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Beneficial Inner-City Quay Walls?

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ABSTRACT: Inner-city quay walls in public urban areas: expense or added value? These civil structures approach, reach or exceed the end of their life span. This threatens the quality of the public urban area. Many municipalities are still willing to invest in the management of inner-city quay walls, despite the costs. Apparently, the quay walls generate more benefits than that are initially expected based on their original functions. Until now, municipalities have failed to determine the added value of inner-city quay walls. Theoretical and practical research suggests that adequate asset management is indispensable. Nevertheless, no research focuses on valuable management of inner-city quays, in terms of performance, costs, benefits and risks. How to decide on a management strategy that adds the most value to the public area? A new framework should identify and incorporate the value of inner-city quay walls in the management process.

Keywords: *inner-city; quay walls, public urban area*

INTRODUCTION

Changes in the urban environment have brought functional modifications for many historic quay walls. Traditional features, such as the handling of goods, are increasingly exchanged for recreational and aesthetic functions. Quays are used as pedestrian walkways, patios, parking areas and as storage for a variety of infrastructure functions. Even trees have become essential in the historic canal image, which is in many municipalities part of protected cityscape (Fig. 1). Previously, the economic value of quay walls was generally considered to be greater than it is now. For decades, relatively little is done to their periodically management. Municipalities are increasingly aware of their role as manager of assets in the public area.

In addition to structural issues, such as load increases and degradation, economic issues play a role. Quay walls are capital goods. If they are not approached properly, they become a financial time bomb for municipalities. This approach should be optimally adapted to the environment. It is expected that repair and replacement investments in these structures require 3 to 4 billion euros in the next fifteen to twenty years [1].

Fig. 1. Protected cityscape

The above is of major influence on choosing a management strategy. Ultimately, this choice is determined by its value contribution to the quality of the public urban area. The value depends on human preferences in addition to a technical definition. Performance, costs, benefits and risks of quay walls should be balanced and optimized. This introduces the discipline asset management: the collection of coordinated life cycle activities of an organization to generate value from assets in achieving its objectives [2].

VALUE

Value is a subjective concept, partially based on human preferences. It provides insight into the relationship between performance, costs, benefits and risks. As asset owner and asset manager, the municipality affects its performance. They can therefore be seen as value creator who facilitates the needs of the value seeker, the user of the public space [3]. These needs are represented by the quality objectives of the municipality: health and safety, functionality, image and societal importance. Also affordability is defined as a need [3-5].

By fulfilling their functions inner-city quay walls contribute to the quality of the public area and they generate benefits (Fig. 2). Quay walls have different location-dependent features. The life cycle of each asset considers activities that affect the quality. This quality is determined by the CROW (2013) in different levels: A+ (very good), A, B, C and D (very bad) [6]. Costs are incurred to keep the asset performance at the required or desired level by effective management. Changes in circumstances create a new situation with uncertainty effects on performance: risk. Approaching these uncertainties in a proper way offers opportunities to create and integrate added value.

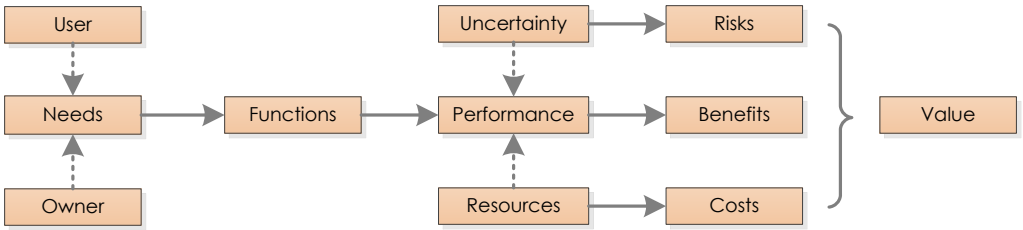

Fig. 2. Relation between needs and value

The technical and functional values of an inner-city quay wall develop over its life cycle (Fig. 3). The technical value represents, partly due to legislation and regulation, technical requirements and gives meaning to the users' needs. The functional value reflects these needs. During the operation and maintenance phase, the technical value decreases by degradation. The functional value increases due to changes in needs and required functions. The difference between the two values may be seen as the combination of flexibility and sustainability of the quay wall.

