INTERNATIONAL ENERGY AGENCY
Solar Heating & Cooling Programme

Task 23
Optimization of Solar Energy Use in Large Buildings
Subtask B
Design Process Guidelines

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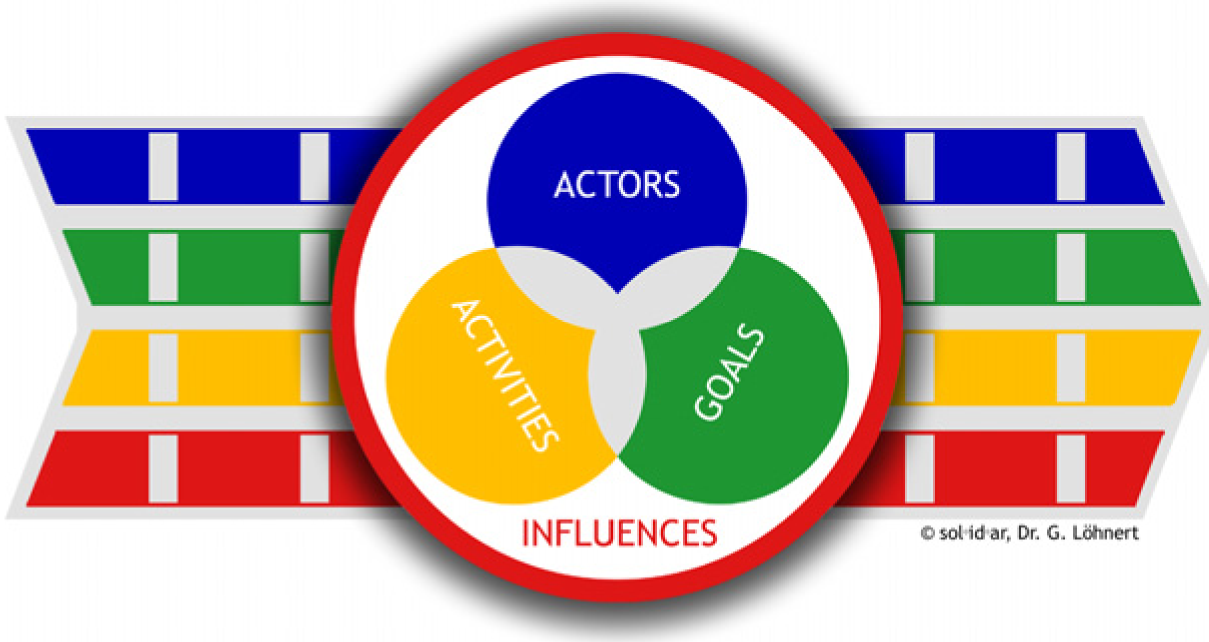
Integrated Design Process



A Guideline for Sustainable and Solar-Optimised Building Design

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KEY STATEMENTS

- The frequently-heard call for increased building quality at lower cost cannot be answered except through the use of integrated design approaches.
- Correlations between economy and ecology need to be linked with future social responsibility and sustainability by a long-term project consideration.
- An investment in a competent design team is the best yield for the client or investor.

Figure 1: High quality integration of building structure and energy system in an architectural concept will also determine the aesthetics of a building: the WAT office building in Karlsruhe, Germany, synchronises both structural and energy purposes by means of a "black wall", which combines several functions in a single unit: a glazed solar chimney in a two-storey core atrium acts as a solar- driven engine for the ventilation system. It also contains service pipes, feed lines and installation systems for the purposes of structural stiffening. The WAT office building is documented by the IEA Task 23 Case Stories collection.

0. Preface

Increasing the qualifications of our design and building culture to promote sustainability, energy efficiency and solar optimisation cannot succeed unless accompanied by the conviction that responsibility for the future is bound up with advantages for all participants – all parties must be convinced that it will be profitable.

