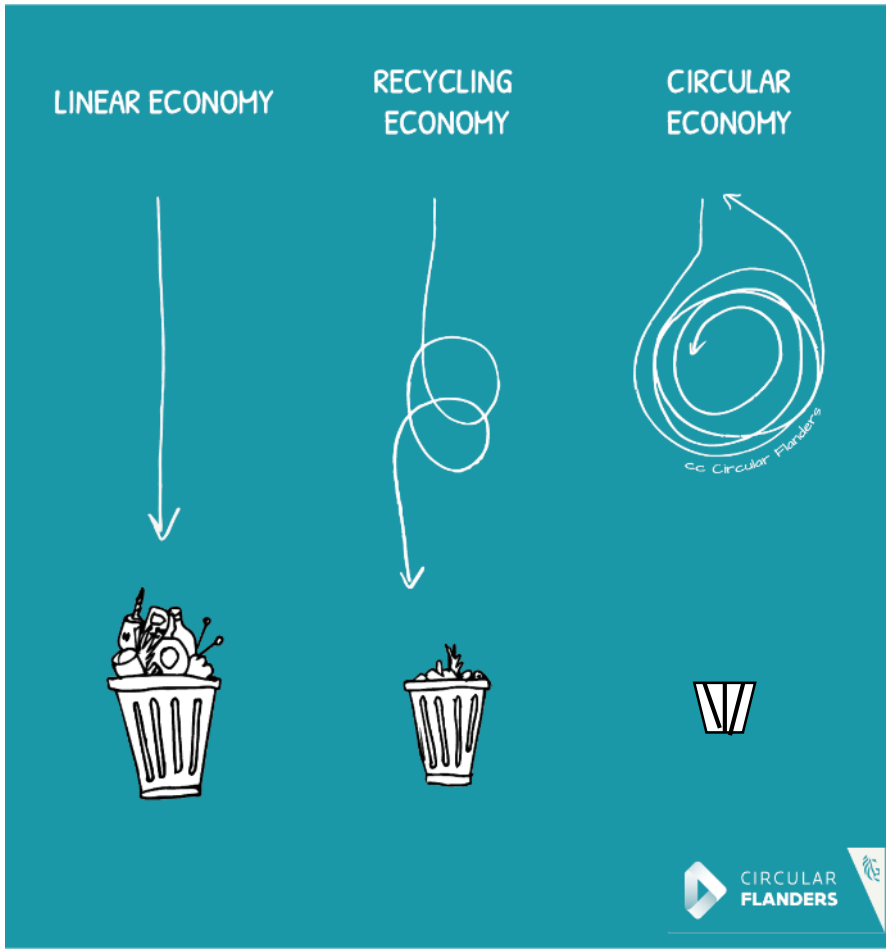

Image adapted for this presentation from Circular Flanders original.

- Regenerating natural systems
- Keeping products and materials in use
- Designing out waste and pollution

" A Circular Economy is one that is restorative and regenerative by design"

