Evaluating prototypes

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Publication date
2002

Document Version
Final published version

Published in
Ways to study and research urban, architectural and technical design

Citation (APA)
van der Voordt, DJM. (2002). Evaluating prototypes. In T. M. de Jong, & D. J. M. van der Voordt (Eds.), *Ways to study and research urban, architectural and technical design* (pp. 169-172). DUP Science.

20 EVALUATING PROTOTYPES

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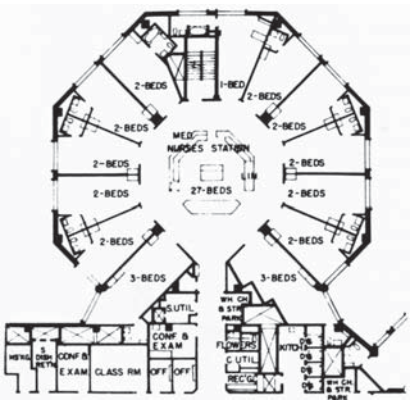
Prototype design usually includes both ex ante evaluation and ex post evaluation. Ex ante evaluation of a first design may lead either to adaptations or to the conclusion that the design is ready to be built. After construction, ex post evaluation of the building may give rise to improvements. When the improved design is built, practical experiences may give rise to further improvements, and so on. This process may be of a sequential order, but design alternatives may also be tested simultaneously (see also Chapter 50). In this Chapter I will discuss several examples of prototype design with different combinations of ex ante and / or ex post evaluation.

20.1 TESTING DESIGNS FOR HEALTH CARE FACILITIES

In the late sixties a 570-bed hospital building was constructed in Rochester, Minnesota, for use as a laboratory for research into various aspects of hospital architecture.[a] One experiment investigated the impact of three different nursing unit designs on the activities and subjective feelings of nursing staff: a radial, single corridor and double-corridor or racetrack type floor plan. All tests using work-sampling and staff questionnaires were completed with the same administration and hospital staff. A total of 590 different people participated over a period of 82 days. In most instances the radial design turned out to be superior to the double-corridor, in its turn superior to the single-corridor design. The radial design showed less absenteeism and fewer accidents to staff members. Staff spent more time with patients, less time in travel. Physicians and patients also preferred the radials. This shows that specially designed buildings can be used to test theories relating architectural design to perception and behaviour. Such research needs designers to design and researchers to research.



149 The radial type nursing unit design

In The Netherlands too, study by design has been carried out in the Public Health System, particularly in Health Centres. Health Centres are co-operative organisations of general practitioners, neighbourhood nurses and social workers; often physio-therapists as well. In several Health Centres a pharmacy, dentist, psychologist and/ or other disciplines have offices.[b] This co-operation under one roof envisages increasing social visibility and the probability of an enduring regaining of health (often from a holistic vision on humanity), as well as using space more efficiently; for instance by sharing reception facilities and waiting-rooms. In the beginning of the eighties the decision was made to develop first-line health care in the New Town Almere entirely along the lines of Health Centres. In order to get more insight into the relationship between programmatic and architectural points of departure, as well as in investment and running costs, four designs were made for the same fictitious organisation. Next, these designs were evaluated in terms of quality of use and costs.[c] Four form variants were studied: peripheral (as many front-rooms as possible) versus compact (with many spaces within the ensemble), and for both variants a one-storey and a two-storey design. Per model two variants for construction were considered: weight carrying façades and inner walls, versus a skeleton structure with non-carrying inner walls. For each model a budget was prepared of the costs of investment, energy supply, technical maintenance and cleaning. Supposing a life-cycle period of 20 years, total costs (of investment plus exploitation) of the compact models proved to be clearly more advantageous than the peripheral models.

a Trites, D.K., F.D. Galbraith et al. (1970) *Influence of nursing-unit design on the activities and subjective feelings of nursing personnel*. For a brief summary see Saarinen, T.F. (1976) *Environmental planning, perception and behavior*.
b Hoogdalem, H., D.J.M. van der Voordt et al. (1985) *Comparative floorplan-analysis as a means to develop design guidelines*.
c Jonge, H. de, W. van Houten et al. (1988) *Prototype ontwikkeling gezondheidscentra Almere*.
d Wener, R., W. Frazier et al. (1985) *Three generations of evaluation and design of correctional facilities*.