If this is an opportunity to reduce both investment and operating costs in favour of greater utilisation quality without compromising architectural qualities - then the time and effort invested into integrated design by a competent team will deliver optimum yields to the client.

Requirements for architects and engineers have undergone fundamental changes in the building sector during the last few years. Clients need integrated solutions, ones which necessarily provide fair answers to all parties and meet their respective needs in as short a time as possible. In addition to the economic viability of building construction principles and their architectural quality, the cost efficiency of the building operation and the usage quality and comfort of its result also play an important role, driven by changes in the real estate sector.

The ready formulation, "only a rented building is a successful building", reflects a simplified correlation between utilisation quality and cost efficiency or, expressed differently, the connection between economics and ecology, paired with future social responsibility.

Years of experience in the design and construction of environmentally-conscious non-residential building projects have shown that an integrated design process is a necessary prerequisite for successfully achieving sustainable buildings.

Today, this precondition can no longer be met without the contribution of an interdisciplinary design team acting as a competent partner to the client for answering questions regarding the relationship between human needs, the environment and the building.

The development of guidelines for a more integrated design approach within the framework of the international research program of the IEA, Solar Heating and Cooling (SHC) Task 23, is intended to help designers and builders to support and master this process.

INFO

Info provides supplements to the body text, overview of the respective chapter, tips and further advice.

HIGHLIGHT

Highlights or summarises important statements and facts given in the body text of the guideline.

EXAMPLE

Examples facilitate understanding of both the subject-related and very specific items.

DEVELOPMENT

Refers to previous and future guideline development from initial aspects up to the NAVIGATOR tool.

ATTENTION

This icon addresses a special warning or an important precept of particular importance.

GLOSSARY

Glossary entries can be found by following this ▶sign.

0.1. How to Use the Guidelines

The intention of the guideline format is to generate information which is easy to read and use on-screen. A special font (Trebuchet), especially designed for excellent readability, and a special size (300x220), for matching monitor screen dimensions, have been selected. The guideline has been set up as a pdf-file to provide specific interactive functionalities. To print out a paper version, please use the built-in functionalities of "Acrobat Reader", which allows you to modify this oversized format to suit common paper sizes such as A4 or Standard Letter.

The complexity of Integrated Design requires ease of navigation and clarity of orientation to guide the reader successfully. For that reason, two main features - a border column and textual associations – have been provided to supplement reading and understanding.

0.1.1. Border Column

- The main guideline body represented by the wide column is supplemented by the left-hand column which contains five categories serving as additional support: INFO, HIGHLIGHT, EXAMPLE, DEVELOPMENT and ATTENTION will underline particular aspects as explained in the left column on this page.
- The blue columns refer to other sections of the guideline that are individually accompanied by grey columns.

0.1.2. Interactive Features

- You can page through the document by using the arrow buttons of the keyboard. The navigation buttons on the upper left-hand side of each page support stepping back and forth for already applied links. A functional explanation is given by “Tool Tips” activated by the cursor.
- Internal links and external links provide opportunities for cross-referencing or will guide you into deeper detail. While internal links represent relationships to other chapters within this document including the ▶arrow links to the glossary, external links address supporting additional information.
- Moreover there are selected items in figures or tables that facilitate to explore the guideline by internal or external links.

GETTING FAMILIAR

The first chapter is dedicated to aiding the reader in becoming familiar with the "environment" of this guide, to explaining its background, announcing its status and describing its features.

HIGH PERFORMANCE SUSTAINABLE BUILDINGS

Building concepts that address the goals of sustainability enhance both the design approach and the qualities of the traditional value structure by adding the dimension of life-cycle and all the design factors interconnected with it.