- Ellen MacArthur Foundation

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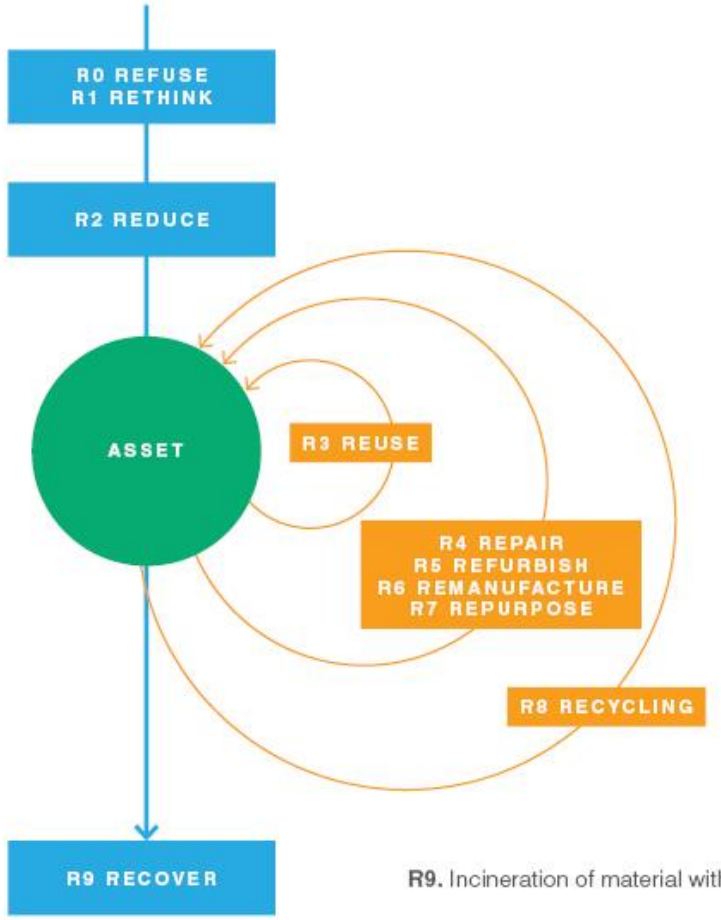
The 9R Categorisation of Circularity

INCREASING CIRCULARITY

R0. Make the asset redundant by making it's function unnecessary. For example compact growth reduces the demand for transport and makes active travel and public transport easier to provide eliminating the need for private cars when compared with dispersed growth

R1. Make the asset use more intensive. (eg by delivering the demand for transport in shared vehicles and in particular buses)

R2. Increase efficiency in asset manufacture or use by consuming fewer natural resources and materials



R3. Reuse by another asset or organisation of discarded asset which is still in good condition and fulfils its original function

R4. Repair and re-manufacture of defective asset which is still in good condition and fulfils its original function

R5. Restore an old asset and bring it up to date

R6. Use parts of discarded asset in a new asset with the same function

R7. Use discarded asset or its parts in a new asset with a different function

R8. Process materials to obtain the same (high grade) or lower (low grade) quality

