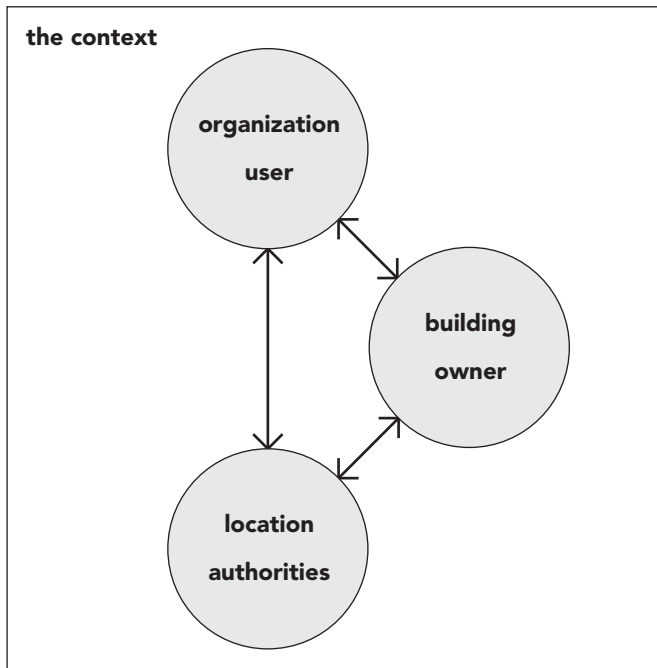


Parap

interactive software for cost modelling

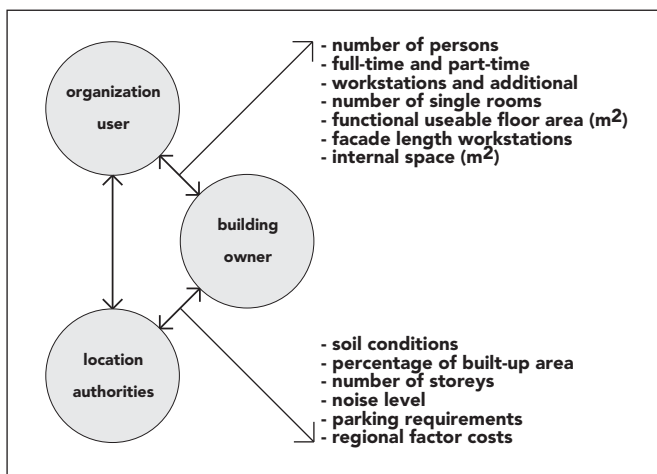


Sheet 1

Parap is a great help in the decision making process of the facility-procurement. In the early stage of the process the foundation of decision-making, within cost-quality relationships, requires very special information. Parap always looks after definitions of context relating cost-quality relations to avoid confusion

The context is triple:

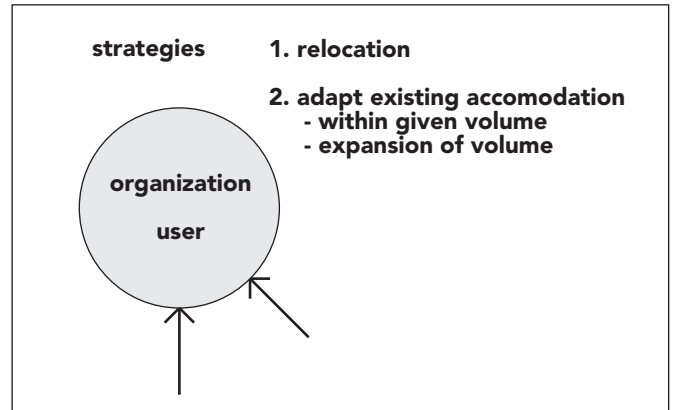
- facilitating which type of organisation;
- the (type of) building;
- the location.



Sheet 2

- The relation organisation/building shows up the aspects.
- the number of employees to be sheltered;
 - the relation fulltime/parttime;
 - the number of workspots and additional rooms and spaces;
 - the number of single rooms;
 - the extent of m² functional area to be considered;

- the available perimeter of the facades, with reference daylight and view;
- the m² of space allowed to be allocated inside the building when no daylight is needed (walled in).

