Workshop on
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Towards a classification of adaptability strategies for the sustainability transition of critical infrastructures

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ABSTRACT:

Recently, sustainability transitions create a lot of movement in an array of sectors, including the construction sector. Steadily, the attention to the transition is changing from sustainability as a reputational asset for businesses toward sustainability as value that can be created. Value is created when the most efficient resources, considering time and money, are used to reliably acquire the desired function that will meet the performance expectations of the customer (Stewart, 2010). The attention to sustainability, as value to be created, therefore is fast tracking the overall attention of organizations (private and public) to transitions. This acceleration can be considered a breakthrough in decisions to be made for many sustainability transition movements. However, not all of these movements are likely to benefit from an acceleration by definition. Critical infrastructure systems, have to make changes in such a complex set of challenges that system wide, risks can seriously impede benefits from any initiative of change. This is due to the interdependence of critical infrastructures with their surroundings (Liu et al. 2019).

In essence, the sustainability transition for critical infrastructures would benefit from strategies that can address the mismatch between opportunity and decision occurrence. Possible approaches exist that could address this mismatch and address the sustainability transition in the process. Until to date, the problem with adopting any insight from them, is due to the scattered representation of these theories in the literature. The scatter prohibits the formulation of adaptability strategies that could effectively resolve challenges as a result of a mismatch between the opportunity and the decision occurrence. This paper aims to address this gap by the conduction of a systematic literature review. The paper concludes with a proposed theoretical framework including the variant ways in which adaptability strategies address the mismatch between opportunity occurrence and decision occurrence.

A circularity assessment framework for bridge and viaduct designs

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ABSTRACT:

To meet the sustainability goals set by the European Union, the efficiency of the use of resources has to increase rapidly in the coming years. The Circular Economy principles provide a restorative and regenerative approach to promote an industrial-economic system without waste. Part of this waste reduction can be achieved in several ways, such as avoiding unnecessary material use, using recycled or reused materials, design-for-deconstruction, design for change and avoiding scarce or toxic materials.
A considerable amount of waste is currently created by the construction sector. Moreover, the transition from the linear make-use-waste system to a circular one is prone to many challenges. As part of this transition in public infrastructure, bridges need to be designed in such a way that they require less materials during the construction and maintenance phases and generate less waste after their service life, thereby resulting in long-term cost savings and reduced environmental impact. However, the current procurement system hampers the possibility for public infrastructure agencies to implement circular principles in a large scale. This is largely due to the fact that uncertainty in future changes make the level of circularity of a bridge or viaduct hard to measure with the current assessment methods.
In this paper, a circularity assessment framework is proposed to measure bridge circularity in an objective and userfriendly way, such that it can be used as an award criterion in public procurement processes. This framework comprises four main sub-indicators: (1) design input; (2) reusability; (3) adaptability; and (4) scarcity. The “design input“ sub-indicator accounts for the share of material type and origin used in the project, i.e. virgin, recycled, reused, biotic and renewable materials. This sub-indicator also takes into account the robustness of the design. The rationale for robustness is based on the fact that whereas it potentially increases the lifespan, it might also promote additional use of resources. The “adaptability” sub-indicator represents the capability of a bridge to be adjusted to changing contextual requirements, such as, an unexpected increase in traffic volume or new height regulations without creating waste related to pre-EoL demolition. The “reusability” sub-indicator represents, as the name suggests, the ability to be reused and it is considered on asset and component levels, depending on the aspect to be measured. For instance, if a structure needs to be removed, or particular parts of a bridge cause the need for removal, value can be retained by designing the components of the bridge in such a way that they can be easily disassembled and transported. Moreover, the less unique a component is, the more likely it is to fit a new situation. Finally, the “scarcity” sub-indicator aims to account for the increasing pressure on the earth’s resources and address the shortcomings of the designs in relation to their demand for abiotic materials. The applicability of the framework is demonstrated by means of real Dutch case studies.

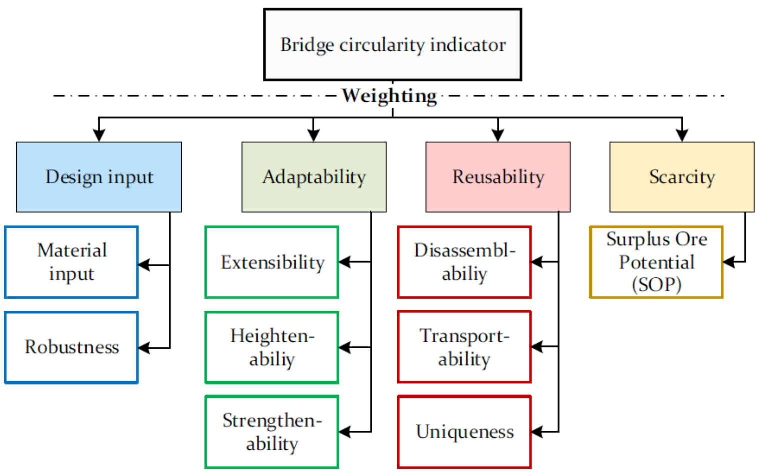

Fig. 1. Outline of the bridge circularity indicator.

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Towards greener asphalt: sustainability assessment for roads and road components in Europe

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ABSTRACT:

Across Europe, the efforts to reduce carbon emissions have increased since countries have signed the Paris agreement in 2016. Europe commited to reduce at least 40% of domestic greenhouse gas emissions by 2030 compared to 1990 and to reach that all sectors of the economy must contribute. The extensive road infrastructure in Europe contributes significantly to carbon emissions considering the maintenance and renovation works it demands every year. Additionally, national authorities have to act on other sustainability targets: air quality, resource use/circularity and life cycle costs.