R9. Incineration of material with energy recovery

Adapted from Rijkswaterstaat

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Circular Business Models

The Value Hill

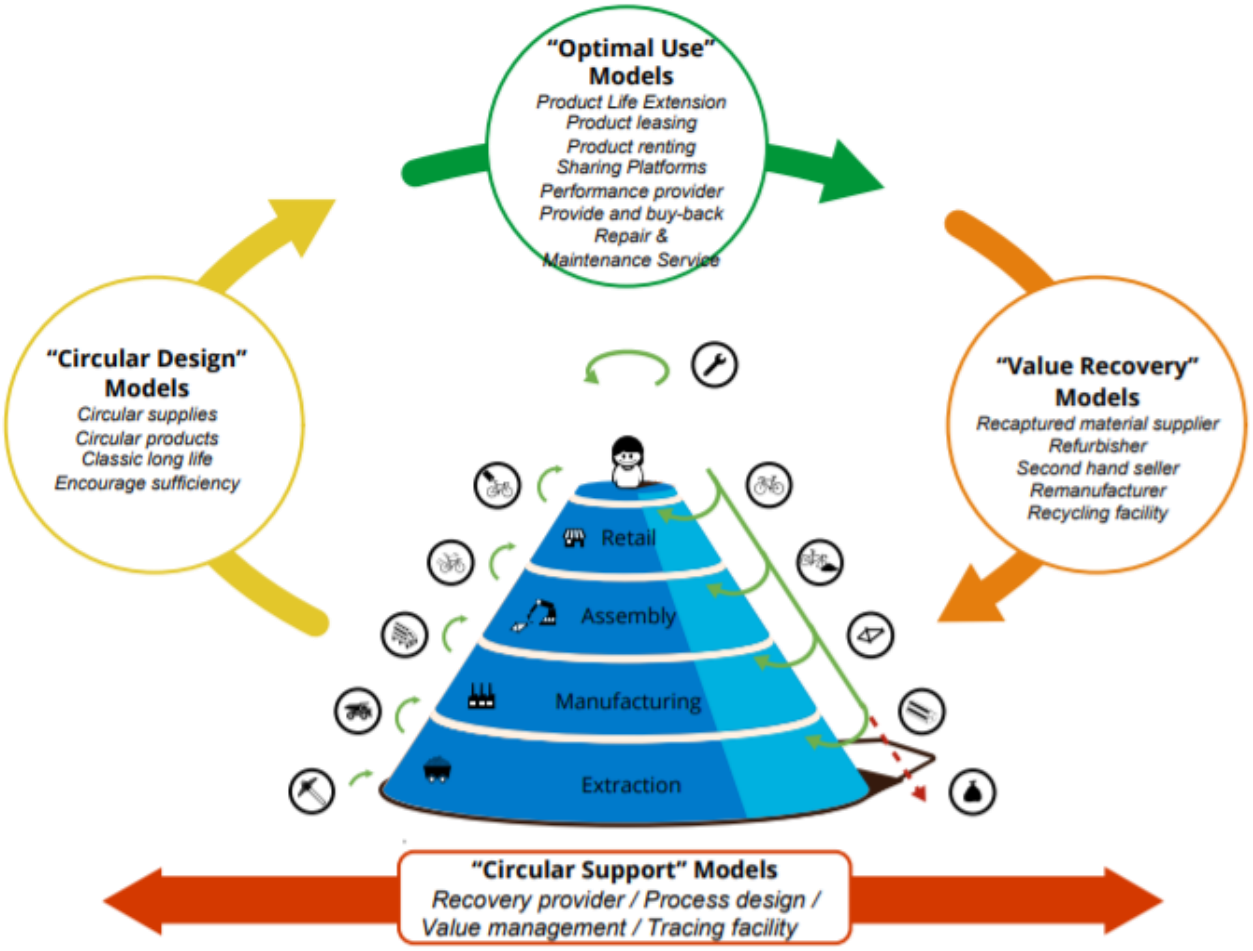

Image credit: Elisa Achterberg, Jeroen Hinfelaar, Nancy Bocken (2016). The Value Hill Business Model Tool: identifying gaps and opportunities in a circular network

The Benefits of the Circular Economy

VALUE CAPTURE
Social, environmental and economic value are optimised. Value capture and reducing consumption of natural resources will result in cost savings to TII compared to the linear approach.

RESILIENCE
Future proofing against supply chain shocks, against a carbon constrained economy and unexpected disruption

BIODIVERSITY
Regeneration of natural systems contributes to a biodiverse environment and reinstation of self-sustaining systems. 90% of biodiversity loss and water stress come from resource extraction and processing.

ZERO-CARBON
50% of carbon emissions result from resource extraction and processing. Minimising the carbon footprint of roads and rail will not only cost less, but also reduce infrastructure contribution to climate change.

REDUCED EVIRONMENTAL IMPACT
Reduction of negative externalities. Place responsive design that is visually appropriate and enables vital and economic activities.

INNOVATION
Innovation and pilot projects are a key aspect of circular economy implementation, in challenging the supply chain and implementing new business models.

REDUCED CONSUMPTION OF UNSUSTAINABLE RESOURCES
Global material consumption is expected to double over the next forty years. The construction sector is responsible for over 35% of the EU's total waste generation.

REDUCED REGULATORY AND PLANNING RISK
Implementation of a circular economy strategy will reduce waste generation from projects, close loops and reduce planning risk. Waste infrastructure in Ireland is operating at capacity.

ENERGY EFFICIENCY
Reducing energy demands for schemes and operating systems and the costs that come with this. Transition to responsible energy consumption adds to value capture and reduces climate change impacts.