This is the ability to respond to internal and external risks that affect both degradation and change in needs.

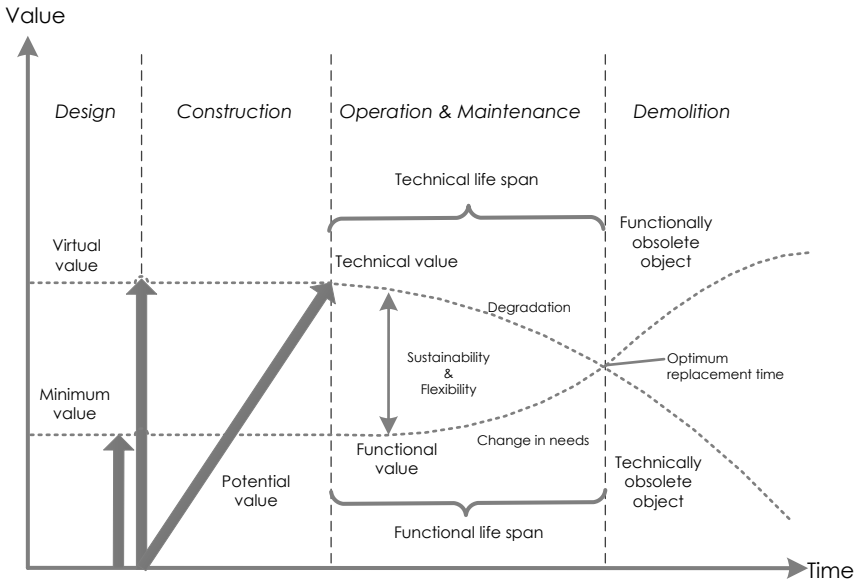

Fig. 3. Development of technical and functional value over time

One distinguishes roughly three management strategies that affect the technical and functional value: change nothing to the current situation; restrict the use of the construction; repair large components; and replace the entire structure. The most optimal time to replace an inner-city quay wall occurs when the technical value equals the functional value. In reality, this is rarely the case. Due to degradation the quay wall is no longer able to meet the functional requirements and expectations.

MANAGEMENT PROCESS

As asset owner, the municipality is functionally oriented: she should determine the strategic level of her quality ambitions for the public area and communicate this with the asset manager. The municipality represents the interests of her citizens and is therefore a direct contact for them. As asset manager, urban management translates these quality ambitions at a tactical level into technical and functional performance requirements. He determines which quality ambitions are when and where pursued and which associated activities are contracted with the contractor(s). As service providers, the contractors and engineering firms represent the operation level and are responsible of the technical implementation of the agreements with the asset manager (Fig. 4).

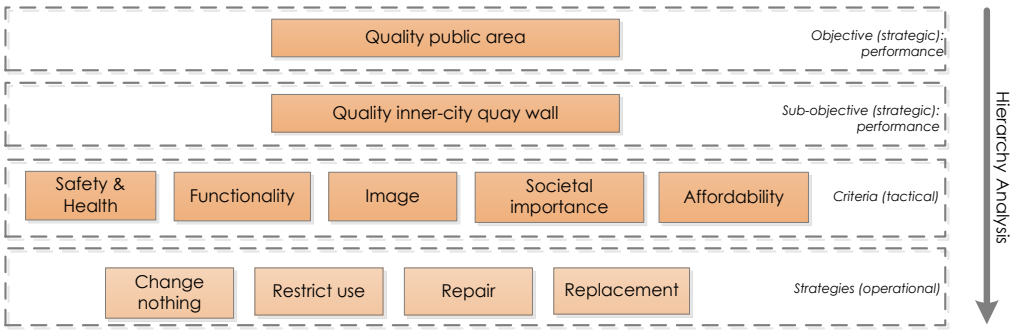

Fig. 4. Asset management levels: strategic, tactical and operational

The technical life span alone is not enough to derive an indicative value of the inner-city quay wall. The functional and economic residual life span is also essential, but difficult to determine due to their dependency on needs, costs and benefits during the entire life cycle. Especially the benefits are in many cases hardly or not at all monetary defined [7-8]. However, managers do have a not clearly defined feeling that inner-city quay walls do contribute to the benefits of the public area. Why else would these quay walls exist?