	CRITERIA	P-1	P-2	I-1	I-2
1.	Plan-organisation				
1.1	Vertical transport	7	6	7	6
1.2	Situation waiting room	4	6	8	7
1.3	Connection waiting reception	8	8	8	7
1.4	Connection staff-public	4	5	7	6
1.5	Accessibility handicapped	6	5	7	5
1.6	Orientation	6	7	8	7
1.7	Acoustics	7	7	5	6
1.8	Inner climate	8	6	7	5
1.9	Reflection organisation	6	7	8	7
1.10	Usefulness	6	7	8	7
Total plan-organisation		62	64	76	63
2.	Urban architecture				
2.1	Fit to location	4	8	2	4
2.2	Entrance accessibility	6	8	7	6
2.3	Entrance safety	8	6	7	6
2.4	Orientation / sunlight	8	6	7	7
2.5	Stacking / vandalism	5	7	6	7
2.6	Noise hindrance	6	5	7	6
2.7	Construction depth foundation	6	8	6	8
Total urban architecture		43	46	42	44
3.	Future value				
3.1	Extendability	8	6	4	5
3.2	Compartimentation	8	8	5	6
3.3	Reserve space	-	-	-	-
3.4	Multi-functionality	8	7	5	6
3.5	Movability inner walls	-	-	-	-
3.6	Adaptability installations	7	6	5	4
Total future value		31	27	19	21

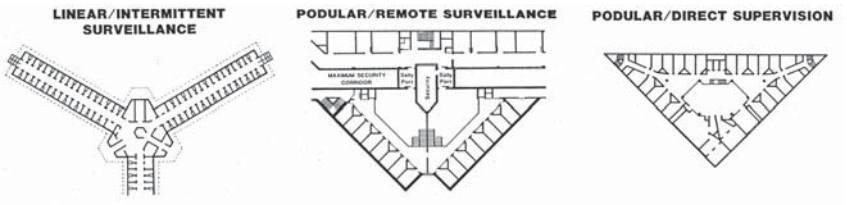
150 Evaluation and ranking criteria

Figure 150 surveys the evaluation criteria and the ranking ascribed to each model by an expert jury.

20.2 PROTOTYPE DESIGN OF CORRECTIONAL FACILITIES

In the mid eighties Wener *et al.*[d] published a paper on the process of data-based design i.e. behaviourally based evaluations in aiding the evolution of a design prototype for correctional facilities. This is a rare, but clear example of a completed cycle of study, build, test and reformulation. As a consequence of a pre-design programming study the Federal Bureau of Prisons rejected earlier models of jail design (generation 0) and developed a new model (generation 1). The old model was seen as oppressive, stressful and dangerous for staff and inmates alike. The new model should provide more humane settings with high levels of security. Basic assumption was that the environment should not be by itself punishing, but should reduce the physical and psychological brutality common in such institutions. Key to the goals of reducing tension and institutional regimentation was the functional unit system in which 40-50 inmates were placed in self-contained housing units. Instead of the usual linear type with intermittent surveillance, the concept of podular/direct supervision was introduced. Officers were placed in the living area, allowing proactive supervision. Each inmate got a single bedroom with a bed, toilet, sink, desk, and outside window. Within units, inmates had considerable freedom of movement through lounge, dining, classroom, and multi-purpose areas. The units were programmed to look non-institutional, by using movable, comfortable furniture, bright colours, and no bars. Most areas were carpeted.