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Procurement

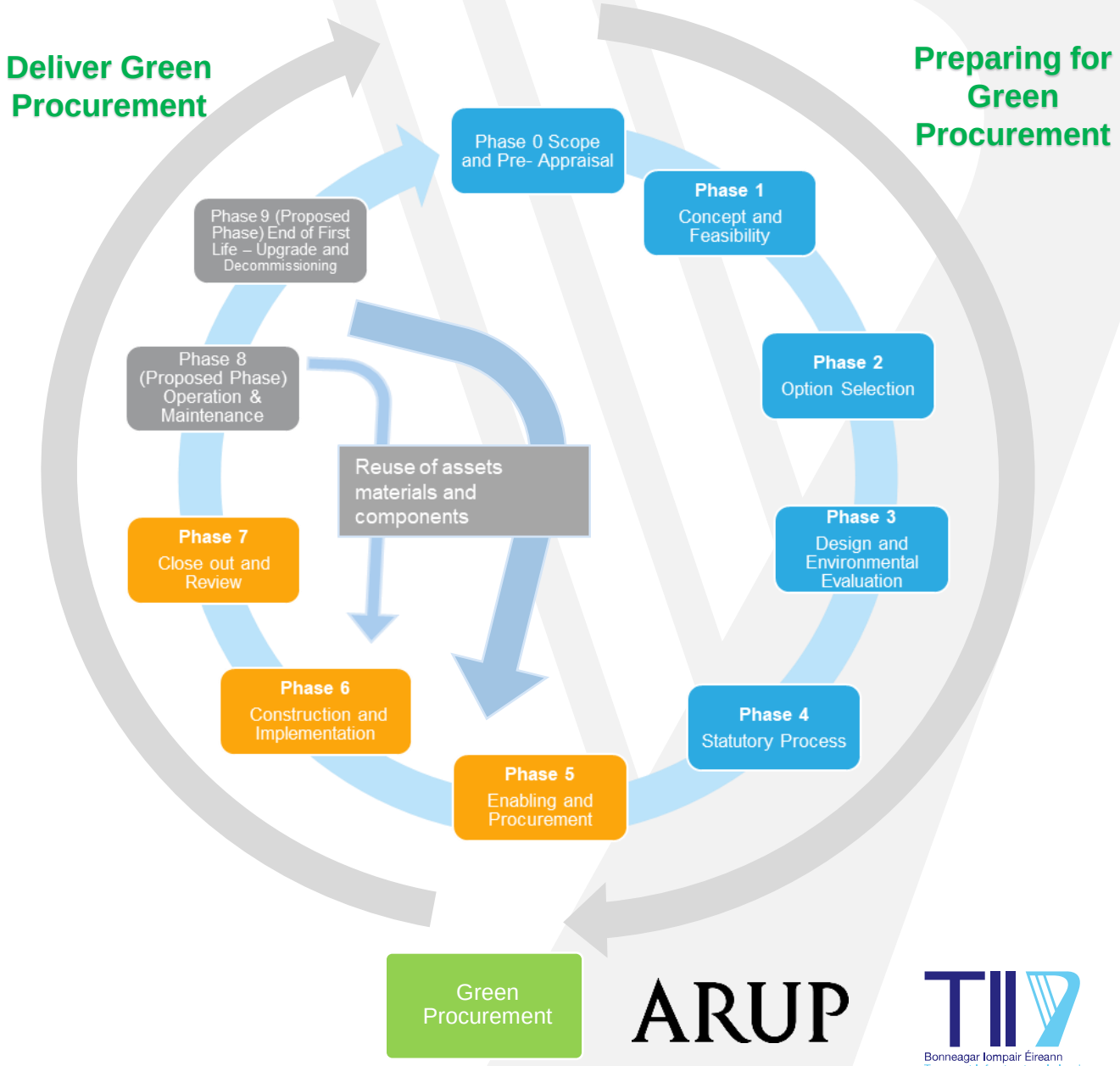
Summary of Findings

OPPORTUNITIES

- Ensure asset optimisation is considered at project outset where there is an existing asset.
- The use of whole life costing in procurement to include environmental and social criteria is permitted if these are clear and transparent
- Pilot projects can be used for roll out of circular economy initiatives and then scaled up to other projects.
- Service models e.g. roads as a service could be adopted to incentivise the industry to provide long-lasting and replaceable, refurbishable products.

BARRIERS

- Cost is currently the main consideration in tendering and budget as opposed to value and investment.
- Time constraints and budget of procurement process. Taking account of whole life cost and treating assets as an investment is likely to be financially beneficial.



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TII Workshops

Overview of Outcomes

Re-engineering of Systems

Ensure asset optimisation is considered at outset of projects. Implement layers design concept, to enable design for deconstruction and ease of maintenance to lengthen asset life.

Asset Management

TII as an asset management organisation through mindset change and re-engineering.

Procurement

The use of whole life costing in procurement, taking account of environmental and social criteria.

Stakeholder Engagement

TII can engage with the supply chain and other agencies to influence UN SDG implementation and vice versa.

Life Cycle Assessment

Consider operation and maintenance at the early project phases. Use new/ appropriate models which strike a balance between economic and social costs.

Information and Materials Management

Gather asset management data to inform timing of (re) design, investments/ divestments etc. Material passport-type data gathering for assets, components and materials