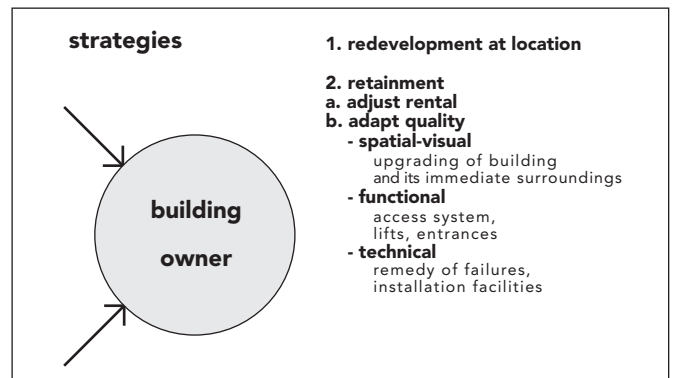


Sheet 3

When an organisation is not satisfied anymore with the facility, the location, or both, a new initiative will be born.

There are two options:

1. change (to another building);
2. adjustment of the accommodation within the building volume, or extending that eventually.

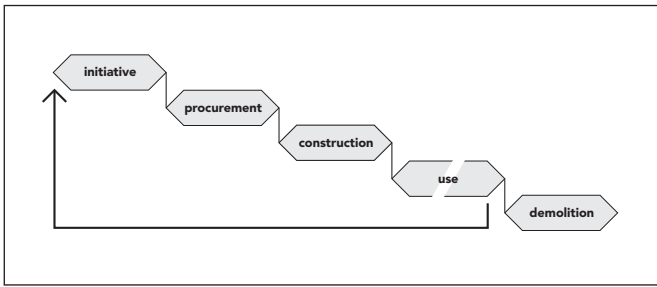


Sheet 4

If the building/accommodation is not acceptable anymore by the organisation (or in general), two strategies are possible:

1. re-development;
2. maintaining, adapting re-calculated rent or an adjusted quality of the accommodation. The latter concerns often the esthetical appearance of the building or/and the environment (upgrading the location).

In a more functional perspective, it is possible to change or adjust entrances lift locations and services. And, to conclude, a technical update of the construction, M&E installations and equipment, also is an option (meeting present-day standards).

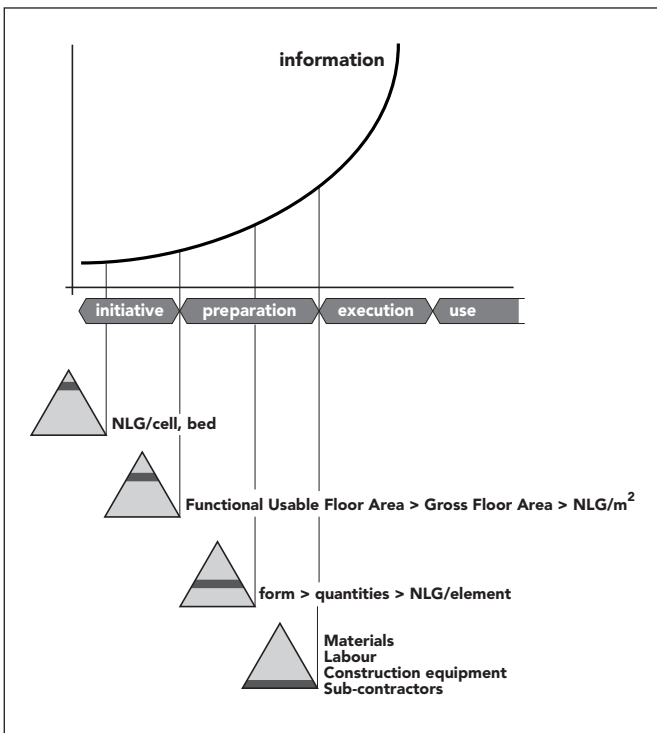


Sheet 5

Building procurement normally shows the following stages:

- initiative;
- preparing drawings, BQ's, calculations;
- constructions, components, buildingsite, use, occupation, management.

If the building does not meet the society's needs or demands anymore, it will be demolished.



Sheet 6

In the course of the procurement process, the extent of information on quality will grow.

Based on that information, the budgeting will also be more detailed.