Sustainability assessment tools and data can be used by National Road Authorities (NRAs) to identify the biggest responsibles for environmental, social and cost impacts in the road infrastructure and tackle them more efficiently by gaining an overview of which interventions and innovations can improve the environmental performance and social impact of roads while keeping costs into perspective. Only a few NRAs make use of sustainability assessment methodologies to prioritize strategies for implementation and maintenance of roads and the development of related innovations. This is due to the lack of specific guidelines/roadmap for roads which is a consequence of the short history of experience with sustainability assessment in this sector.

Therefore, in the PavementLCM[1] project we produce several deliverables to help the NRA's understanding and implementation of sustainability assessment of roads and to guide them how to use sustainability assessment in order to make choices that will improve sustainability of their roads. Data and tools are key elements to achieve this and therefore a worldwide research on data and tools available for sustainability assessment of roads was performed. In the study, a list of 26 tools including generalist LCA softwares and road management specific tools were described in order to support tool choice and datasets search. The second step of the study was to perform case studies of the environmental impact four greener asphalt mixes in three tools to show the impact of the specific tool selected. Furthermore, an uncertainty and a cost analysis were performed to show how (un)certain carbon footprint results can be, where the uncertainties come from and how to deal with these uncertainties. Another work package is dedicated to durability assessment of innovative asphalt mixtures and how incorporate the results from durability assessment into the sustainability assessment.

The final product of the project will be the *PavementLCM Package*, consisting of guidelines and recommendations on how to do sustainability and durability assessment for roads, a "sustainability compass" which helps the user to find data sources and tools and a roadmap about international harmonisation of data.

References:

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Monetary evaluation of environmental impacts of buildings

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ABSTRACT:

Life Cycle Assessment (LCA) is being established as the tool to evaluate and compare environmental impacts of buildings. However, practitioners face the problem that the multitude of environmental impacts calculated often render contradictory results and are therefore difficult to communicate to stakeholders.To address these problems we tested monetization as a means to summarize environmental impacts. We collected data on pricing of environmental costs (EC) and applied two of the pricing models, eco-costs [1] and external costs [2], to 5 sample office buildings [3]. For these buildings, both an LCA and life cycle costing (LCC) were conducted. The LCA results were converted to EC and summarized.
Results show that the evaluation is strongly dependent on the pricing of GWP and, to a lesser degree, AP (Acidification Potential) and PENRM (Primary energy non-renewable, material). Comparing the EC of embedded impacts to the actual life cycle costs of the building structures we see that taking EC into account would only add around 5% to the life cycle costs. Considering also the energy use, EC would add 14% to 21% in total [Fig. 1]. This shows that converting environmental impacts to costs offers a chance to make LCA results more communicable but at the same time runs the risk of suggesting that environmental impacts might be negligible.
Points for discussion following this analysis are: What is an appropriate pricing model for environmental impacts of buildings? Should and can other impact categories, namely resource depletion and toxicity, be included? What are the possibilities to optimize a building design from an LCA and LCC perspective?

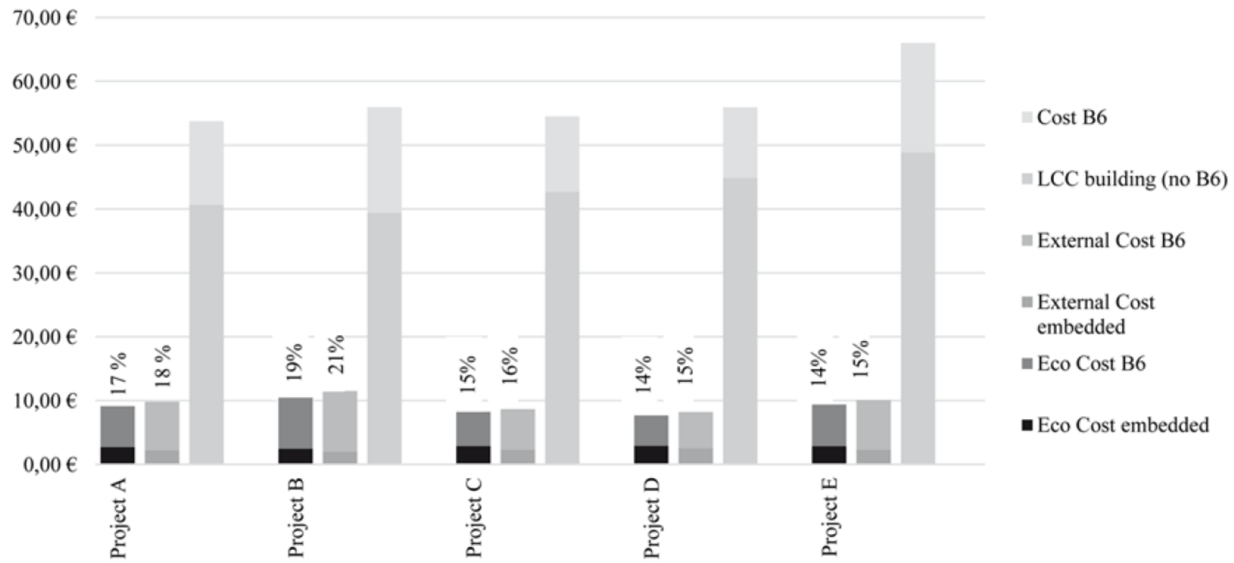

Fig. 1. *Comparison of environmental costs to life cycle costs of buildings: embedded impacts and operation per m² and year*

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