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Implementation: Circular Economy Principles for Projects

Principles

- Design for **longevity, adaptability and recoverability**
- **Minimise resource consumption** during construction, excavation, operation and end-of-life decommissioning of the asset.
- Asset, product or material **"Material Passport"** to aid deconstruction
- Compatible with **GIS** Systems
- **Planning & Regulatory** Compliance

Value to TII and Industry

- Evaluate **whole life costs** and **resource consumption**
- **Terms, conditions, governance** in relation to CE interventions
- Reduced **carbon** emissions.
- Provided at key project **phases: inception, planning and post construction handover** with increasing levels of detail and as built data provided as the project progresses
- **"Material Passports"** for Assets, and accurate **as built project data**
- Planning, by products and materials **regulatory compliance** evidence base
- Materials and by products project **forecast and benchmark** data gathering

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Systems Approach

Key to Circular Economy Implementation

1. LIFE CYCLE VALUE

Circularity requires that whole life value of investments: includes operation and maintenance phases in addition to construction. Residual value and design for deconstruction are key

2. UNDERSTANDING RELATIONSHIPS

System dynamics, roles of stakeholders and relevant actors are mapped. Strategic plans that guide decisions on investments are identified and considered.

3. METRICS

A balanced scorecard approach to metrics is in development at project and organisation level in TII. Reuse potential and residual value for assets, components and materials must be calculated. Social value added through infrastructure to be metricised using the tool.

