Controlling Costs and Quality

in the Early Phases of the Accommodation Process

Kees Gerritse

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VSSD

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Preface

'Precious' can have two meanings: expensive and valuable. This is a good illustration of how inseparable the concepts of cost and quality are. During the design process, designers make thousands of decisions which interact with one another and which have major consequences for both quality and costs. So designing is an iterative process, an ongoing effort to make the best decisions within the given conditions. Designers are also in the habit of seeking new possibilities by challenging the limiting conditions. The increasing complexity of building projects has meant that various designers and consultants have to work on solutions in parallel, as a team. It is a situation in which cost control in the traditional sense (of budget monitoring) is likely to have an inhibiting effect on any readiness to try new possibilities. The involvement of costing experts in the planning and design decisions is intended, rather, to promote unexpected solutions. Such specialists are required to consider costs from the viewpoint of a designer rather than that of an accountant. Unfortunately, knowledge about the relation between quality and costs is not widely spread, so that this subject is poorly represented in the training of designers. This results in missed opportunities.

In the Netherlands, extra research efforts have been made in this field since the early 1980s on the initiative of the Government Architect of that period, Tjeerd Dijkstra. A body of knowledge has been acquired that has made the relation between costs and quality transparent and open to discussion. Extensive use of this knowledge has been made in recent decades for the development of new building types, which have been built and evaluated in practice. The Netherlands has consequently built up a lead in the area, so stimulating international efforts to explore the subject farther. It is surprising that this knowledge continues to play so little part in the training of designers; they are after all the ones who can take advantage of the knowledge to explore new possibilities. Kees Gerritse was one of the researchers who played a key role in this field in recent decades, contributing his background as an architect. In this book he introduces us to the world of cost/quality control in the early phases of the accommodation process, the phases where the most important decisions affecting cost and quality are made. It is a clear, accessible text that gives the reader insight into the possibilities and limitations of design decisions. I warmly recommend this book for use in training, practice and research.

Prof. Ir. Hans de Jonge

Chairman Department of Real Estate & Housing
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Contents

1 Introduction

1.1 Background to this book

In 1983, the Government Buildings Agency commissioned the Faculty of Architecture of TU Delft to carry out a substantial research project into the relation between costs and quality for new VWO (pre-university education) schools. Hans de Jonge led the research team, which consisted of Wietze van Houten, Kees Gerritse, Kees Wassenaar and Aart Schuur. The study was wide-ranging, in-depth and fundamental. It concerned both investment and operating, and drew heavily on expertise from the professional field. Cost/quality modelling using computers yielded useful insights into the relations between cost and quality for these schools. A series of studies followed to investigate cost/quality relations for prisons, health centres and office buildings. Some members of the research team became employees of the Government Buildings Agency, where the research projects were set up under the leadership of Hans de Jonge. The Government Buildings Agency and TU Delft began collaborating in the area of research into the relation between costs and quality. The research concentrated on office buildings, with cost/quality modelling forming the main basis for budgeting. A computational model for offices was developed (Levensduurkostenmodel, the 'Life Cycle Cost Model LCC') as a further development of the model created for the schools.
A platform was established in 1994 to allow pioneers in the field of cost/quality modelling to exchange experiences and develop new ideas together. The platform was called 'PARAP' (a reference to the paraplu or umbrella under which knowledge areas and various forms of experience were gathered). The PARAP group consisted of Wietze van Houten and Kees Gerritse, who created the LCC model as part of the Government Buildings Agency/TU Delft collaboration, Sjoerd Bijleveld and Wout van der Toorn Vrijthof, who developed cost models for education at TU Delft, Karel Dekker, who created the DECIM model on behalf of the Foundation for Building Research (SBR), and Willem Meijer, the prime mover of the HOLOMOD computational model. The inspiring sessions of the PARAP group formed a context for the participants to exchange the knowledge and experience gained in the development of the various models, and to combine these in the quest for new concepts. The PARAP group carried out the 'Kantelpuntonderzoek' (Crossover Point Research) on commission of the Government Buildings Agency. This study aimed to establish a basis for reducing energy consumption in the government's stock of buildings, while preserving a reasonable return on investment. The team for the study was expanded to include Bert Elkhuizen (TNO Building and Construction Research – HVAC) and André van Delft (TNO Building and Construction Research/ DEMO). A supplementary phase of the Crossover Point study emphasized the impact of autonomous social developments, such as increasing computer use and flexible working hours, on energy consumption. This part-study was led by Ruud Melis in a collaboration between PARAP and the consulting engineers Deerns Raadgevende Ingenieurs.
The present book is thus the outcome of considerable cost/quality research and of the efforts of people who have had an opportunity to learn a lot from one another. The author is grateful to these individuals, as well as to the inspiring leadership from members of the Government Buildings Agency, initially by Hans de Jonge in the post of Director of Research and later by his successor Wim Pullen. It is high time to share the empirical knowledge and insights gained more widely. That is the purpose of this book.