DESIGN ASSET MANAGEMENT FRAMEWORK

The concept for the asset management framework for managing inner-city quay walls as part of the public area is shown in Fig.5. It incorporates often implicit preferences, based on knowledge and experience of the municipality, urban management and possibly other actors in relation to the quality of the public area. The framework not only facilitates in the prioritisation of management strategies by defining knowledge and experience, but also of costs, benefits and risks.

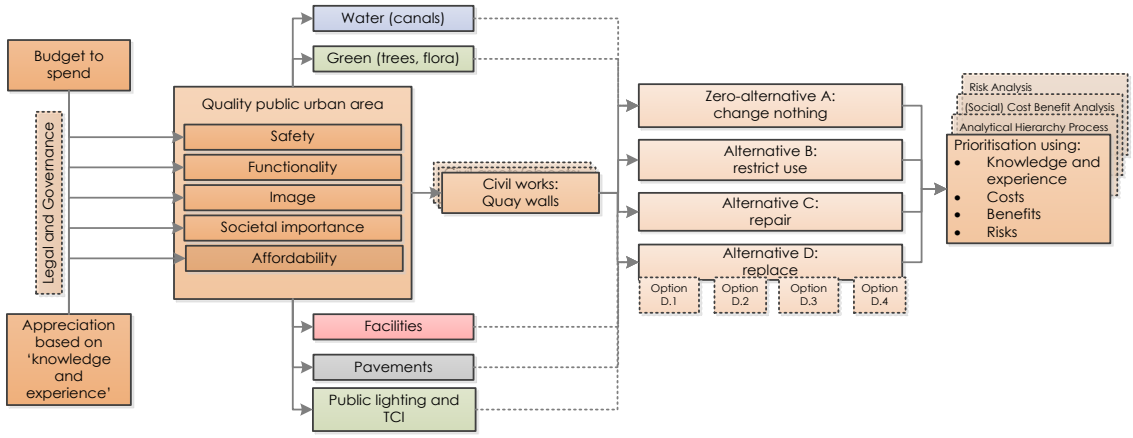

Fig. 5. Asset management framework for inner-city quay walls as part of public urban area

Decision-making

Decision-makers are often faced with a lot of information and little time to analyse the situation. They need a 'quick-response' analysis that integrates their knowledge, intuition, judgment and experience. With the above process, necessary information on the quay wall in relation to its environment is obtained. That information is used for the final decision. For this purpose the value in terms of performance, costs, benefits and risks is decisive. What will it be: leave the situation as it is now, limit the use, repair or replacement?

Most asset management approaches try to quantify and monetise the value of every aspect. It results in a total value expressed as monetary value. The best choice is the management strategy that adds the most value. The zero-alternative, the strategy to change nothing and accept the risks, serves as a reference with respect to the other alternatives. The quantification is subjective. Both the likelihood and impact of risks are estimates. Also assigning weight to the quality ambitions is based on knowledge, experience and skills. A change in these estimates lead to different results. This influences the reliability of this approach. How can the asset owner, in collaboration with the asset manager and service providers, integrate subjectivity in the decision?

Decisions may be made with reasonable confidence, by incorporating stakeholder preferences in identifying and weighing quality objectives or performance criteria. The presented framework facilitates this. It organizes and structures technical and functional information on assets in public urban areas. Human assessment is included as a factor, together with the costs, benefits and risks, to prioritise the management strategies. In addition, it is not the responsibility of the asset manager, but of the asset owner to capture these stakeholder interests [9]. The

definition and appreciation of the quality ambitions are not the only truth; they are rather a starting point for (political) debate.

The module 'knowledge and experience', using the Analytical Hierarchy Process method (AHP method), enables the municipality to allocate its preferences to the quality ambitions themselves and in relation to the management strategies. Subsequently, the different preferences are combined into a societal prioritisation.