Managing Assets Vs Asset Management

Infrastructure Delivery

Design obsolescence

Up-front cost

Maintenance

Local expertise

Work in Progress

Long Term Performance

Condition and Risk

Whole-life cost

Lifecycle management

Integration

Proactive and Resilient

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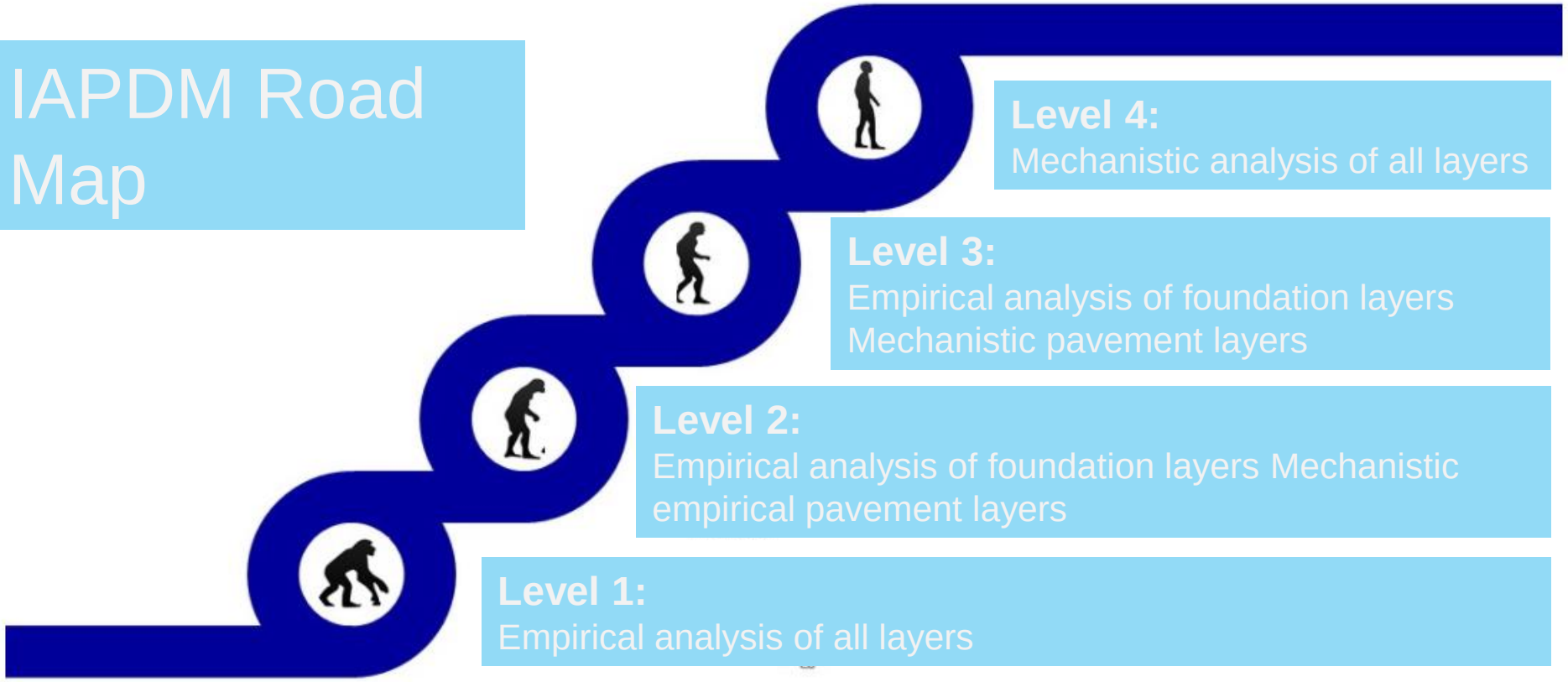
CE & New Pavement Design

CE & Pavement Design

IAPDM Road Map



Level 4:
Mechanistic analysis of all layers

Level 3:
Empirical analysis of foundation layers
Mechanistic pavement layers

Level 2:
Empirical analysis of foundation layers Mechanistic empirical pavement layers