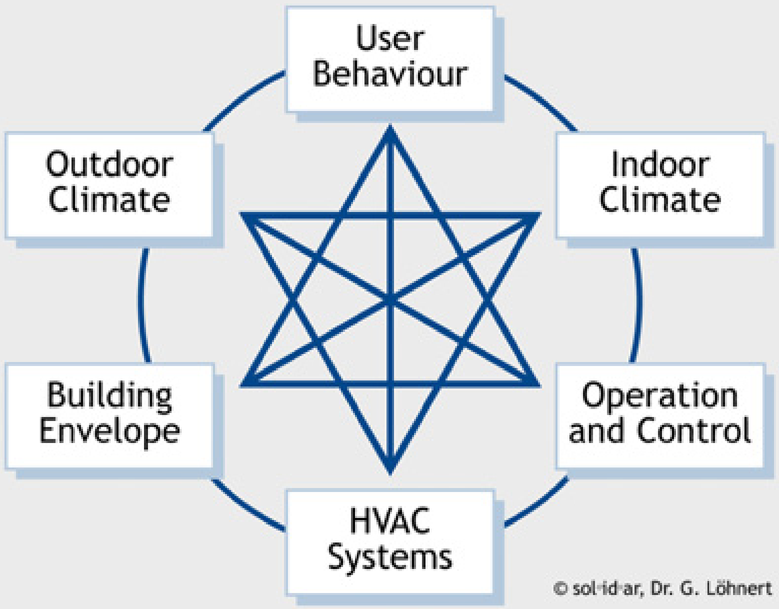


Figure 2: Variables influencing the energy performance of high-performance buildings.

1. Introduction

Before presenting process features, it will be useful to provide a summary of the reasons why the ▶Integrated Design Process (IDP) is considered to be so important for modern building design, especially with projects that require high levels of environmental performance.

1.1. High-Performance Buildings and Integrated Design

The global drive towards sustainable development has resulted in increasing pressures on building developers and designers to produce buildings that have a markedly higher level of environmental performance. Although various experts have offered somewhat different interpretations of this, a consensus view is that such "green" buildings must be characterised by a measurably high performance, over their entire life-cycle, in the following areas:

- Minimal consumption of non-renewable resources, including land, water, materials and fossil fuels
- Minimal atmospheric emissions related to GHG and acidification
- Minimal liquid effluents and solid wastes
- Minimal negative impacts on site ecosystems
- Maximum quality of indoor environment, in the areas of air quality, thermal regimen, illumination and acoustics/noise.

Some authorities in this rapidly developing field would also include such related issues as adaptability, flexibility and initial and life-cycle costs.

In addition to a new array of performance issues to be addressed, contemporary developers and designers are faced with more stringent performance requirements being imposed by markets or regulations or both. Chief amongst these is energy performance, and current expectations in this area pose a definite challenge to designers, in terms of reducing purchased energy consumption and in the application of solar technologies, all within the constraints of minimal fees and the time pressures of the modern development process.

REASONS FOR INTEGRATED DESIGN PROCESS

- Increasing pressure on building developers and designers caused by a rapidly changing market
- Adaptability and flexibility during entire life-cycle
- High energy performance expectations
- Increasing requirements caused by high complexity
- A steadily growing consciousness about the environment