The module 'costs and benefits' offers the opportunity to urban management to determine the costs and benefits associated with the performance of the quay wall. A Societal Cost Benefit Analysis (SCBA) monetises societal effects positively or negatively. The relationship between the costs and benefits over the life cycle determines the Net Present Value (NPV) and thus the feasibility of a management strategy. Urban management can adjust several variables to analyse their impact on the NPV. This module results in financially prioritised management strategies.

The module 'risks' uses the preferences determined in an earlier module as weights for the risk categories of the risk matrix. This matrix shows the effects of uncertainty in time on reaching the quality ambitions. The urban manager translates these municipal quality aims into performance requirements and defines associated acceptance levels. For this, he communicates with the municipality. With the help of engineering firms and contractors, he inspects and assesses the current risk profile of the quay wall. If this profile does not match the minimum requirements, associated with the acceptance levels, Stadsbeheer proceeds to implement one of the management strategies. Within the risk module, urban management does this the basis of risk reduction. The more effective the strategy, the greater the risk reduction. This module provides an economic (societally and financially) prioritisation.

All of these priorities, societal, financial and economic, represent input for the final overview. Urban management advises the municipality in her choice for the most valuable management strategy. In most cases, urban management does make a recommendation and asks the municipality for financial approval in the form of a credit application.

To test its utility for urban quay walls as part of the public space, the asset management framework is used for one case: the historic quay walls in the centre of Delft. The developed theory is applied in practice. The added value is determined and used for balancing the management strategies as part of the decision-making process. Due to limited available data, it was decided to elaborate the Delft case fictional, including the available data.

RESULTS SIMULATION

The inner-city quays walls in Delft date from the 16th and 17th century and are part of protected city-scape [8]. The preservation of these quay walls, just as other cultural heritage, requires large investments. According to several representatives of the municipality of Delft they, unfortunately, just use the replacement value of these civil works to support of their investment decision. The municipality considers the development of a framework that captures other (more emotional) values as a time-consuming process. She argues decision-making on urban quay walls based on their functions [8].

Knowledge and experience

The prioritisation based on knowledge and experience (performance expectations) derived from municipal vision and management plans, indicates a preference for the quality ambitions 'health and safety', 'function', 'social interest', 'affordability' and 'image'. ‘Replacement’ is the most valued management strategy, followed by ‘repair' and 'restricted use'. ‘Changing nothing’ is least appreciated.

Costs and benefits

The life cycle cost of quay walls in Delft consist of investment costs, annual management and maintenance costs, demolition costs, contingencies and (predicted) damage costs. The annual benefits are most reflected in the port and quay charges, parking fees and sales of recreational, tourism and hospitality sectors. The benefits depend on the share of inner-city quay wall in relation to the total public urban area (area ratio) and are therefore specific for each municipality. The greatest benefits are prevented damage costs, regardless of the fact that they are not seen as 'hard' cash inflows. They give an indication of the monetised prosperity effects that relate to safety and health.

The assumptions with respect to the four management strategies result in different NPV (Table 1 and Fig. 6). Alternative D, replacing the inner-city quay wall, is financially considered to be the best.

Table 1. Management strategies, remaining technical life span and NPV

Management strategy	Remaining technical life span [year]	NPV +/- 20% [million €/m]
Alternative A – Change nothing	10	-0.4
Alternative B – Restrict use	50	0.2
Alternative C - Repair	30	0.1
Alternative D - Replace	80	0.3

