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MAINTENANCE BUDGETING METHODS

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ABSTRACT

In Germany, public facilities are in need of rehabilitation. Strategies to maintain the value of buildings are ignored by governmental entities at all levels. Reactions are based on the occurrence of damage and are not preventative in character. Consequential damages and the associated economic, ecological and sociocultural losses are disregarded. It is important to allocate financial resources appropriately so that maintenance measures can be undertaken before serious damage occurs. The professorship of Facility Management at the Universität Karlsruhe develops maintenance strategies and methods for budgeting maintenance to address these issues. Empirical maintenance data for 20 buildings (schools and office buildings) were compiled that cover their complete past life-cycles. The data from this survey includes information about all maintenance measures that were carried during the lifetime of each facility. The real estate holdings that make up this 20 building sample have a floor area of 190,000 square metre and included over 24,000 maintenance measures. Financially, the upkeep for these 20 buildings ran up maintenance expenses of 1.76 billion euros. In addition to the maintenance expenses, the evaluation of the actual building substance expressed in euros was part of the analysis. The maintenance data that was collected on these real estate holdings enabled the development of a budgeting system. Common methods of budgeting were validated using the data. The result is: these methods are unsuitable. Their results produce maintenance estimates that differ enormously from real maintenance expenses. Realistic methods for predicting and budgeting the cost of future maintenance expenses do not exist currently. In practice, the maintenance staff responsible for facility upkeep have huge problems every year as they try to calculate a budget for the following year. Due to missing knowledge about real maintenance requirements and other cost relevant factors, mostly previous year values are used for budgeting. This approach is imprecise. In order for the planning and budgeting of maintenance measures the results of the investigation provide the required support.

KEYWORDS: building maintenance, maintenance expenditure, budgeting methods

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INTRODUCTION

Buildings and public facilities shape our cities and municipalities. In Germany, many public facilities are in ramshackle condition and in need of rehabilitation. This is the result of a lack of a strategy to maintain the value of these public buildings. Civil servants and other individuals responsible for these facilities often fail to act before damage has occurred to facilities, and preventative actions are too late at this stage. The consequence of poor planning in terms of public facility management is expensive damage to buildings and economic, ecological and sociocultural losses. The poor condition of public buildings in Germany is often not only unaesthetic, but also results in negative impacts on health, comfort, creativity and productivity for building users and occupants. Against this background, a strategic maintenance programme for public facilities is imperative. However, most building owners do not have fully developed tools to calculate upcoming maintenance costs, a fact which complicates this task.

Germany's public authorities own an enormous building-stock. This fact alone makes it clear that a strategic maintenance programme that would deal with the all-encompassing and increasingly a complex maintenance of such huge holdings should be put in place. In the past, maintenance measures were often planned poorly and, as a consequence, the financial resources necessary for repairs were not available in a timely fashion (Kalusche and Oelsner, 2003). In order to maintain the value of our buildings, budgeting carefully is of vital importance. Unfortunately, the recognition of the urgency of budgeting for facility maintenance has not been a matter of high priority prior to now, and other issues have been the focus of government facility managers (Henning and Klapproth, 2004).

The challenge, in terms of budgeting maintenance costs, is handling the long-term use of buildings. In comparison with non-durable goods, the service life of building is much longer, lasting several decades. The demands and requirements that government entities have for their facilities can undergo major changes over time. Against this backdrop, forecasting maintenance costs is difficult. Many factors influence maintenance expenses, including parameters that are usage-dependent, building-dependent, and site-dependent. Quantifiable information about the amount of influence these different parameters have on maintenance demands and the accordant maintenance costs rarely exist.

Public building owners need to pay greater attention to maintaining the value of their buildings, as the need for these facilities will endure. The goal should be to provide healthy and comfortable facilities that support the creativity and productivity of the people that inhabit these public spaces. This can only be achieved if financial resources are set aside and allocated for preventative maintenance measures. The Department of Facility Management at the Universität Karlsruhe (TH) has developed maintenance strategies and methods for maintenance-budgeting as a part of the BEWIS (Optimized upkeep strategies to maintain value of buildings) research project.

PREVIOUS BUDGETING METHODS

Four different approaches to the determination of maintenance budgets have been identified:

- Key data-oriented or history-based budgeting,
- Value-based budgeting,
- Analytical calculation of maintenance budgets,
- Budgeting by condition-description.

Using key data-oriented budgeting methods, budgeting results are derived by making rough estimations of general key figures. Using this method, a budget can be calculated easily and without much time and effort, but the key figures only provide rough reference values. Only the average expense of maintenance over several years can be reflected, and high uncertainty situations are not projected by this method.

The value-based approach calculates the maintenance budget using only general flat rates, which are multiplied by a percentage value for the building. Depending on the approach, either the building value, replacement value, or the replacement value based on the year 1913 is used. Only minor knowledge of maintenance costs and projections are necessary to complete this type of calculation. When using these value-based approaches, the only relevant factors are those that determine cost. The annual rise in building prices are not taken into account by this method. Therefore, each year this method is applied, the funding available for maintenance actually decreases.

