LCM 2019 WORKSHOP — iaLcce —

Workshop on
Life Cycle Management
27-29 October Rotterdam

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Towards an Systems Engineering based framework for interoperable Asset Life Cycle Management processes

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ABSTRACT:

In 2007 the civil engineering sector in the Netherlands, clients as well as contractors, has adopted the Systems Engineering (SE) methodology with the intent to enable the realization of successful systems. In the past decade, Rijkswaterstaat has deployed SE as an key instrument in almost all of its Design, Engineering, Construct and/or Maintain contracts. In this context, SE can be perceived as having a more modest goal: the realization of successful individual projects.
The past decade has seen a change in the challenges that Rijkswaterstaat and other public clients are facing in the Netherlands. The shift from green field to brown field solutions leads to demand for better and more adaptive collaboration between public partners and their stakeholders. The aging of the installed base dating back to the period after WO II, as well as global demand for a circular economy, results in a shift towards replacement and renovation of structures and reuse of materials, as well as reuse of information over the lifecycle. Finally, the digital revolution and the promise of digital twins calls for increased technical and sematic interoperability between clients and contractors.
This requires the shift from the realization from succesful projects tot succesful infrastructural networks and systems, the adaption of a common framework to tackle the problems of lifecycle performance (satisfying requirements), lifecycle risks and lifecycle costs, as well as the sharing and reuse of information (meaningful data) over the complete lifecycle of these systems. A roadmap for such a framework is currently under development within Rijkswaterstaat. In this paper, we will identify its principles, and describe how interoperability of information shared within this framework can be achieved.

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Implementing an ISO 55.000 series based generic management system for governmental asset managers

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ABSTRACT:

As the Dutch foundation and knowledge platform for public space, CROW and its stakeholders have created a system for governmental asset managers to manage their public space. As increased demands and decreased budgets make the management of public space a more and more precious activity, transparent and fact diven efficient management of public space is essential for governmental bodies. The ISO 55.000 series give a framework for an asset management system, but is seen as a rather abstract guideline. The decentral governmental bodies have decided to work together on a description of a more practical and detailed management system that can be broadly implemented without loosing the specifics of the public space and the organisation and culture of the governmental body. The system is called the “management system public space” (BS-OR or, in Dutch, beheersystemeatiek openbare ruimte). For public space in general the system is in place and introduced in the sector. For structures some further tools will be developed in the coming years to add this specific issue to the system.

One of the implementation tools is the so called interactive poster. A poster with all tasks and results defined in the system, presented in a deming circle like way, with blanks to appoint persons responsible for each task or result. In a workshop an organisation can go through the complete management process and fill out the blanks with responsible persons or departments. *Figure 1 The interactive poster*

It serves several goals: discussion about the need and content of the system, the tasks and results, appointing the right person to each task and result and to get a grip on the missing links in the organisation specific management system. Although confronting organisations with gaps in their responsibility appointments, this tool has proven to be useful.

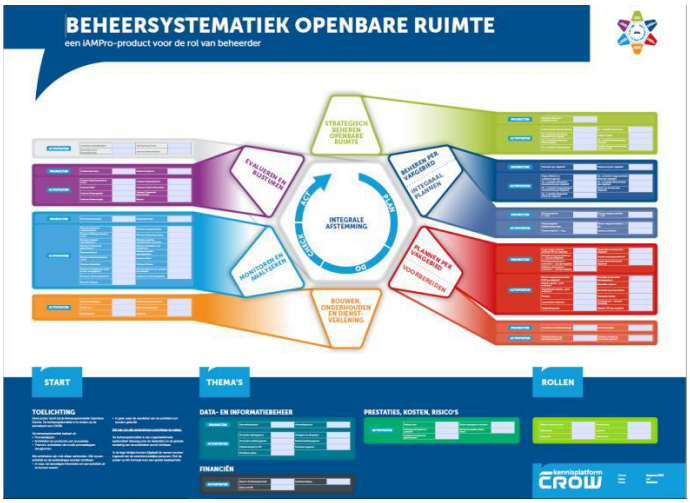

Figure 1 The interactive poster

During the IALCCE workshop we will shortly explain the structure and content of this interactive poster as a tool for implementation of an assetmangament system. Furthermore we will present the lessons learned and the benefits by describing the experience of the use of the tool in two governmental bodies.

