26 THE EMPIRICAL CYCLE

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26.1 SELF-CONTAINED APPROACH

For decades, a generally accepted research methodology existed in behavioural and technical sciences; taught for decades by faculties at institutions of scientific education. In all these educational programs, the letters M&T form a fixed component of the foundation course; methods and techniques of research are a part of every student's standard equipment, and certainly of every graduate.

Presently, the Faculty of Architecture at the TU Delft is looking for its own building methodology, its own design methodology. This does not happen with knowledge from, and reference to, the classical methodology of research at other faculties, nor does it happen together with faculties in other countries where people study architecture and learn design, nor together with other TUD sub-faculties in which building (Civil Engineering and Geosciences) and/or design (Industrial Design Engineering) play a central rôle, and not even together with the associated Faculty of Architecture at the TU Eindhoven. Is this wise? No. Is it effective? No. Are there good reasons for this self-contained, eccentric approach? No.

26.2 SCIENTIFIC FORUM

Let me take the methodology of the behavioural sciences for a starting point, as I learned it 35 years ago from Prof. Dr. A.D. de Groot, one of my supervisors. De Groot is author of the standard work, *'Methodologie. Grondslagen van onderzoek en denken in de gedragswetenschappen'* and was trained as a psychologist.[a] Many followed him, like Baarda & De Goede and Swanborn, each in his own way.[b] Some decidedly more modern authors also concur with the approach presented by De Groot, who strongly emphasises the rôle of the scientific forum. The nomological network of every science (discipline) is constantly in motion, thanks to new empirical data, new insights, new questions, new answers. Discussions within the forum, i.e. the international community of leading researchers (peers) in the field, constantly determine which insights and theories are considered 'true', or labelled untenable. In this process, international associations and/or networks of researchers in the respective domain play a crucial rôle, like international conferences and workshops, along with international journals.

This is a problem for architectural research. The CIB (Conseil International du Bâtiment) is not orientated towards design, the UIA (Union Internationale des Architectes) is not orientated towards practicing of academic science, and there are not many international scientific activities in the field of design. While there are indeed respected international scientific journals, like *Environment & Planning Ed. B (Planning and design)* and *Built Environment*, no designer from Delft has published in them since Olim's day.

Research methodology is first and foremost a habitus: an active willingness to write down insights, justify them, make them verifiable to others, make oneself vulnerable, seek out critics, and allow others to take a look behind the scenes. This is the function of debate in the scientific forum, epitomised in presentations and discussions during international conferences, and in articles and commentaries in academic journals. The faculty is familiar with this phenomenon, for example in the form of the successful Ph.D. conference of architectural schools, organised in Delft several years ago (with Herman van Wegen and Theo van der Voordt as driving forces), or the conferences launched by Arie Graafland. But, on the whole, design research gets unsatisfactory marks. The architectural intervention seems to have been a very local renovation until now.

a Groot, A.D. de (1961) *Methodologie: grondslagen van onderzoek en denken in de gedragswetenschappen*. English translation: (1969) *Methodology: foundations of interference and research in the behavioural sciences*.

b See e.g. Swanborn, P.G. (1991) *Basisboek Sociaal Onderzoek;* Baarda, D.B. and M.P.M. de Goede (2001) *Basisboek methoden en technieken*.

26.3 EMPIRICAL CYCLE

The empirical cycle can be used as basic scheme for a logical-methodological consideration of research, thinking, and reasoning in empirical science. The cycle according to De Groot:

- *Phase 1: Observation*: collecting and grouping empirical factual material; forming hypotheses;
- *Phase 2: Induction*: formulating hypotheses;
- *Phase 3: Deduction*: deriving particular consequences from the hypotheses, in the form of verifiable predictions;
- *Phase 4: Testing*: of the hypothesis, or hypotheses, based on the possible results of predictions in new empirical material;
- *Phase 5: Evaluation*: of the test results with regard to the proposed hypothesis/hypotheses and/or theory/theories, and to possible new, related research.

Phase 1 can be classified almost completely under the psychological induction process. It is assumed that a researcher rarely collects material without some "viewpoint". He chooses, selects, or abstracts from certain data or aspects, groups and registers according to certain criteria. Throughout, at least certain implied hypotheses have inevitably already been decided upon.