1.2 This book

Control of costs in relation to quality

People still tend to interpret efforts to control cost in relation to quality merely as a matter of cost-cutting. They effectively turn the clock back to the early 1970s, when the management budget was the first reliable indication of building costs. The management budget was based on the consumption of assets such as materials, labour, equipment and subcontracting, and could thus not be drawn up until the specifications and contract drawings were largely complete. By that time, the briefing phase was no more than a distant memory and the preparatory phase was in full swing, while everybody was still operating on a building costs budget based on crude indications of quantities per m² or per m3. Attempts to adjust the budget at this late stage in the process generally took the form of cost cutting, with inevitable frustration on the part of the client and the architect, and wastage of time and resources.

The introduction of the 'cost elements method' in the 1970s made it possible to bring the moment of truth forward to an earlier part of the process. Because element-based cost estimates are calculated using quantities determined during the design process, it is possible to directly influence the cost/quality relation using a more reliable cost estimation basis than mere quantities per m² or per m3. The 'cost elements method' relies on knowledge obtained at the level of production resources, and operates at a different level with different cost units. Knowledge obtained in the late process phases is brought forward in the process and applied at a different level. Data obtained at the level of elements can be put to use in the preceding brief definition phase. This data originates both from the analysis of existing buildings and from thematic model studies.

This book is about how this kind of knowledge is developed. It concentrates especially on cost/quality control in the early phases of the process, and examines the possibilities offered in this area by cost/quality modelling.

The structure of this book

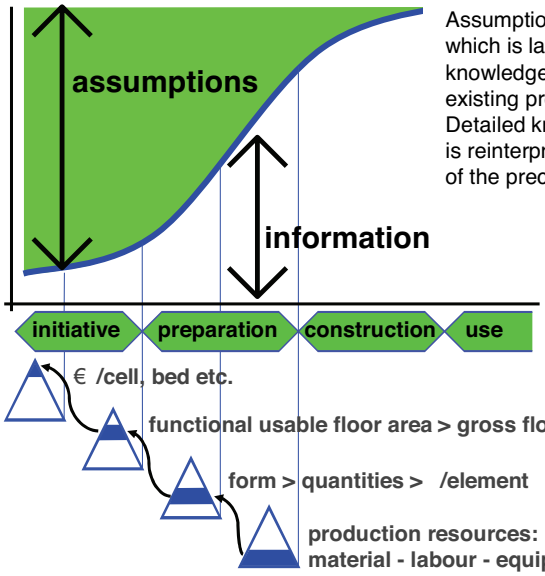
Chapters 2 and 3 describe the context in which the control of costs and quality takes place. They explain some of the terminology used. Chapter 4 goes into detail about the problems of controlling of costs and quality. Chapters 5 to 8 examine quality aspects that strongly influence costs. Chapter 9 discusses cost/quality modelling as an important tool for managing the relation between costs and quality. Chapter 10 is an epilogue, and Chapter 11 presents a selection of relevant literature and other sources.