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Guidelines for a Common Approach to Life Cycle Cost Analysis in the Dutch Construciton Sector

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ABSTRACT:

Within the context of the construction industry, life-cycle cost analysis (LCCA) assesses and predicts the long-term cost performance of construction work. It aims at facilitating choices among alternatives or sustainable options to achieve client's objectives. These alternatives differ not only in initial costs but also in operation, maintenance, replacement and repair, end of life costs and residual values. LCCA allows these alternatives to be compared on the same basis. It also aims to optimize the design at an early stage of the investment project in such a way that the full costs of the construction throughout the life cycle are minimized. Decisions about construction related investment are surrounded by much uncertainty about costs and benefits. Performing life cycle cost analysis greatly increases the likelihood of choosing an investment project that saves money in the long run.
So far, the Netherlands has not yet developed a country-specific standard method for life cycle cost analysis in the construction sector. The Dutch national standard NEN 2699 provides the country-specific cost classifications and cost breakdown structure. The majority of Dutch construction companies applies NEN 2699 for their life-cycle cost (LCC) calculations. However, this standard does not provide basic life cycle costing terminology and economic evaluation methods to LCC practioners. Complementary details of LCCA are set out in the following two documents:
- NEN-ISO 15686-5 providing general LCC definitions, guidelines, principles and instructions on the application of LCC economic appraisal techniques
- BREEAM MAN 12 defining LCC analysis reporting requirements and a nine-step process.

Yet the life cycle cost analysis (LCCA) process description in these two documents are too general for consistent, harmonized implementation within the Dutch construction sector. To bring this about, the Dutch construction sector needs to develop a country-specific supplement to the NEN 2699 and NEN-ISO 15686-5 standards.
This paper elaborates a common LCC analysis approach for the Dutch construction sector in the Netherlands.
In its preparation, the author researched international LCC practices, gathered LCC project information and conducted a survey among seven participating member companies of the Dutch High Complexity Building (HCB) Life Cycle Cost (LCC) working group. The paper proposes common guidelines for:
- LCC terminology.
- LCC calculation formula.
- The use of generic assumptions and economic parameters.
- An improved process for conducting LCC analyses.
- Supplementary measures of economic performance.

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2. Sieglinde K. Fuller, Stephen R. Petersen, 1995, NIST Handbook 135 Life-Cycle Costing Manual
3. British Standards Institution, 2008, Standardized Method of Life Cycle Costing for Construction Procurement

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Performance age - A method to decide on the remaining functional life of bridges

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ABSTRACT:

A recent study has revealed that most bridges of the Dutch road network are replaced due to functional reasons (e.g. bridge dimensions, traffic capacity, safety, landscape fragmentation, etc.). Thus, the decision to renew a bridge is not solely determined by technical conditions. It also requires an assessment of the functional performance of a bridge. The Performance Age is proposed as a simple method to decide on the functional end-of-life of bridges. The method is structured around a hierarchy of functional criteria to be assessed in two-steps. First, the pre-evaluation step aims at ensuring that the bridge shows a minimum performance level for those criteria which are seen essential for the service provision in terms of safety, traffic volume carried, load bearing capacity, bridge geometry and noise emissions. The expertise of bridge managers and monitoring data is used at this step as input to determine the pre-evaluation score of the bridge. A threshold is defined and if the bridge does not score above that threshold, the remaining functional life is 0 years. In other words, the bridge should be directly replaced. If the bridge succeeds the pre-evaluation step, in the second step the other performance criteria are assessed and scored again based on the input from experts and monitoring data. The score is used to, with a set of mathematical equations, calculate the gllobal functional bridge performance, a number between 1 (“perfect”) and 4 (“poor”) that indicates how the bridge functionally performs. Finally, the global functional bridge performance is set in relation with expected functional dvelopments over time to obtain the remaining functional life or performance age. After applying the method together with bridge managers from Rijkswaterstaat to a highway concrete bridge the following conclusions can be drawn:

- The Performance Age is a useful methods for decision makers as it allows a repeatable, sound and objective procedure to make well-informed decisions among competing alternatives.
- The method can allow decision-makers to make decisions based on empirical grounds rather than the subjective justifications that are currently used. This will help decision makers to defend their decisions against stakeholders.
- Involving decision-makers in the design of the method is an adequate approach to focus efforts in the right direction and to inculcate an ownership feeling with the method that eases its implementation.
- The information given by the method (remaining functional life and the performance score) will allow decision makers to define more precise replacement strategies and to plan and prioritize among different alternatives.
- The functional performance of bridge can be assessed with a set of 10 performance criteria validated by bridge management experts and decision-makers.
- The method can improve the life cycle management at infrastructure agencies by allowing for the integration of life cycle performance with life cycle costs and life cycle risks.
- The Performance Age can be combined with an economic analysis over the remaining functional life to decide on the effectiveness of bridge interventions and to make the trade-off between bridge renewal and bridge maintainence.

References

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Risk visualisation approaches for risk-based maintenance planning for bridges and tunnels

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ABSTRACT:

Risk-based maintenance prioritises the tight-budgeted maintenance activity to the infrastructure components that require attention to sustain the performance of infrastructures such as bridges and tunnels.The challenge appears on the process of communicating the results from the risk analysis so that the infrastructure asset manager can easily recognises which bridge or tunnel components should receive the higher priority for the maintenance planning. To answer this challenge, this paper develops risk visualisation approaches for bridge and tunnel to communicate the output from a risk analysis. Not only that, the visualisation approaches also take the characteristics of the damages on the bridge and tunnel into consideration. The included damages into this visualisation are cracks and scour for bridge as well as tunnel lining deterioration and water damage for tunnel. The reason are cracks often appears on bridges [1], scour contributes the most in bridge failures [2], and the most common damages for tunnel are tunnel lining deterioration and water damage [3]. The visualisation approaches utilise traffic light colour set as the risk communicator and a 3D model as the representation of the real object for the visualisation. The combination of traffic light colours and 3D model yields a risk visualisation that can pinpoint the exact bridge or tunnel components that should receive the higher priority for the maintenance planning (Figure 1). Finally, this paper also discusses the potential improvement as a bridge and tunnel risk visualisation for risk-based maintenance planning.

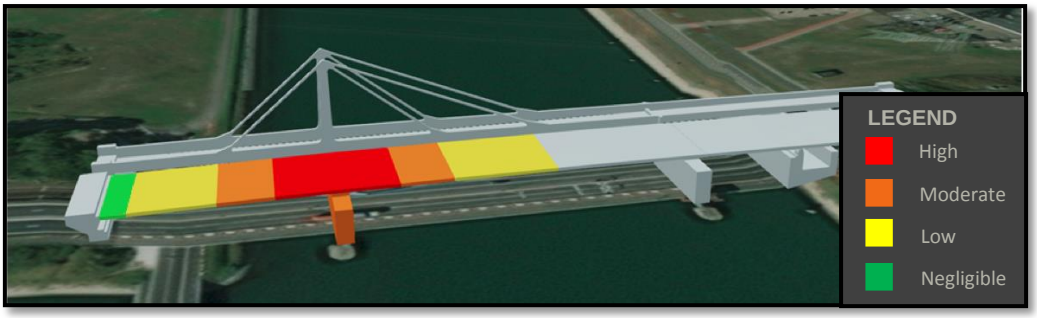

Fig. 1. *The 3D bridge model appears with traffic light colour sets as the colours express the risk value of the damaged bridge components.*

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4. Huang, S., & Guo, M. (2015). Analysis and Strategies of the Common Tunnel Problems. *Proceedings Of The 2015 International Conference On Artificial Intelligence And Industrial Engineering*, 312-314.