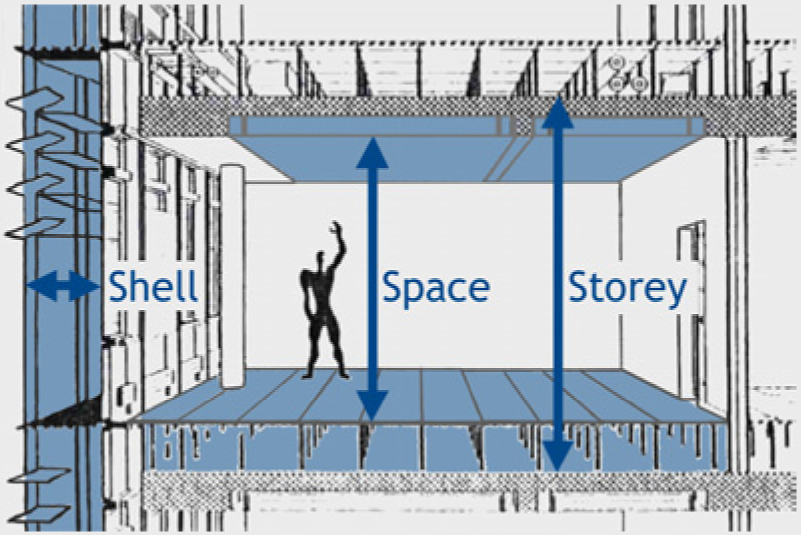


Figure 3: Complex building systems do not automatically guarantee high performing operation and so-called "intelligent" buildings are often characterised by a considerable demand of floor area and space volume, high energy consumption and an increase of building and operating costs.

An efficient and successful building design requires a broad range of issues and qualities be considered during the *design process* including

- Constructive co-operation with client, designers, operators, users, contractors and regulatory authorities carried out in an atmosphere of shared teamwork.
- Consideration of all structural and technical concepts and systems as a whole in order to increase performance efficiencies.s
- Consideration of the "true impacts" that a building project can bring to the local and the regional environment and neighbourhood.
- Consideration of the life-cycle costs of building products and technical systems – costs which are interconnected with the buildings' production, application, maintenance and waste disposal.
- Inclusion of interaction with natural surroundings and incorporation of such environmental conditions as climate into the design concept.
- Optimised use of renewable energies co-ordinated and technical building equipment that is optimised in size for maximum performance.
- Communication of the philosophies, control strategies and service functions to the occupants and building users.

PRIME INTENTIONS

- Sensitisation of the "key players" in the building design community to "soft" factors of design
- Closing the gap between classic technical knowledge, intuition and management abilities
- Support of designers for confirming and developing their competence and management abilities

TARGET AUDIENCE

- Architects and Engineers as key players
- Clients and Investors as decision makers
- Students as future actors in the building industry

Figure 4: All suggestions given by this guideline can only succeed when implemented by a qualified design team committed to an open and continuing communication structure through the entire design process.

1.2. Philosophy and Intentions of this Guideline

This guideline focuses on exploring the nature of the Integrated Design Process or IDP, an approach and design procedure that has proven to be highly effective in producing high-performance and environmentally-friendly buildings.

The intent of this guide is to characterise and describe mechanisms of design processes analytically in accordance with the concept of "integrated design".

For this purpose, a ▶Design Process Development Model has been created to allow presentation of the individual elements and characteristics identified. The model combines interrelating structural elements and features of the generic design process. In this way it became possible to create both relevant Key Issues reflecting the most typical and important aspects to be considered and Recommendations related to the entire process and individual process phases.

The guideline demonstrates strategies and methods for aiding individual participants in the design process to identify, assess and influence complex textual and organisational requirements. In addition, it provides stimulation for the practice-oriented improvement of the process and will ultimately enable the optimisation of the design process as one component of the building task.

In view of the fact, however, that buildings are not mass produced, and because individual backgrounds also need to be considered, no design recipe as such is offered in the sense of an overall generalisation but rather in a generic way. Although there can never be just one single patent or recipe for an integrated design process, recurrent patterns and sequences in the course of design could nevertheless still be identified and can be transferred programmatically onto individual design situations and individual conditions. Advice and recommendations are developed in combination with professional background knowledge which effectively offer support to the designer at any given moment.

The guide primarily addresses architects and engineers as the key players within the design process, because they have the opportunity and responsibility of preparing and guiding their client's decisions. Consequently, the objective of this guideline is to promote its understanding and application and to increase the realisation of what are referred to as ▶High-Performance Sustainable Buildings.

If this intention bears fruit, then the guideline will contribute to enhancing the qualifications of individuals involved in general design and building.

DOCUMENT STATUS

This document represents an intermediate step and a structural and generic basis for future national adaptation in the participating countries. One part of its purpose is to explain theoretical background knowledge necessary for using the NAVIGATOR, it is therefore expected that it will undergo further development to become a handbook for using this tool.