Form and content

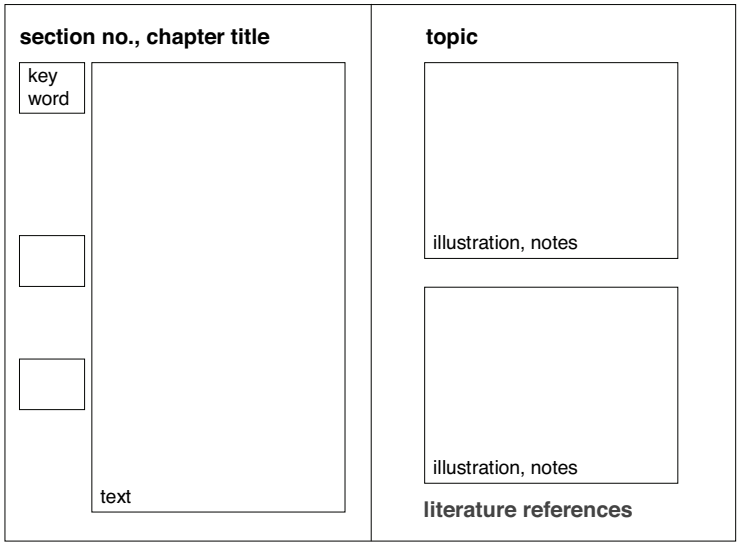
This book is designed so that you will find a specific topic dealt with on the facing pages wherever you open it. Each double-page spread is organized in principally the same way: the left hand page contains text and keywords, and the right hand page bears two figures and some literature references. The figures support the text opposite. A figure may be a photograph, a diagram illustrating a concept or a representation of data (such as a chart) relevant to the text. The main purpose of the figures is to help the information stick in your memory. You can surf the book at random and pick out any topic that interests you a particular moment.

Literature

A building is a complex organism which can be described from the viewpoint of many different areas of knowledge. It is outside the scope of this book to treat all these areas of knowledge in depth. That is why each double page has separate literature references.



Assumptions make up for information which is lacking. They are based on knowledge obtained by the analysis of existing projects and model studies. Detailed knowledge from later stages is reinterpreted at the abstraction level of the preceding stages.



one self-contained topic per double-page spread

Literature [35], [49], [56], [62]

2 Costs and quality

This chapter outlines the principle subject matter of this book. It considers the building as a product and explains some concepts involved in costs and quality

2.1 Terms and definitions
The building as a product. Concepts, conventions and definitions. Characteristics and qualities.

2.2 Characteristics and how to measure them.
Various types of quality based on a wide range of different characteristics. The problem of measuring and evaluating characteristics.

2.3 Hard and soft qualities
Communication and decision taking about quality and the level of detail. Hard qualities on the basis of measurable characteristics, as opposed to soft qualities for which no yardstick is available. Evaluating tenders on the basis of performance specifications.

2.4 Cost definitions
Costs incurred today versus costs incurred in the past or costs to be incurred in the future. Dealing with terms and definitions. The concepts 'expensive' and 'cheap'.

2.1 Terms and definitions

Building production

Manufacturers of consumer goods such as cars or washing machines generally devote considerable attention to product improvement. They use prototype development in an effort to improve the price/performance ratio, and they draw heavily on user experience data for this purpose. But the production of buildings differs in several typical respects from industrial manufacturing processes:

- The separation of design and production.
- The low level of serial production of the end product.
- The widespread lack of systematically gathered data on the use of the product.

The long service life of buildings and the considerable impact they have on their users and the surroundings make building into a production process where considerations of politics and urban development militate against a product-like approach. The cost/quality studies described here relate primarily to the building as a product, rather than to the process aspects of building production.

Terms and definitions

The relatively tight financial situation and growing operating costs of buildings in recent years have prompted people to take a greater interest in cost/quality issues, in order to provide a sounder basis for strategic decisions. Since cost/quality issues are largely a question of measuring and comparing, at least a minimal glossary of terms is needed. The amount of terminological confusion surrounding cost concepts is enormous. With regard to investment costs, 10 to 15 years of discussion have been required to achieve some degree of clarity. For operating costs, the situation is even more difficult: should the refurbishment of a building be classified as preservation, maintenance, or investment? The 'quality' concept is yet harder to pin down, because many of the qualitative aspects of a building are undefinable in objective terms. The meaning people attach to the term 'quality' is often confused. The ISO 9000 standard defines quality as the degree to which something satisfies the demands placed on it. Quality in this sense means the judgements people make about characteristics or sets of characteristics.

Characteristics and quality

Characteristics are open to unambiguous description, so at least we can communicate with one another about them. A length of 1 metre is the same size in France as it is in the Netherlands, and was the same size in 1960 as it is now. The International System of Units (SI) is a set of consensus definitions of units. The metre, for example, is defined as the path length traversed by light through a vacuum in 1/299,792,458 seconds. We can express heat transmission in Watts per m^2 per degree Kelvin; and the Watt and the degree Kelvin similarly have unequivocal definitions.