In comparison to the two methods described above, the calculation of maintenance funds using analytical methods is much more precise. Analytical methods include the consideration of different variables, such as building age, number of technical installations, or the kind of use. These variables allow a more precise and building-specific calculation to be made.

Most of the described methods are based on adapting the replacement value to so-called correction factors that could occur due to certain impacts. However, there are also other methods that employ completely different approaches to maintenance calculations. The condition-based budgeting method requires detailed knowledge of different components. The maintenance requirements are assessed via systematic and periodic building inspections. Early identification of necessary maintenance measures helps to prevent consequential damages. This approach to the calculation of maintenance budgets requires a comparatively large time commitment.

All these budgeting methods were analyzed in the BEWIS research project (Optimized maintenance strategy to maintain the value of existing buildings).The project analyzed maintenance data on 20 existing public buildings, and enabled the research team to compare real budgets with budgets produced using the different methods outlined above.

BEWIS RESEARCH PROJECT

The analyses that are a product of the BEWIS research project were generated from the lifecycle data of the 20 building data set. The research project was initiated by the Department of Facility Management at the Universität Karlsruhe (TH), and included facilities of several German towns and municipalities and buildings of the Catholic Church. Within the project, 20 office and school buildings were analyzed in terms of the maintenance measures that had been conducted in these facilities and their costs. The data covers these facilities from the point of construction until the current day, and they were collected empirically.

- cost of building construction
- year of construction
- type of use
- geometrical dimensions (building size dimensions)
- maintenance measures differentiated by:
  - type of measure (DIN 31051, German Institute for Standardiziation))
  - affected component
  - time
  - costs of the measure
- repair backlog for the analyzed buildings [€]

The analyzed buildings were constructed between 1952 and 1984. In 2004, when the project analyses were completed, the age of the buildings was between 20 and 52 years old. Depending the type, age, and size of the buildings, somewhere between 700 to 2 500 datasets were collected and analyzed for each facility. Each dataset represents one maintenance measure. Altogether approx. 29,000 data sets were analyzed.

To compare the lifelong maintenance costs for the facilities, it was necessary to consider the rising cost of maintenance interventions. All the cost data were indexed with the official price index list of the German Federal Statistical Office for the base year 2004.

EVALUATION

The construction value-based budgeting methods were tested by the BEWIS Research Project using the data sets from the 20 buildings that were part of the project. Calculating the maintenance budget using this method, building costs had to be multiplied using a defined percentage (yearly standard rate). The maintenance costs depended primarily on the building construction costs. The value of the percentage rate varied between 0.8% and 3.0% of the construction costs (HK). The different percentage rates are multiplied by the construction costs of the analyzed buildings. The calculated maintenance costs and the real maintenance expenses of the buildings are shown in the figure below.

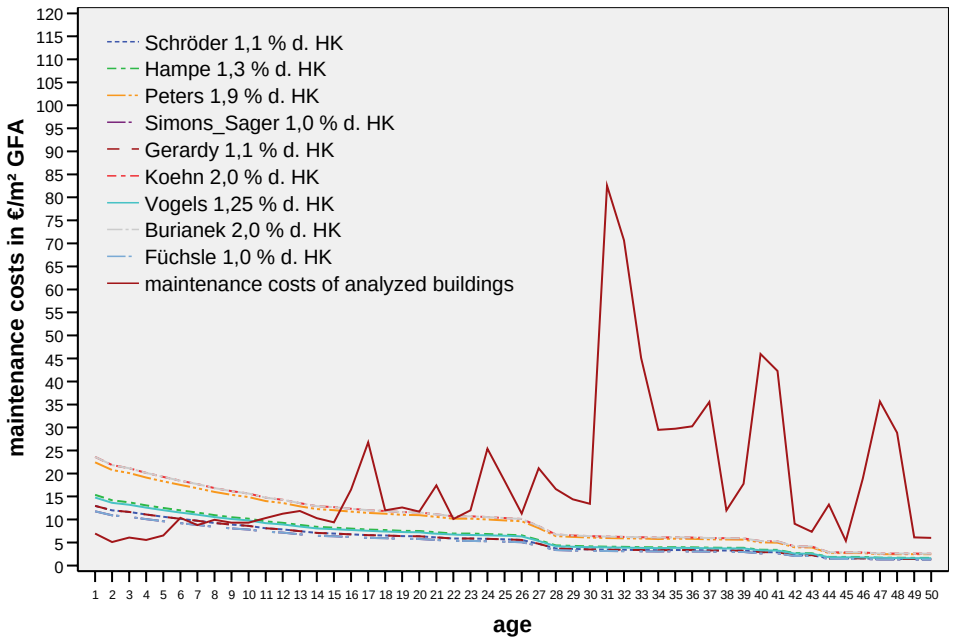

Figure 1: comparison calculated costs with real maintenance expenses, (Schröder, 1989), (Hampe, 1986), (Peters, 1984), (Simons und Sager, 1980), (Gerardy, 1980), (Koehn, 1976), (Vogels, 1977), (Burianek, 1973), (Füchsle, 1970)

The construction cost-based methods did not include a mechanism to estimate the rising cost of annual maintenance measures. Because of this inflation-adjustment calculation was missing, the maintenance funds set aside using this method actually decreased over the years. As a result, the employees responsible for maintenance had less funding available each year with which to maintain the value of their buildings. Figure 1 shows that real cost requirements for maintenance increase each year, as buildings get older .