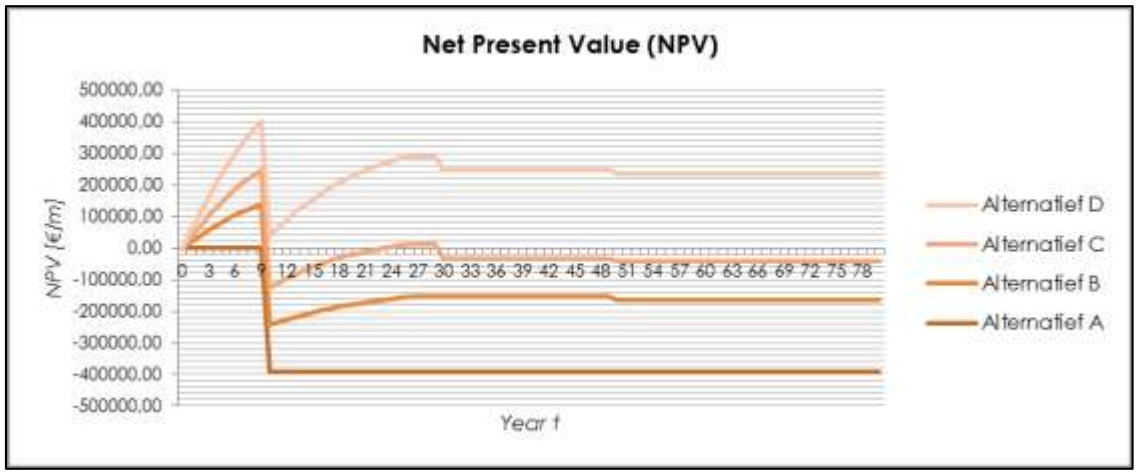

Fig. 6. NPV management strategies

The sensitivity of the NPV functions of the various management strategies depends strongly on the applied cost and benefit levels. The NPV of replacement (Alternative D) shows great sensitivity to changes in costs and benefits. This can be explained by the high investment costs of this strategy, which are determined as a function of the retaining height. Varying successively the discount rate and the retaining height shows that the NPV of restricted use (Alternative B) and repair (Alternative C) is the least sensitive. The greater the uncertainty effects (risks), the higher the applied discount rate.

The prosperity effects and benefits accrue to different actors in Delft, such as the municipality (taxes, port and quay charges and parking fees); entrepreneurs (turnover); and residents and users of the surrounding buildings (property tax). The prevented damage costs are (eventually) in favour of each of the above actors in the public area. The municipality experiences benefits in terms of avoided damage claims; entrepreneurs, local residents and other users in the form of prevented (in) tangible damage.

Risks

The risks are assessed using monitoring data and inspection results provided by engineering firms and contractors. The weights of the risk categories, the preferences regarding the quality ambitions, have already been determined by means of the AHP-method. Replacement has the greatest risk-reducing effect, based on the weighted and unweighted risk scores and risk sum. It is therefore considered the most effective management strategy. Risks cannot be separated from performance, costs and benefits. Risks are often reflected in positive (benefits) and negative (costs) impacts. To reduce risks and increase opportunities, the cost-effectiveness should not be strikingly different from that of other alternatives. A next step could be to relate the risk reduction of each management strategy to the costs and / or benefits (NPV). This results in the efficiency which integrates risks, costs and benefits.

CONCLUSION AND RECOMMENDATIONS

The presented asset management framework provides municipalities, as managers of the quality of public space, a tool that facilitates choosing a proper management strategy for an inner-city quay wall. The framework gives an understanding of the added value of a management strategy.

The quality of the public urban area should be discussed. Identification and assessment of values regarding the quality ambitions must be achieved by consensus. Inner city quay walls contribute to the livability, accessibility, recreation, health and safety of the surrounding area. This entails considerable costs. These life cycle costs are expressed as a percentage of the construction costs, which are determined by the retaining height of the quay wall.

Additionally, often not-expressed preferences of stakeholders play a role in maintaining or improving the technical and functional value of an asset such as a quay wall. This framework also integrates this subjective side. In addition to the expected performance, which is based on knowledge and experience, the costs, benefits and risks are revealed. It results in a final prioritisation of the management strategies: change nothing, restrict use, repair and replace the inner-city quay wall.

It is recommended that asset owners, in addition to defining expected performance, management costs and risks, also identify the benefits related to the presence of inner-city quay walls, such as: port and quay charges, turnover hospitality sector, property taxes, parking fees and other revenues. The presented framework is used with calculated location-dependent data as input and facilitates decision-making.

The problems regarding inner-city quay walls cannot be denied any longer. The quality of the public urban area is at stake. Many municipalities do not integrate these structures as a distinct component in their budget for the public area. When asset owners and managers only consider the costs during the revaluation of assets, they become discouraged to invest in their management and maintenance. Therefore, visualising benefits is just as important.

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