DETAILS ABOUT TASK 23 WORK

The focus and relationship of individual stages of the guideline development is given in Figure 5 on page 5.

A brief description of the Methods and Tools of Task 23 is given on page 55 and their usability related to the design process is illustrated in Figure 32on page 56.

1.3. Background: IEA Task 23 work

Solar and other regenerative strategies and systems are only effective when they are understood as integral components of the building and utilisation concept of the project from the very beginning and not considered as single elements added on at any time during the course of the design.

Only if they are integrated within energy-efficient and sustainable building concepts can they have a significant positive impact on building performance and achieve significant effects for the environment.

Therefore, the special interest of the IEA Task 23 concerns the strategies, methods and tools with which architects and engineers can achieve their goal of realising solar-optimised building concepts.

The guide is the main product for integrated design in this subtask and represents a process-oriented support with recommendation character.

In addition to the work of other subtasks, different cooperative studies and complementary investigations have been carried out prior and parallel to the guideline development:

- Analysis of principal Working Methodologies used by architects and engineers and the examination of existing guidelines related to the integrated design process.
- Analysis of Traditional Design Phasing (TDP) and related fee structures in nine different countries participating in Task 23.
- Development of a structure on participant relation and dependence and examinations of contract and workflow relations by using the developed Actors Relation Chart which has also been introduced into the demonstration building booklet to describe the individual design process characteristics on actors.
- Development and presentation of project-referential design courses (Workflow Charts), which serve as the basis for the Generic Process.

Moreover experience and findings could be exchanged in a mutually-supporting way with other Methods and Tools of Task 23 such as the Introductory Booklet, the Case Stories Booklet and the Demonstration Building Booklet, the development of the Multi Decision Making Method (MCDM) and the blue-print for a Kick-off Workshop for the Integrated Design Process.

FUNCTIONAL INTERRELATIONS

Investigations and progress carried out during the Task 23 research programme include a string of interrelated developments as shown in the graph opposite:

A INSPECTION OF BASICS

Identification and inspection of relevant material from a wide spectrum of adjacent topics on a national level serving as input for the Task 23 development

B ANALYSIS OF ISSUE CONTEXT

Well-known, recurring typical problems had been identified and collected by a Context Analysis. The issues (list) thus compiled were used to generate parts of the present recommendations in this Guideline Booklet.

C DESIGN PROCESS DEVELOPMENT MODEL

Four elements establish the basis for two dimensions of the process - the structural and the process level. Taken in combination, these two levels generate a cognitive approach for describing the design process.

D GUIDELINES AND RECOMMENDATION

This document summarises both the philosophy and possible solutions for applying integrated design.

E IMPLEMENTATION BY AN INTERACTIVE TOOL

Developed structures and strategies are combined to an interactive navigation tool to be adapted on national level supporting team leaders, architects and engineers in creating individual integrated design processes.