Level 1:
Empirical analysis of all layers

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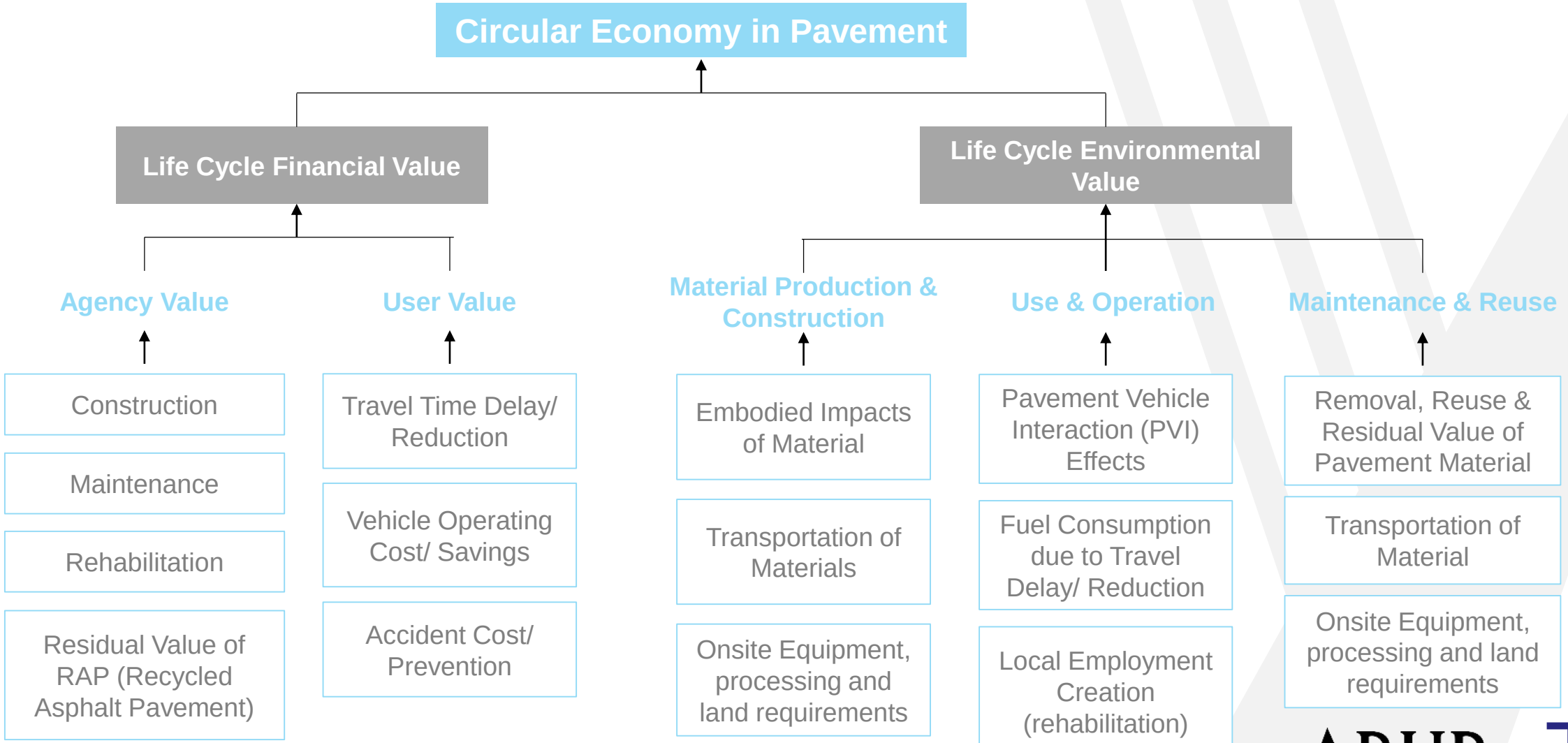

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CE & Pavement Management

Take Away Messages

- Goals - to realise value from assets, through minimising waste and keeping assets in use by effective maintenance

- Need new solutions for reducing life cycle costs and impacts by adopting risk-conscious and data-driven decision-making and circular design strategies

- Circular Economy and Pavement metrics in development consider:
  - Circular procurement of production systems,
  - Practices to increase material efficiency and energy efficiency and
  - Selection of primary or secondary raw materials- reuse at their highest possible value and preventing downcycling.

Next Steps

- Thank you for your attention- Any questions?
- Engineers Ireland Talk to follow in February- www.iei.ie
- Contact us at: TIICEPlan@arup.com