Result, more certainty about risks.

The information in each stage of the process evaluates towards a status of completeness quantitatives goes from element level to BQ level, ending up in material, labour, equipment and subcontractors.

In the earliest stage of an initiative there is not even a design or, moreover, a brief.

Nevertheless, one has to make decisions about new facilities (penitentiary, health, education). Decisions will be made on 'functional unitcost' number of cells, beds, students multiplied by the cost of a well defined function, generated from historical data.

The brief stage initiates the use of cost per m^2 , for the size of

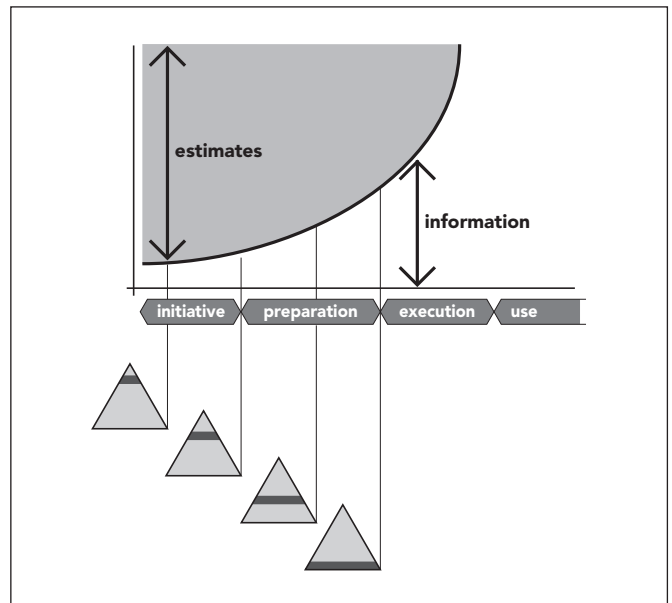
the facility will be approximately known. The functional total m^2 must be evaluated to gross floor m^2 (GFA).

Collecting data from the existing stock, and condensating them to find the key factor is indispensable: from functional m^2 to GFA using the cost/ m^2 GFA.

If there is a design, a budget can be established based on element cost data.

Quantities of footprint, facade, roof, separating walls, completion can be measured and element cost added.

Element costs also are compiled from databases, containing historical or composed data.



Sheet 7

Lack of information will be compensated by assumptions to get a good view on cost-quality developments. Assumptions are founded on:

- analysing built projects;
- model-research, series of archetypes.

cost generators

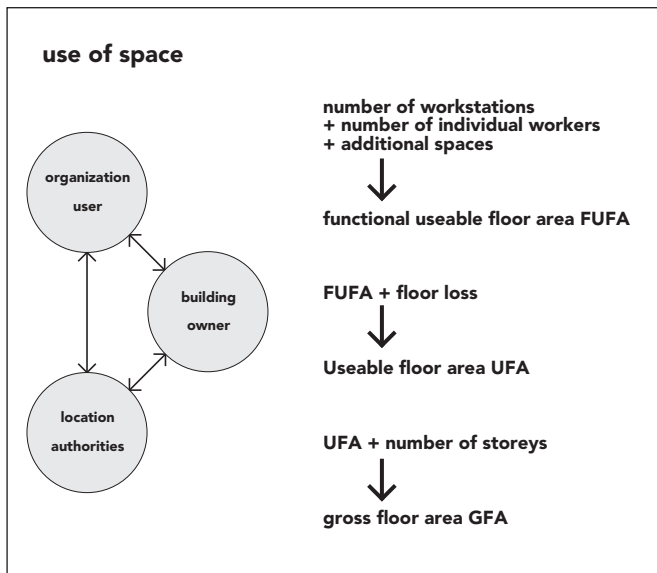
- use of space
- building form
 - stacking
 - average room size
 - internal space
- technical quality

Sheet 8

Analyses of many projects, and a remarkable number of model studies delivered know-how of the items which generate cost information. These items are:

1. the space, the use of m^2 ;
2. The building form (archetype), with as important aspects the number of storeys, the 'grainsize' which is responsible for the quantity of m^2 internal walls and the measure of non-daylight rooms (demanding rooms to be situated on the facade-side);
3. The extent of technical quality (to build in 'wood' or in 'gold').