Post-Occupancy Evaluations showed that the facilities were, for the most part, successful. Vandalism and graffiti were almost non-existent; violence and tension were considerably lower than in most other institutions. The staff perceived the environment as safe, clean and challenging. However, the high-rise buildings (12-26 stories) resulted in a frustrating dependency on elevators. Because units were self-sufficient, inmates often spent days or weeks without leaving the area and felt considerable monotony and boredom. Furthermore, two televisions per unit turned out to be too little, and complaints emerged on lack of personal control over physical systems (heating, ventilation). Based on these experiences, a great number of recommendations was made. Most of them were applied in a four storey federal prison in California (generation 2). Again this prison has been evaluated, showing high satisfaction levels overall, but still dis-satisfaction on the ability to individually regulate temperature and fresh air. Other issues of dis-satisfaction were overcrowding (the facility was designed for 383 beds, but in the event used by 520 inmates) and the lack of a secure perimeter beyond the building walls. A desirable result of adopting the direct supervision podular design was to raise the professional competency level for custody staff. Because staff mingles with inmates, they are able to prevent many problems from occurring. The POE-results can be used to improve the prototype again (generation 3).



151 Three different types of correctional facilities

In The Netherlands a study by design of prison systems was also conducted.[a] Considerable shortage of cells for inmates caused an accelerated building programme. Based on systematic analysis of realised projects four models have been developed with well-defined typological differences (figure 152). Particularly the way in which the cells are positioned *vis-à-vis* one another, and with regard to the space outside and to the other facilities, differs:

a. *Model 1: the* radial. The habitation building features two identical wings, four storeys high, at right angles. The cells are opposite one another, the common rooms at the ends. Duplicating both wings generates the so-called 'cross-type', characterised by short walks and ease of surveillance. The idea necessitates a surrounding wall.
b. *Model 2: the* back. This type is provided with a stark, almost blind, outward skin. All spaces are orientated towards the inner court. "Residing" is allocated within two triangular building masses with a lot of inner spaces. The requirement that cells are not allowed to be situated on street level if they adjoin the space outside caused a stapling in five storeys with a surfeit of space on street-level. A surrounding wall is not needed.
c. *Model 3: the* cupola. Point of departure here is a compact form of building. The cells make for the four sides of a square; the pavilion facilities lay in the inside along large viewing apertures. This idea necessitates a surrounding wall.
d. *Model 4: the* atrium. In this model the cells are situated at the outer side, opposite of the pavilion facilities. All parts of the building have been grouped around an area for sports and airing. A surrounding wall is also necessary in this case.

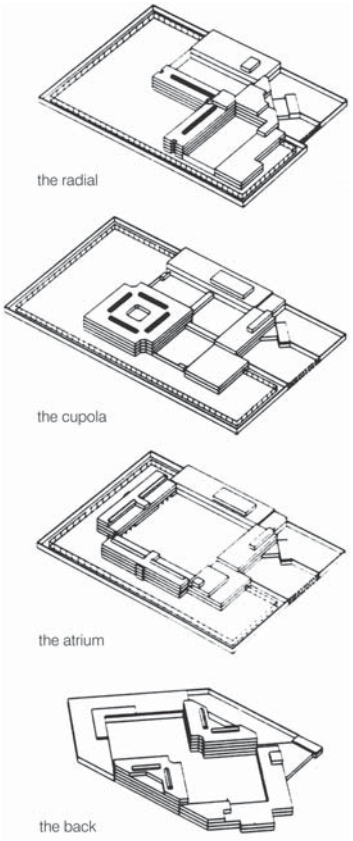
Just as in the case of the study concerning Health Centres, the four models have been compared to one another in terms of costs and quality (figure 153). In this case an important cost variable is utilisation of personnel, an important quality aspect of safety. The costs of construction, including additional costs, those of the site and of Value Added Tax, varied demonstrably between Dfl 254.000 and 360.000 per cell (price level 1989); a lot lower than the 500.000 initially budgeted. This profit mainly stems from sophisticated designs – particularly from a better ratio between net versus gross floor surface than in existing prisons – ascetic use of material and rapid construction.

Model 1 – the radial – boasts the lowest costs per cell, particularly by the lower demand for services of personnel (less static posts).