For quality, the evaluation of characteristics, it is a different mater. We use expressions like 'good' or 'bad' or classes 1, 2 or 3. Assessments like these vary according to time, place and culture. In the 1960s, the insulation value of an uninsulated cavity wall was classified as 'good', while today the Dutch building regulations would prohibit the use of a structural component with the same characteristics. The detailing of a sliding door ground sill of a type used in southern Spain is not approved for use in a cold, wet country like the Netherlands. Similarly, different house plans are preferred in different regions.

The Netherlands Standards Institute issues standard documents which define terms and specify agreed standards. The standard documents are compiled by bodies involved in the industry and are evaluated in the field.

The standard documents most relevant to cost/quality relations are:

NEN 2580 Surface areas and volumetric content of buildings: terms, definitions and determination methods (2001)

NEN 2658 Schedules of Requirements for buildings and the associated project procedure (1993)

NEN 2631 Investment costs for buildings: lexicon and classification (1979)

NEN 2632 Operating costs of buildings: lexicon and classification (1980)

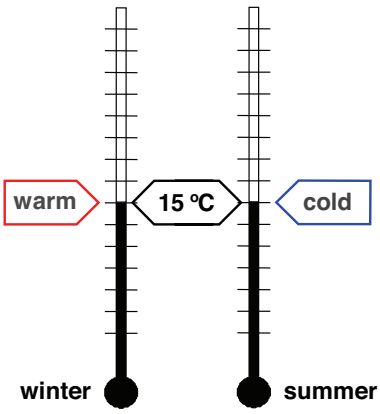
NEN 2634 Terms, definitions and rules for communicating information on costs and quality aspects for building projects (2002)

NEN 3699 Measuring method for determining net quantities of building components, plant components and results with specification guidelines (1993)

quality according to the definition:
the degree to which something satisfies the demands placed on it

the judgement of a property is dependent on:
- **time**
- **place**
- **culture**

a property is independent of :
- **time**
- **place**
- **culture**



Literature [31] t/m [36], [62], [66]

2.2 Characteristics and how to measure them

Differing characteristics

The factor that makes communication about quality so difficult is the fact that we usually implicitly refer to a large set of different characteristics. One person may attach great value to certain characteristics in the set, while someone else may dwell on those characteristics he considers undesirable. This judgement often says more about the person performing it than about the object being evaluated. Consider the example of two housing projects built in or near Paris, both designed by the Spanish architect Ricardo Bofill. It is the quality of these projects at the city scale that attracts people from all over the world to visit them. Judging the projects from the standpoint of an organization with a focus on residential quality such as the Dutch 'Women's Advisory Committees' – concerned with matters such as a private outdoor space, room to hang washing lines, bicycle parking facilities and storage space for dustbins – one is likely to arrive at an entirely different assessment.

The dualism of the quality judgement persists down to the level of details. A large glazed wall may assessed as positive with regard to the inside-outside relation, but as a disaster from the viewpoint of building physics.

Measurability of characteristics

Following the example of the Ancient Roman architect Vitruvius, we can divide the qualities that play a part in buildings into three categories:

- The spatial-visual quality, which comprises the area of aesthetics. Form, colour, texture, scale and light are involved. The subjective experience of the building and its spatial effect are crucial.
- The functional quality, which comprises the characteristics of the building which enable the functioning of an organization or process housed in the building. The available floor space, building form, plan organization, clarity of layout and orientation are involved. It also relates to flexibility and the possibility of adding or splitting off sections of the building.
- The technical quality, which comprises the structural characteristics of the building and its installed services. This concerns the building materials and detailing, strength and building-physical characteristics.

The interrelatedness of different characteristics and the way these are incorporated into a single concept, is a quality in its own right. The whole is more than the sum of its parts.

This summary of characteristics brings us to the question of their measurability. In the case of the technical quality, most of the characteristics involved are measurable. Examples are temperature, total hours out of preferred range, kilowatts, decibels etc. Matters become more difficult in the case of functional quality. Surface areas can be measured, and it is possible to communicate about walking distance, ceiling height and the number of lifts; but concepts such as flexibility are hard to quantify. Measuring spatio-visual quality is vastly more difficult still. There are no unequivocal yardsticks in these areas, and history shows us that the appreciation of a specific architectural solution can vary considerably through time. Stichting REN has developed a set of standards in which hard-to-measure qualities have been categorized into five classes on the basis of references. The characteristics are stated and thus open to discussion.