These 'costgenerators' are subjected to a closer look.



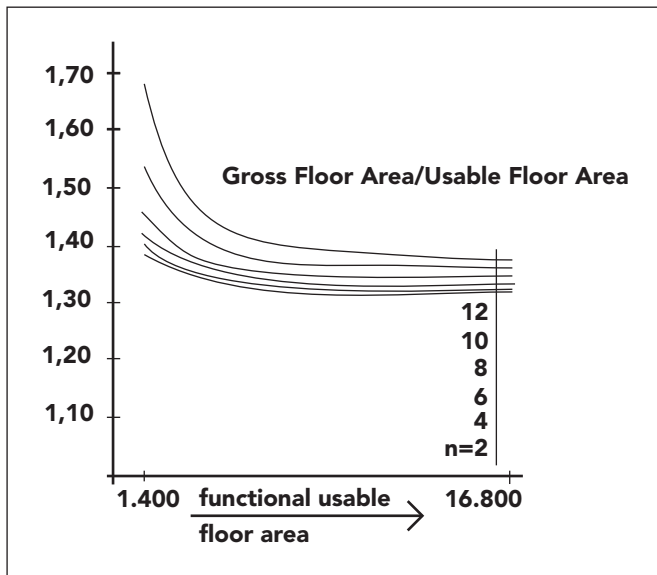
Sheet 9

Use of space.

Organisations claim a total functional area. The number of work spots, single rooms and additional space (meeting, archives, cafeteria) are relevant in this respect. Adaptation of the m^2 by a certain design structure (baysize) will conclude to a certain 'design loss': the real figure of m^2 functional space is more than indicated in the brief. Studies indicate this loss at 5-10%, depending on the character of the structure (archetype).

The access system and the number of storeys influence the step from functional space to GFA. This step needs an other 20 - 40%.

An important role plays the number of storeys influenced by the location of the building (building act. city planning).