In Phase 2 these hypotheses are specified. A hypothesis only becomes a hypothesis if it has been formulated so that particular consequences and specifically concrete, verifiable predictions can be derived from it (operationalisation), then to be tested. This takes place in Phase 3: from a general hypothesis a concrete prediction is derived, one which is strictly verifiable.

Testing hypotheses (Phase 4) has to do with a general connection presumed to exist in, or apply to, a collection of elements considered to be non-identical. On this basis, the researcher makes his prediction regarding cases not yet researched. The results of this test are evaluated in Phase 5. What is the value of the test results? Do they support the hypothesis? Must the hypothesis be dismissed? And what happens to the theory to which the hypothesis is connected? Can it be maintained? Does the theory have to be adjusted? Or completely dismissed?

For Phases 3, 4, and 5, i.e. deduction, testing, and evaluation, there are many statistical techniques and means of calculating probability. These three phases seem to be far removed from the culture of architectural design. Design more closely resembles the processes that take place in Phases 1 and 2: the observation and the "devising" of hypotheses. But, it would be strange to conclude that design could be adequately described using De Groot's empirical cycle. And this was never De Groot's presumption. What is important, is that a designer making a design for a building ensures that his design (which can be compared to a hypothesis) be verifiable. This can, for example, take on the form of a Post Occupancy Evaluation: an evaluation of the building's use. Before an architect makes a design, it is advisable that he learns from prior experience. He needs to become acquainted with previously executed evaluation research, and to be able to interpret the results of this research well. When he has completed his design, he must be able to declare that the design can stand up to the test of experiences and evaluations from comparable buildings that have already been built (precedents).

Even if the designer wants to give maximal space to his creativity, he can be supported by research methods like systems analysis.

26.4 SYSTEMS ANALYSIS

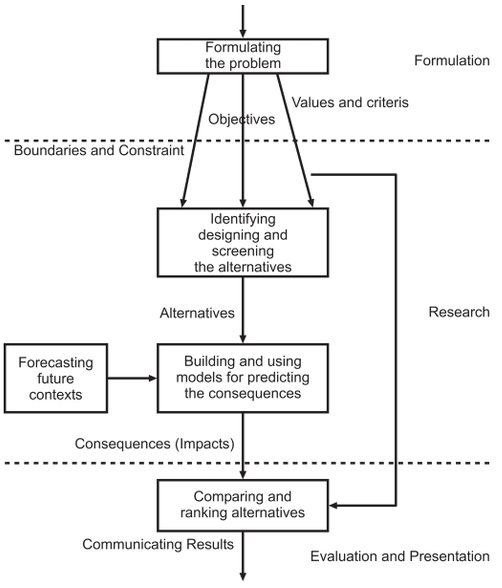
Systems analysis is a craft developed in the United States (for instance by researchers from the Rand Corporation), that was gradually introduced to Europe. This approach is popular with the sub-faculty of Technische Bestuurskunde (Systems Engineering, Policy Analysis and Management). The standard work is the *'Handbook of systems analysis. Overview of uses,*

procedures, applications, and practice' edited by Hugh J. Miser and Edward S. Quade. What follows has been extracted from Chapter 4, *'The Methodology of Systems Analysis: An Introduction and Overview'* by W. Findeisen and E.S. Quade. These authors make use of the diagram alomgside (see figure 264).

Distinctions are made between the following components:

- Formulating the problem;
- Identifying, designing, and screening possible (solution) alternatives;
- Pre-calculating future contexts of "states of the world";
- Constructing and using models for predicting results;
- Comparing and classifying the (solution) alternatives.

Systems analysis is specifically orientated towards the future. The procedure begins with the formulation of a problem. Without a problem, there is no need to think up solutions. The goals are specified, along with the values and criteria, as well as the borders and limits. One can only talk of a problem when a goal has been introduced, along with the obstacles related to reaching this goal. For a designer, this can be a programme of requirements for a building, as well as budgetary pre-conditions. The problem is that what is desired is a building that has not yet been built, one for which the design must first be made.



264 System analysis: procedure (according to Findeisen & Quade).[a]

Step 2 involves identifying, designing, and screening alternative solutions. Here, designing as a solution-orientated strategy is the primary concern. What is interesting is that Findeisen & Quade fail to mention a single word about any specific solution, but instead discuss alternatives. In general, there are many roads to Rome, and only later will it become apparent which road best meets the requirements. In this second phase, there is ample space for fantasy and creativity. As long as an alternative can be verified according to the pre-determined requirements, this is the criterion that determines whether or not an alternative "complies" with this stage.