The deviation in construction costs based on maintenance expenses to the real expenses are shown in the following figure.

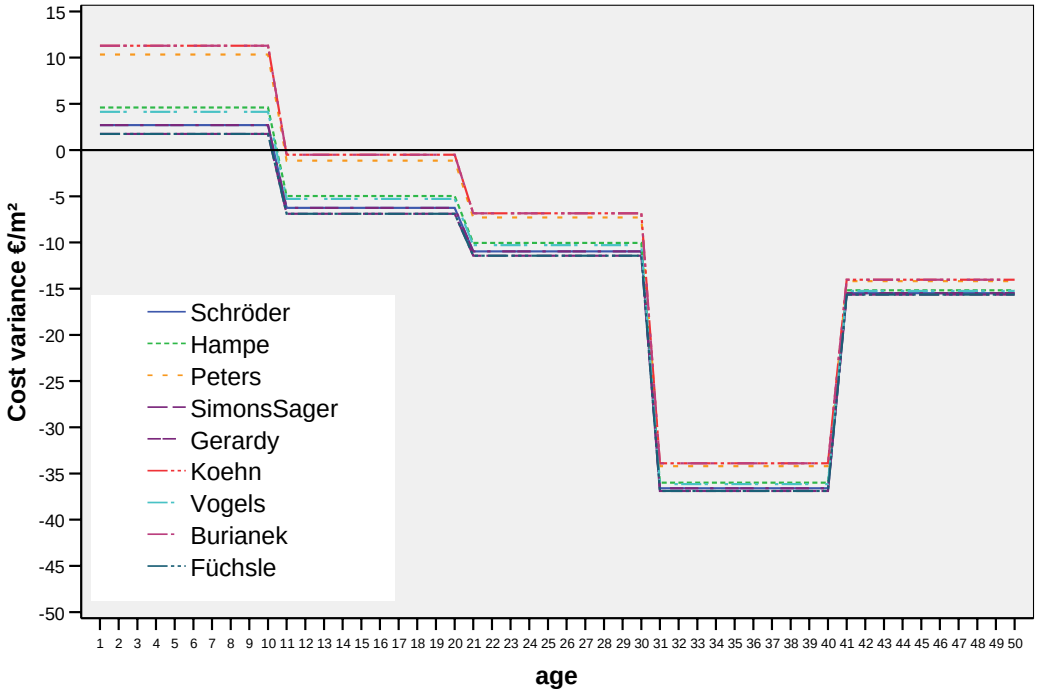

Figure 2: Variations of the calculated values of the real maintenance costs

The analysis shows, that all calculated values for all budgeting methods fall below the real maintenance costs after 10 years. Maintenance costs that were calculated in this manner will be under-funded.

In the context of the research project, key figure-oriented budgeting, replacement value-oriented budgeting, and analytical budgeting methods were also tested. The percentage deviation of the calculated value estimates from the real cost data are shown in the following chart:

Table 1: Percentage deviation of the calculated values from the real maintenance expenses

Budgeting Method	Process	Deviation (age 0-30)
Key figure-oriented	IIBV	-57 %
	BMI Büro	207 %
	BMI Schule	157 %
	FM Monitor	22 %
	OSCAR	22 %
	IFMA	116 %
Value oriented	EFNMS	77 %
	Christen / Meyer-Meierling	11 %
	Frutig / Reiblich	33 %
	IPBau	170 %
analytical	Naber	-43 %
	KGSt	-8 %
	AMEV	19 %
	Berliner	94 %
	Essener	-23 %

The analyses illustrate the lack of reality based methods for the calculation and estimation of maintenance funds.

PRACTICAL APPLICATIONS

In practice, the fact that the budgeting methods that are being used to project maintenance costs for publically-owned facilities fall short of real needs, as described above, is a problem. The Facility Management staff that are responsible for calculating maintenance budgets for facilities are using budgeting methods that will cause their projected budgets to fall short in terms of real needs each year. Because essential knowledge about real maintenance requirements and other cost relevant factors are missing in the previous year estimates that are being used, the calculation of maintenance budgets continues to be imprecise and unpractical. Rational and reliable calculations are not possible using these methods. This fact belies a general lack of transparency in the planning and budgeting of maintenance measures that this project was able to uncover.

To maintain the value of public buildings, the allocation of the appropriate amount of financial resources for maintenance has to be predicted ahead of time and appropriate methods for the calculation of these costs have to be employed. The Department of Facility Management at the Universität Karlsruhe (TH) developed a method for calculating maintenance budgets which would enable Facility Managers dealing with public holdings to calculate accurate budget projections for the maintenance of their real estate portfolios. The BEWIS research project was able to contrast and compare different budgeting methods and

finally identify parameters that affect maintenance costs. The budgeting method this project produced can be used as a tool for the future estimation of maintenance costs for facilities of all types.

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