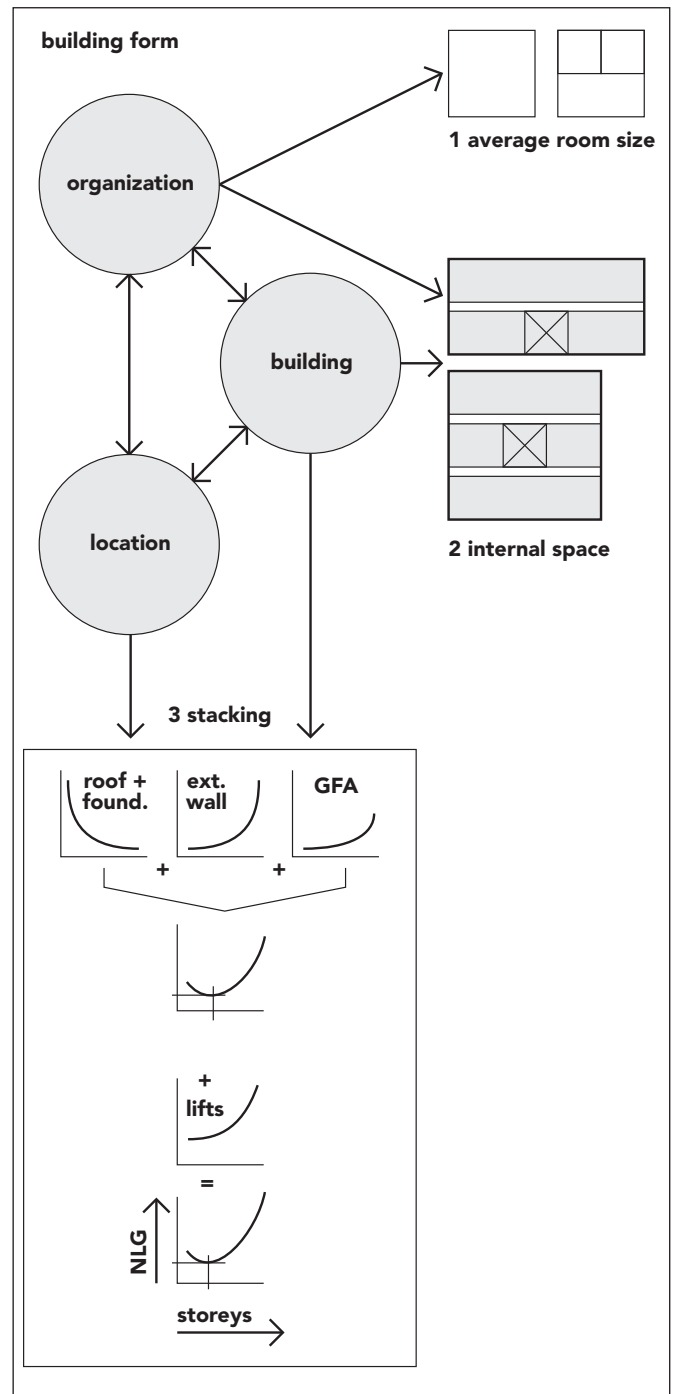


Sheet 10

Analyses of existing stock and a remarkable number of model-studies, by the university of Delft and the 'Rijksgebouwendienst' (procurement office of the central administration), resulted in a deep knowledge of the impact of the number of storeys (floors).

The graphic shows the relation GFA/Net area; the band width is 1,3 to 2,7 within the range of 1.400-16.800 m^2 GFA. The values relate to 2-3-4-6-8-10 and 12 floors.

More floors mean more m^2 GFA. Highrise related to low m^2 GFA results in excessive cost.



Sheet 11

The form of the building. Three aspects are important:

1. The 'grain-size'.

An average small-size room results in more m^2 separating walls. In the brief stage of the project, the average size of the rooms already has been fixed.

2. Rooms without daylight.

The more this type of room is part of design-options, the more possibilities to create a building with as less facade as possible. A twin-corridor layout offers the possibility to allocate daylight poor rooms easily.

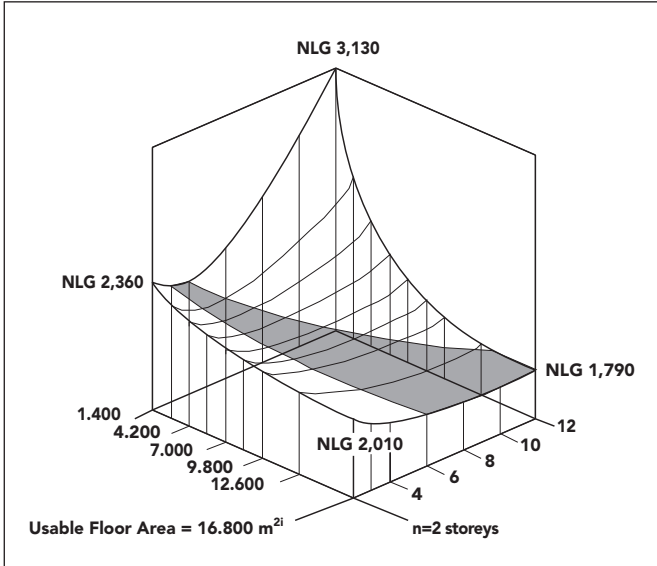
3. Number-of-floors impact.

Townbuilding assimilation and architectural concept defines the number of floors. The impact of the number of floors can be dramatic, focused on cost.

Highrise means:

1. less foundation and roof;
2. more exterior walls;
3. increasing GFA.;
4. sophisticated (expensive) elevators.

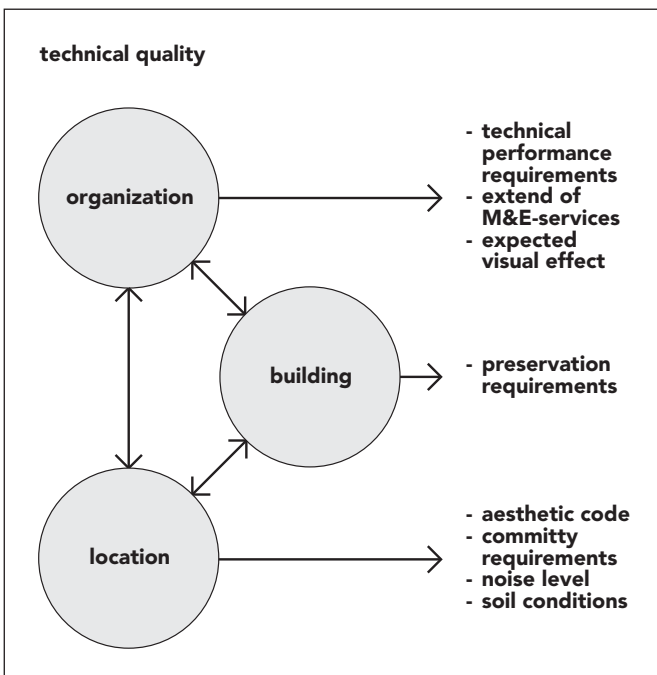
'Translating' these phenomena in a mathematical way results in a minimum domain: a building form (number of floors) showing minimum cost related to defined quality.