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Life Cycle- and Asset Management; two of a kind

Same goals, same approach and same techniques

Jan Swier, Swier Advice Asset Management

ABSTRACT:

What is the difference between Life Cycle Management (LCM) and Asset Management (AM)? The IALCCE describes LCM as follows*: "Life Cycle Management is concerned with the management of performance, risks and costs from a life cycle perspective in a constantly changing environment. It is necessary to implement LCM in civil engineering, to build a sustainable future, suitable for future needs, resistant to expected and unexpected events and cost-effective over time".* PAS 55 uses the following definition of AM [1]: *"Asset management is the set of systematic and coordinated activities that ensure that an organization has its assets and asset systems and their related performance, risks and expenditures throughout the life cycle optimally and sustainably, with the aim of achieving the strategic plan of the organization in accordance with the requirements and wishes of the stakeholders".*

Conclusion: there is no difference. Both methods have the same goals and approach. Both are also not a management technique but a management system. The challenge of both systems is to let organizations/processes/people work on the same goals at different stages in the life cycle; they must be and remain connected to each other. This is possible with dedicated management techniques. An AM/LC-system includes a collection of management techniques to bridge the gap between the people working in the exploitation and investment phase, and between the asset requirements and wishes of the stakeholders and realization thereof [2]. Examples of these dedicated management techniques are RAMS management (forexample described in the EN 50126 [3]), RISK management (like RCM, FMECA, RISMAN, ISO 31000) and LIFE CYCLE COST management. An overview of all required techniques for AM/LCM is provided in the document "Asset Management – An anatomy" [4]. It is an explanation how the AM system described in PAS 55 works, and what is needed for that. The document groups 39 system requirements - similar to 22 in PAS 55 and 24 in ISO 55000 - in six topic groups. In Figure 2, these are indicated above the six vertical arrows.

Based on this insight, it would be helpful to adjust the IALCCE structure for workshops and focus points (Figure 1) to match the AM structure in "An Anatomy" (Figure 2). In this way you create a common basis for LCM and AM and make it clear that they are synonymous. This makes users share knowledge and experiences faster and easier. In this way they reinforce each other instead of being stuck in inproductive fundamentalist discussions about unimportant differences.

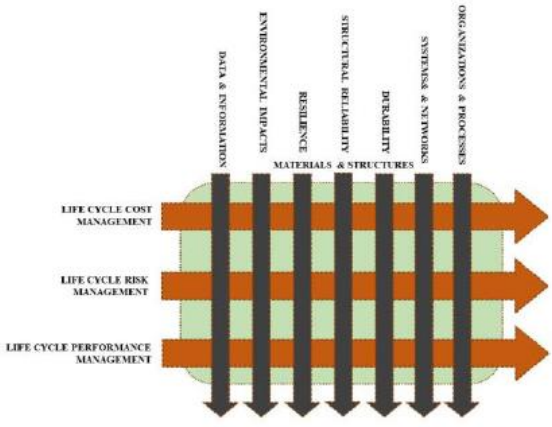

Figure 1 IALCCE structure for workshops & focus

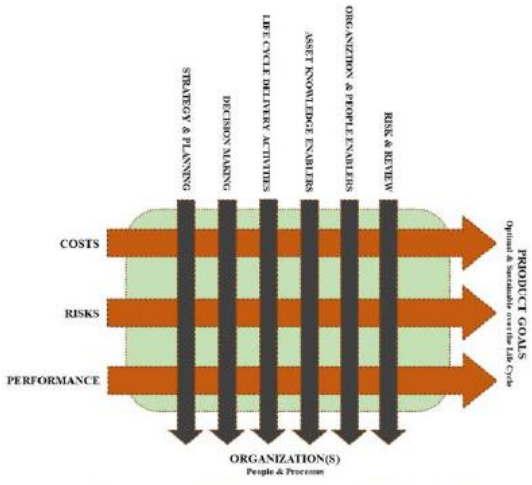

Figure 2 Structure & focus AM & LCM

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