residential development in Paris, designed by Bofill

residential development in St. Quentin-en-Yvelines, designed by Bofill

Photographs: Photographic Service, Faculty of Architecture, Delft University

2.1.6 suitability for allocation as occupiable rooms

m2 UFA of facade zone with glazing (6m depth or less for loadbearing walls) as % of total m2 GFA of a standard office floor

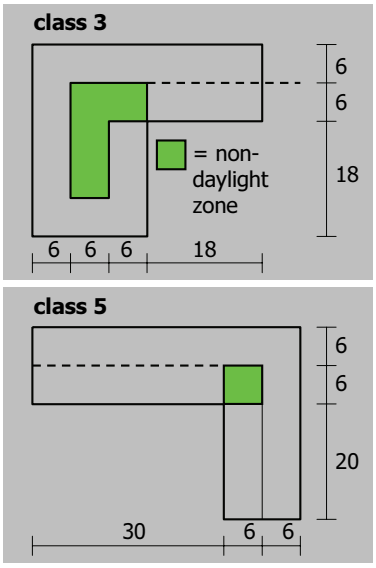
class 1 less than 70%

class 2 70 to 80%

class 3 80 to 85%

class 4 85 to 90%

class 5 90% or greater



Source: Real Estate Norm Quick Scan Kantoorgebouwen. (1994)

Literature [40], [62] t/m [66]

2.3 Hard and soft qualities

Keeping it simple

Among the partners in the building process, there is an observable inclination to avoid taking troublesome, context-dependent decisions. People prefer to decide on the basis of a limited number of considerations, without ifs and buts. It is sometimes said that €1,000 per square metre gross floor is a reasonable price for the building costs for an office building of moderate quality. For good quality, the price may easily rise to €1,500, and for excellent quality it may be €2,000. On the other hand, you can't expect much for €700. These cost bandwidths are usually based on rough indicators, as the example opposite shows. An approach of this kind may well have the charm of simplicity, but it can easily go wrong. The table gives an illustrative example of this. The implicit assumption for the costs of the facade per m² GFA given in the table is a facade/GFA ratio of 0.5. For typical office buildings, this ratio lies in practice between 0.4 and 0.8, according to the size, the number of floors and the building depth. An unfavourable facade/GFA ratio thus automatically produces almost twice as large a figure for the cost of the facade per m² gross floor area! The choice of an HVAC installation is similarly constrained. Besides the characteristics of the building, it is chiefly a question of building use. If the users make extensive use of computers in spaces with large areas of facade glazing, as often is the case on the top floor of an office building nowadays, even opting for a central heating system with mechanical ventilation and a chilled ceiling system is insufficient.

Hard and soft qualities

The danger inherent in keeping it simple is the problem of hard-to-measure characteristics. It is easy to give way to the temptation of basing decisions solely on qualities that are easy to measure – known as 'hard' qualities. They almost invariably represent the smaller part of the whole. This phenomenon is not only applicable to developing buildings, by the way. The most important aspects of life usually relate to 'soft' qualities. Just try describing whatever you care about most in terms of metres or kilograms. Quality is not properly analysable: characteristics are lost in the process of analysis.

Performance specifications

The problem situation also affects the evaluation of building plans. To keep evaluations transparent, unambiguous criteria are required. This is not only the case for competitions, but also for calling for tenders on the basis of performance specifications. In normal tendering procedures, the qualities are set down in the specifications and the drawings of a building which has been designed in a specific location. A solution has been adopted in which the soft qualities relating to experience value and possible use are legible from drawings and descriptions. Tender acceptance is in principle on the basis of the lowest price. In the case of tendering on a performance specifications basis, the solution is not yet defined – only the requirements the solution has to satisfy. And here the problem makes itself felt in full. Specifications relating to technical qualities are generally well defined, but practical criteria for the soft qualities are often unavailable. Yet contracts are awarded not only on the basis of price but also of differences in the soft qualities between different designs. So it is hardly surprising that the parties involved in tendering and contracting sometimes end up having to settle their differences in court.