Sheet 12

Modelstudies delivered a number of algorithms to be applied to the relationship buildingsize/number-of-floors and cost of the building. The graphic shows this relationship. Cost per net functional area related to building size (1.400 to 16.800 m²) and number of floors (2 to 12). The difference (say gap) between lowest and highest cost is by factor 2!

The minimum domain is shown clearly (grey area).



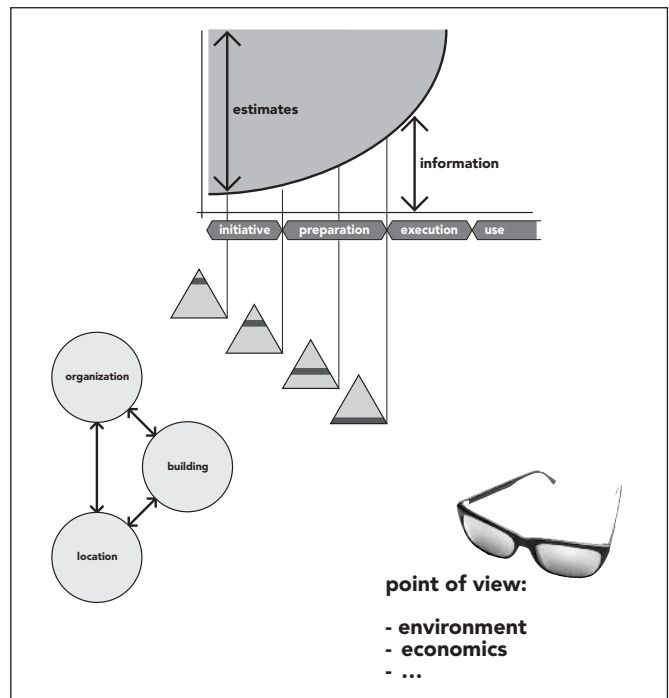
Sheet 13a

ext.wall	NLG/m ² e.w.	NLG/m ² GFA
brickwall/ concrete	400-800	200
curtain wall	800-1300\$	500
high-tech	1300-1500	700
finish		NLG/m ² GFA
standard representational	200-300 500-800	200 800
installations		NLG/m ² GFA
central heating + natural ventilation	100-120	100
central heating + mechanical ventilation	170-200	
central heating + natural ventilation + peak temperature cooling	270-350	
air conditioning	350-450	450

Sheet 13b

The extent of technical quality. Organisations will express their demand for a certain level of technical outfit in terms of quality, i.e. performance of M&E, building components and esthetics. A (protected) monumental building has its character and typical demands too. The location will impact specific solutions in terms of town building, form of the building and appearance thereof.

Also noise-ratings (traffic), soil conditions (pile foundations) and contaminated sites, will have impact on decisionmaking.