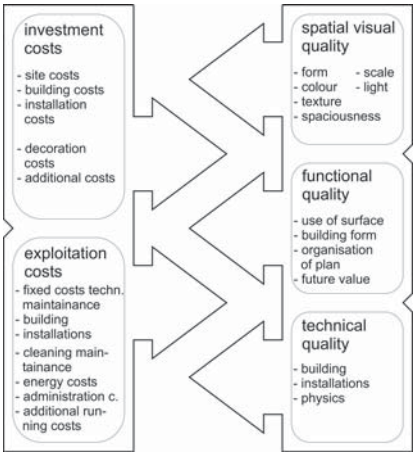
The financial influence of securing the environment proves to be so significant, that model 2 – the back – in spite of the highest costs associated with building itself ends up in terms of total costs in the next but lowest position. Disadvantages of model 2 are mediocre functionality and high level of personnel services. The possibilities for future adjustments are limited.

The financial advantages of the compact model 3 – the cupola – are largely annihilated by the high costs of internal compartmentalising. The model is not readily inspected and requires, just like model 2, a lot of personnel.

Model 4 is the most expensive variant except one; functionally it is rather good, with a reasonable demand for personnel activity. Differences in construction costs, caused by the type of building, are in the order of magnitude of 7% for the cheapest variant. The influence of the technical levels almost triples this. The impact of openings in inner walls and fronts, air-conditioning, sanitary installations and those for security and communication may accumulate to costing differences in the order of magnitude of Dfl 35.000 per cell. This study brought the consequences of some important design decisions to light. In addition to a plan-documentation and analysis of existing prisons, the results were used by government to legitimise empirically the policy for building prisons.



152 Four models for correctional facilities



153 Variables for a cost/ quality comparison

20.3 REFLECTIONS AND CONCLUSIONS

Study by design in conjunction with careful effect analyses may prevent many problems. The examples described demonstrate that considerable advance may be made as far as costs

a Jonge, H. de (1988) *Het beheerste ontwikkelingsproces, voorbeelden van productverbetering;* VROM (1989) *Een vergelijking van penitentiaire inrichtingen in Nederland.*

and quality are concerned. A kindred example is the range of designs for primary schools in the new town Almere in the Netherlands, previously mentioned.[a] By applying extra isolation, recycling heat from mechanically ventilated air, a lot of day-light and automation of electrical illumination, it could be shown for the first generation schools per annum and per building, that on average some 26.000 m^3 natural gas less was needed, compared to traditional school buildings (generation 0). The extra investment could be earned back in less than 10 years. Because of this success in the second generation schools additional energy conserving provisions were implemented, in combination with 'alternative' energy facilities like solar collectors and a wind turbine. It is hoped that this way an additional 2400 m^3 natural gas may be conserved.

In spite of this obvious usefulness of prototype design based on design study and study by design, it is still relatively scarce; and largely exists 'on paper'. This is partly explained by the time and costs incurred by alternative designs and effect-analyses. Another factor is, perhaps, that in design the personal vision of the designer and/ or commissioner is greatly valued. Personal considerations and ideals often guide designs. A thorough effect analysis carries the risk that the design has to change fundamentally. There is also fear of standardisation and repetition; in this case re-producing an existing design solution one more time, in The Netherlands also called 'stamping', a term of derogation. In the long term this can lead to monotony and cultural poverty. However, prototypical buildings are not like mass production products functioning in any context. Each building – even with a generic style or function – is unique in location, orientation, client and user population. Although certain key aspects of the design may stay constant, others necessarily change to fit different needs.

For higher levels of the craft of designing in terms of the profession and of scholarship a continuing exploitation of study by design is crucial. The building blocks: further development of the framework of study (how to make which variables measurable), and establishing databases with reference projects, including plan-analyses and evaluations of costs and quality. Another important condition is the willingness to formulate design objectives and expectations explicitly and openness for objective evaluation. Usually, designers and advisers work together on the same plan during the stage of plan development. It ought to be just as evident that while analysing and evaluating the effects various disciplines should co-operate. Only then 'synthesis' and 'integration' become really meaningful expressions.

a Niesten, J. (1983) *Almere bouwt tweede serie energiezuinige scholen*.