In Step 3, we take a look into the future and investigate how the world will look in 10 or 20 years, or even further along. What demographic and economic changes are to be expected? In the Netherlands, we can fall back upon the body of work of the *Centraal Bureau voor de Statistiek* (Statistics Netherlands) (population prognoses), the *Centraal Planbureau* (Netherlands Bureau for Economic Policy Analysis) (economic prognoses), and the *Rijksinstituut voor Volksgezondheid en Milieu* (National Institute of Public Health and the Environment) (environmental prognoses). We do not need to choose between these three calculations. Sometimes it is more useful to construct a sensitivity analysis: how adequate is a certain (solution) alternative under various presumptions about the future?

The results, per alternative, are pre-calculated in Step 4, using models that are constructed and then applied. This is an art that hardly anyone within the Faculty of Architecture possesses, and thus professional help would need to be called in here. During Phase 4, we investigate how each alternative would actually turn out concretely, under various presumptions. A given solution might, for example, achieve good results under economically favourable conditions, but may fall short when interest rates increase or if economic growth stagnates.

With the help of the criteria specified in Step 1, the alternatives are compared and classified during Step 5. This can take place based on various presumptions. Ultimately a choice must be made. This means dealing with uncertainty, since no one knows precisely what the future will bring. The policy of the decision-makers plays a major rôle here. Are they trying to reduce risks? Or aiming for extraordinary results? What priorities are they setting with regard to how the building will be used?

a Findeisen, W. and E.S. Quade (1985) *The methology of systems analysis: an introduction and overview*, p.123.

Systems analysis is an extremely suitable tool for helping designers. It forces the designer to consider criteria, values, and goals, that have been specified in advance necessarily. It introduces the desirability of thinking in alternatives, of scanning the future. Alternatives are evaluated *ex ante*. The balancing of various alternatives becomes discussable, and in part even quantifiable. Discussion between various designers, each of whom believes in his or her own design principles, will be removed from the realm of nagging and mutual condemnation. This allows both long-term and short-term discussions of uncertainties, and supports policy considerations of the final decision-maker. In short: an ideal tool for the architectural engineer.

26.5 OPENING THE SHUTTERS

If the Faculty of Architecture takes the search for a methodological foundation seriously, it should continue to build on long-standing, carefully developed, generally applied research methods and techniques. This is the language spoken in scientific education and research, the language of the NWO *(Netherlands Organisation for Scientific Research)* and the STW (Technology Foundation), as well as the one of the international scientific forum. This basic methodology must be offered in the foundation course, so that architectural education can be considered scientific education.

These methods should be employed in architectural research, and the ill-will and bungling which currently exist in the faculty with regard to empirical research (exceptions excluded) must be cast aside. Every designer must be able to evaluate critically the results of empirical research. Toward this end he must be thoroughly familiar with the methods and techniques used.

A complication in the discipline of architecture is heterogeneity. Each building, every location is unique. The formation of theories implies that one is striving for generalisation. In a domain where heterogeneity holds the trump card, there is a tendency to emphasise the uniqueness of the object considered. The tension between uniqueness and generalisation is interesting, but certainly not fatal. The same tension is familiar in psychology: each person is completely unique; yet it remains possible (and wise) to make generally applicable statements about human behaviour in certain situations and circumstances.

If the faculty wants to concentrate more on design in addition to the induction phase, and wants to offer a better methodological substantiation for design, its practitioners should be required to steep themselves in systems analysis, a craft pre-eminently useful to designers. Systems analysis reasons in a problem-orientated way, and stimulates the researcher or designer to think of alternative solutions in evaluating and balancing these alternatives. One must be explicit about the criteria by which these alternatives will be tested. This introduces goals and values to the order of the day. These interesting currents of discovery blowing into the world of methods and techniques need not exist exclusively in the corridors of the Faculty of Architecture in Delft, but rather should encourage communication between researchers., teachers, and students from other faculties and other universities, both domestically and abroad. These currents are an invitation to participate in international conferences, and in the circuits of refereed scientific journals, authors, as well as reviewers. Currently there is not much evidence of such an open, external orientation. The shutters of the Architectural Building seemed to be closed in regard to issues of research methods and techniques. Would it not be a good idea to open these shutters wide for once?