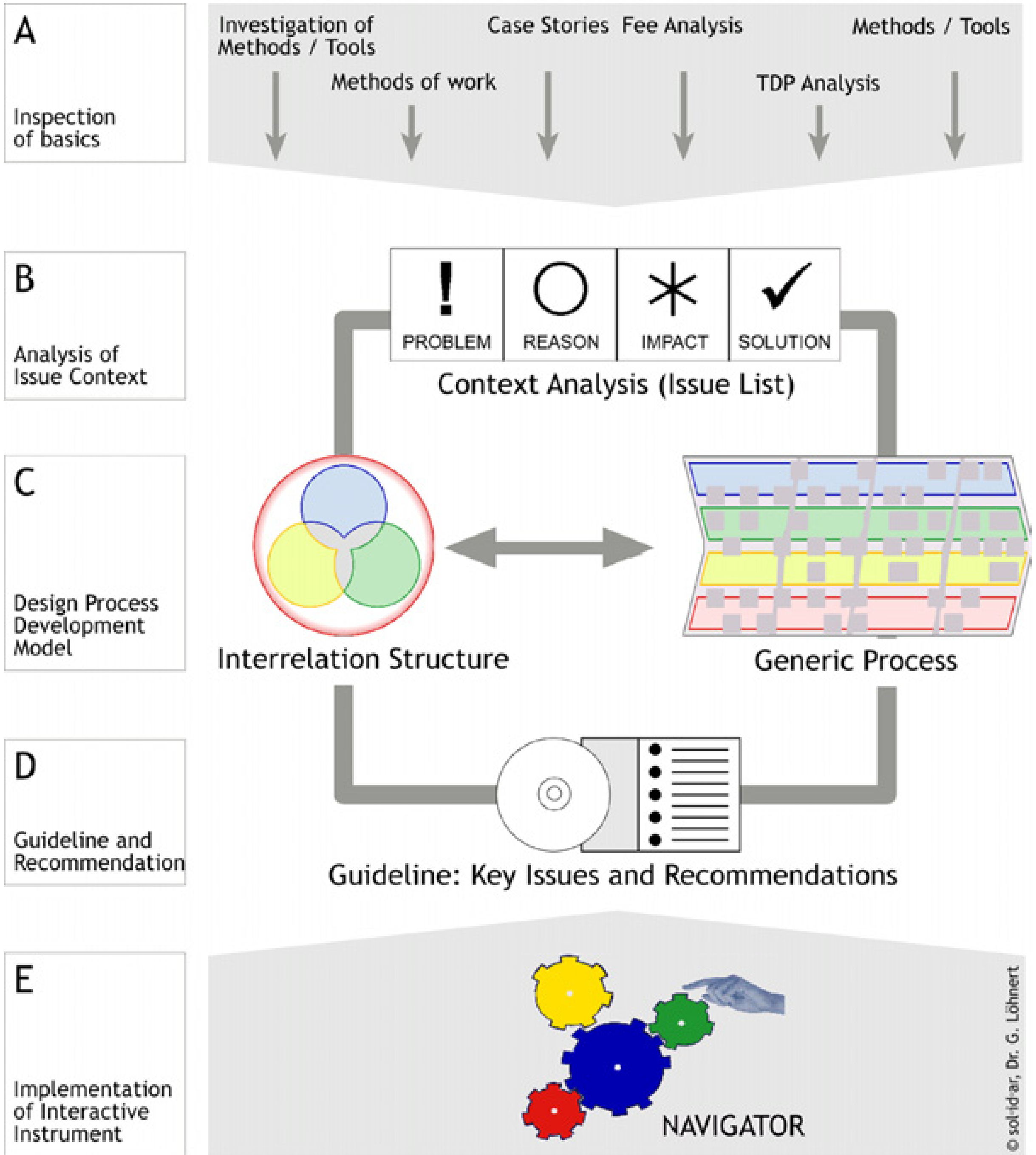


Figure 5: Stages of development and resulting products during the progress of Task 23 work. The grey areas represent more nationally-focused developments and implementations.

WARM-UP

The intention of this section is to introduce aspects addressing the take-off and step-by step development of an Integrated Design Process.