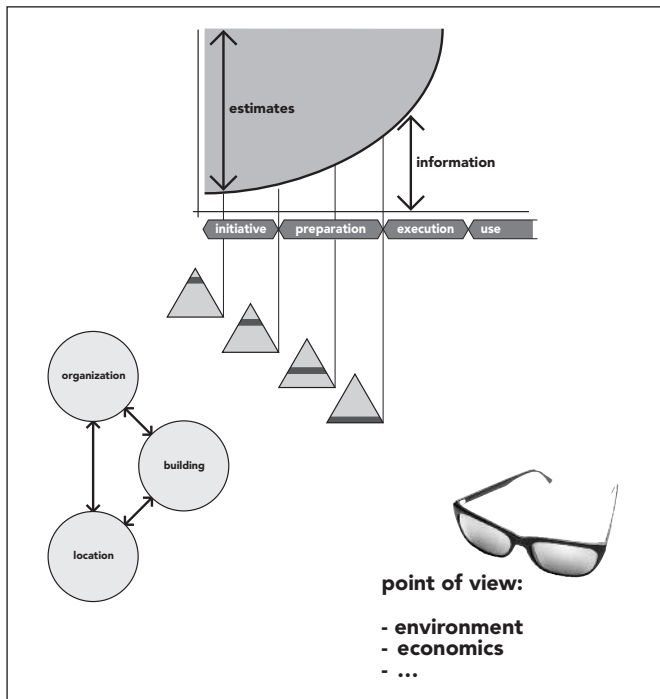


Sheet 14

Parap offers an integrated approach, applying operational research as much as possible, to assist decisionmakers in making choices or selections concerning cost/quality relations, especially in the early stage of project development. The possibility to go for a minimum domain is part of it,

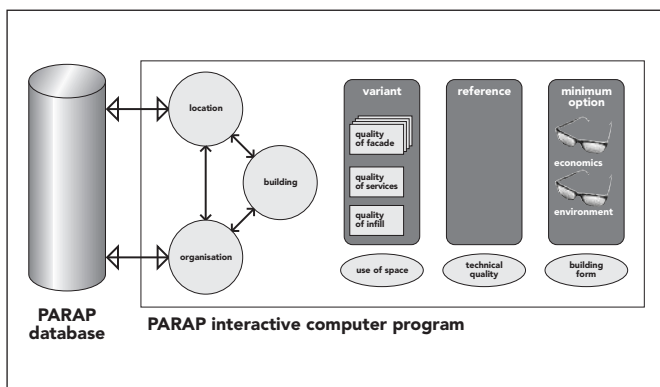
whether for reference or reality. However, this calls for a standpoint; which domain is the objective?

- investment, capital cost;
- cost in use, occupancy cost;
- life cycle cost (LCC) or the 'green issues';
- energy consumption;
- energy content (materials/ equipment);
- demolition (less contamination);
- all the aspects together or a selection.



Sheet 15

The interactive software of Parap has two relevant parts (or fields): the database containing automatic updata facilities and a calculation facility, systemized by mathematics (MCM). The calculation facility offers possibilities to focus on alternatives, references or MD (minimum domain).



Sheet 16

PARAP's input concerns:

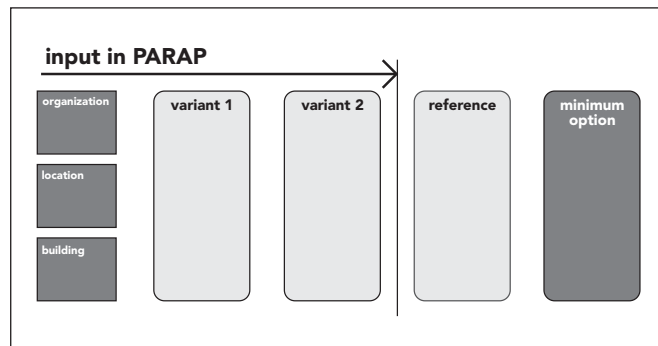
- organisation character;
- building archetype;
- location properties and handicaps.

Each alternative is based on the application of preselected variables. The software looks for (and presents) a reference building (stored in the data base) and offers the MD. Depending on the kind of the decision that will be taken, it is

possible to open a window, indicating organisation parameters. After completion of the format the functional net area will be calculated, and in sequence:

- GFA;
- Quantities of building elements;
- options in quality;

It is also possible, in case an existing building has to be investigated, to start with the building properties and parameters. After completion, the match with the organisation parameters will be done.



Sheet 17

The PARAP output.

Alternatives, references and minimum domains will be shown based on an elongated, oblong form with simple symmetry (slice form).

Cost information is selected:

- total investment;
- cost in use owner;
- cost in use user;
- comparing financial consequences (financing models);
- quality with respect to green issues.

The author is senior lecturer at the Faculty of Architecture – Delft University of Technology (TUD)