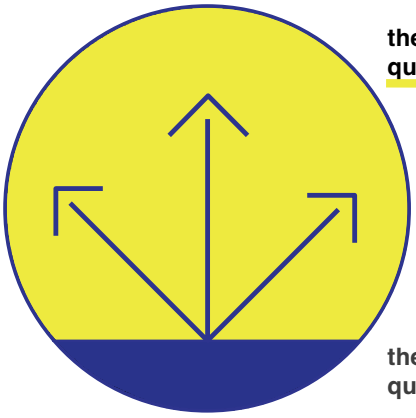
facade	€ /m2 element	€ /m2BVO
brickwork concrete	180 - 360	90
curtain wall	360 - 600	↓
high tech	600 - 700	350

finishes		€ /m2BVO
standard	90 - 130	80
prestige	230 - 360	320

building services		€ /m2BVO
central heating + natural ventilation	40 - 60	40
central heating + mech.ventilation	80 - 100	↓
central heating + mech.ventilation + top cooling	130 - 200	↓
air conditioning	200 - 330	330

reference date 2002

qualities and costs



Literature [40], [63], t/m [66]

2.4 Cost definitions

Measurability

Unlike qualities, costs appear to present no problems of measurability. We can measure them in Euros etc. and the nature of each cost unit is defined in the standards documents. But this simplicity is an illusion. Problems arise as soon as you try apply reference costs from the past to present situations. You have to index the amounts for inflation, thus making assumptions with regard to developments in wages and material prices (input) and with the regard to price developments for buildings, in which developments in the market play a part (output). Indexing over periods longer than 10 years produces extremely unreliable results.

Communication

Despite the terms and definitions laid down in standards documents, there is a tendency to for people to deviate from them, either deliberately or unwittingly. This is not a problem in itself as long as the deviations are explicit and unambiguous. Cost estimates are made at all stages of the building process. Cost data from varying sources is used, varying from databases compiled by the parties themselves on the basis of recent experience, and similar databases purchased from specialized publishers who regularly publish cost data, to information extracted from architecture magazines about the costs of a published building. Since past cost information is essential for estimating future costs, it is important to remain alert to the pitfalls associated with the data and with the definitions and terms.

Misuse of definitions

A problem that often crops up is that people do not know the definitions, or they use them in a way that is contrary to the intentions. The consequences of this can be considerable, as an example will make clear. The building costs as defined in standards document NEN 2361 are made up of the direct costs and 'other costs'. Sometimes it is unclear whether people are speaking of the direct costs or the building costs. People also mention building costs but are actually referring to the costs of structural work, i.e. building costs excluding building services, fixtures and structural fittings. The confusion can become even greater when it emerges that someone is using the term building costs to indicate building costs including the ancillary costs. Terminological confusions of this kind can easily result in differences of a factor of two!

Standards documents are a reflection of the state of affairs at a given moment in time. But society, and hence the world of building makers and users, is subject to continual change. The standards document that sets out definitions of investment costs was drawn up from the viewpoint of building for own use. Office buildings are nowadays often built as investment properties for rental. The tenants rent an empty shell and install their own partitions; in that respect, they pay part of the building cost themselves. So it is misleading to compare the costs of an office buildings rented as unpartitioned shell with office buildings where all the internal walling is installed.

Computer networks are business equipment and the costs forms part of the fitting-out costs of the building. But the cost of network cabling is often included in the building costs since the cables are installed at the same time as the mains electrical wiring.

Cheap and expensive

We use the terms 'cheap' and 'expensive' to indicate whether we get value for money or not. These adjectives must not be confused with low or high costs. A number of similar buildings may range from low-cost to high-cost; but the building with the highest costs may well be the cheapest!

Capital costs according to NEN 2631:

- land costs
- building costs
- ancillary costs
- fitting-out costs

→

- site preparation
- cost of building(s)

→ **cost of:**

- **structural work**
- **installed systems**
  - mechanical
  - electrical
  - other systems
- **fixt fittings**

Operating costs according to NEN 2632:

- fixed costs
- technical maintenance
- routine cleaning
- energy costs
- administration charges
- specific operating costs

- land costs

- building costs ---------- direct costs----------**100 %**

staart

site costs	10 %	
general costs	8 %	
profit + risk	4 %	**124 %**

- fitting-out costs

furnishings
services

- ancillary costs---------- 25 - 30 % -----**161 %**

consultancy fees — run-up costs
levies — price increase compensation
insurances — contingencies
finance

- visual art---------- 1 - 1,5 % -----**163 %**

- VAT ---------- 19 % -----**194 %**

Literature [33], [34], [49], [56]