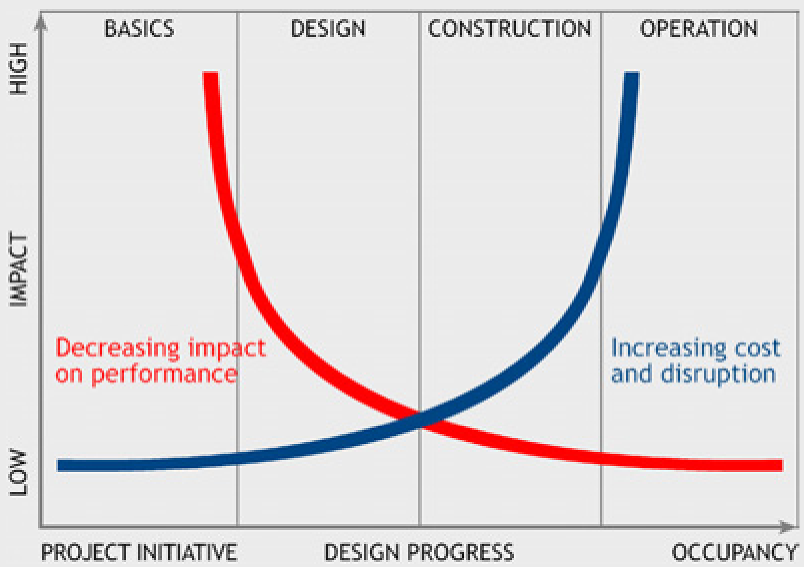


Figure 6: Influence on project performance during design progress: Only an early intervention in the process can utilise the potential optimisation for energy and cost efficiency. The building cost and energy performance will be nearly defined as the final stage of design development is approached. Conceptual design alternatives are no longer possible at this point, and any attempted "repair design" will have an opposite effect to the one intended: increases in expenditures of cost and disruption.

2. Considerations of Design

2.1. From Traditional to an Integrated Design Process

Traditional design can be understood as a linear process, but sequential work routines may be unable to support any adequate design optimisation efforts during individual decoupled phases, which of course leads to higher expenditure. Although there are many exceptions, we can refer to a "traditional" design process as one consisting of the following features:

- The architect and the client agree on a design concept, consisting of a general massing schema, orientation, fenestration and (usually) the general exterior appearance, in addition to basic materials;
- The mechanical and electrical engineers are then asked to implement the design and to suggest appropriate systems.

Although this is vastly oversimplified, this kind of process is one that is followed by the overwhelming majority of general-purpose design firms, and it generally prevents their performance from rising above conventional levels. The design features that result from such a process often include the following:

- Limited exploitation of the potential advantages offered by solar gain during the heating season, resulting in greater heating demand;
- Possible exposure of the building to high cooling loads during the summer, due to excessive exposure of glazing to summer sun;
- Non-utilisation of a building's daylighting potential, due to a lack of appropriately located or dimensioned glazing, or to a lack of features to channel the daylight further into the interior of the building;
- Exposure of occupants to severe discomfort, due to excessive local overheating in spaces facing west or glare in areas lacking adequate shading;

All these features are the result of design processes which initially appear quick and simple, but which then result in high operating costs and the creation of an interior environment that is sub-standard. Naturally, since the conventional design process usually does not involve computer simulations of predicted energy performance, the resulting poor performance and high operating costs generally comes as a surprise to owners, users and operators.

AVOID SYSTEM PATCHING

High-performance systems and components added on retroactively cannot overcome the handicaps imposed by the poor initial design decisions. It is even possible that these factors may in turn greatly reduce the long-term rental or asset value of the property.

ADVANTAGES

- Timing: fine-tuned engineering knowledge and specialist experience at the appropriate process stage.
- Complexity: consideration of a wide range of professional performance options.
- Iterations: enabling of fundamental design options until the potential performance of different alternatives has been assessed and optimised.
- Options: the client is not pushed into solutions by irrational choices based on unilateral suggestions.

CONCLUSION

In summary, conventional design processes are not generally capable of delivering the high levels of broad-spectrum performance that are currently required in many contemporary projects.

Integrated design is essentially based on the idea of an optimised teamwork, a qualified design process management including the application of modern tools and strategies which fit to the project goals.

If the engineers involved in such a process are clever, they may suggest some very advanced and high-performance heating, cooling and lighting systems, but these may then result in only marginal performance increases, combined with considerable capital cost increases. The problems outlined above represent only the most obvious deficiencies often found in buildings resulting from the conventional design process.

Integrated Design is a procedure considering and optimising the building as an entire system including its technical equipment and surroundings and for the whole lifespan. This can be reached when all actors of the project cooperate across disciplines and agree on far-reaching decisions jointly from the beginning. The integrated design process emphasizes the iteration of design concepts early in the process , by a coordinated team of specialists. The results is that participants contribute their ideas and their technical knowledge very early and collectively. It is important for the early design phases that concepts are worked out together for all design issues. The concepts of the energy and building equipment are not designed complementary to the architectural design but as integral part of the building very early.

The integrated design process is not new in principle. What is new is that the knowledge and experience gained by an analytic consideration of design make it possible to formalise and structure the process and to incorporate it into design practice. In particular, this means:

- **Motivation and competence**: A qualified project starts with team members who are willing to achieve a high quality design, to provide a wide range of technical and communication abilities and to deviate from traditional practices.
- **Clear objectives**: Interdisciplinary teamwork is begun in the pre-project stage on the basis of a clear definition of goals and by applying different analytic and evaluative tools as needed.
- **Continuity of quality assurance**: Continuous examination of the design goals by a qualified design management takes into account any number of structural alterations and disruptions from the outside over the course of the entire design and building process and during the initial period of building operation.

The integration of specialists at a later stage of the process reduces their opportunities to influence the design, since client and architect have already agreed on a sub-optimal solution.

IDP FEATURES IN BRIEF

Based on experience in Europe and North America, the main characteristics of Integrated Design Process are

- Inter-disciplinary work between architects, engineers, costing specialists, operations people and others right from the beginning of the process
- Discussion of the relative importance of various performance issues and the establishment of a consensus on these matters between client and designers
- The addition of an energy specialist to test out various design assumptions through the use of energy simulations throughout the course of the process, to provide relatively objective information on a key aspect of performance
- The addition of subject specialists (e.g. for daylighting, etc.) for consultations with the design team
- A clear articulation of performance targets and strategies, to be updated throughout the process by the design team

FACILITATING THE DESIGN PROCESS

In some cases, an external Design Facilitator may be added to the team, to raise performance issues throughout the process and to bring specialized knowledge to the table. A Design Process Facilitator is to be contracted separately to guarantee effective coordination and management and an independent avoiding and treating of problems like goal / interest collision, communication, goal conflicts and evaluation of risks.

2.1.1. Features of Integrated Design Process

The Integrated Design Process involves a different approach from the very early stages of design, and can lead to a very different result. In the simplest of terms, the IDP process creates a synergy of competency and skills throughout the process, involves modern simulation tools, and leads to a high level of systems integration. All of this can allow clients to reach a very high level of performance and reduced operating costs, at very little extra capital outlay.

An integrated design process ensures that different knowledge of specialists is introduced at an early project stage and takes into account a wide variety of opportunities and options from the very outset.

In the IDP process, the architect is not the only person to make decisions, although he retains his guiding function through his position of team leader and moderator. He/she gains knowledge of technical solutions while the engineers are simultaneously gaining insight into the complexity of the architectural design process. The design process itself emphasizes the following sequence:

- First, establish performance targets for a broad range of parameters, and then develop preliminary strategies to achieve these targets. This sounds obvious, but in the context of an integrated approach it can bring engineering skills and perspectives to bear at the concept design stage, thereby helping the owner and architect to avoid becoming committed to sub-optimal design solutions;
- Then, minimise heating and cooling loads and maximise daylighting potential through orientation, building configuration, an efficient building envelope and careful consideration of amount, type and location of fenestration;
- Next, meet these loads by an optimum use of solar and renewable technologies and a use of efficient HVAC systems, while maintaining performance targets for indoor air quality, thermal comfort, illumination levels and noise control;
- Iterate the process to produce at least two, and preferably three, concept design alternatives, using energy simulations as a test of progress, and then select the most promising of these for further development.

From an engineering perspective, the IDP process permits the skills and experience of mechanical and electrical engineers, and of more specialized consultants, to be integrated at the concept design phase from the very beginning of the design process.

ACTORS RELATIONSHIP

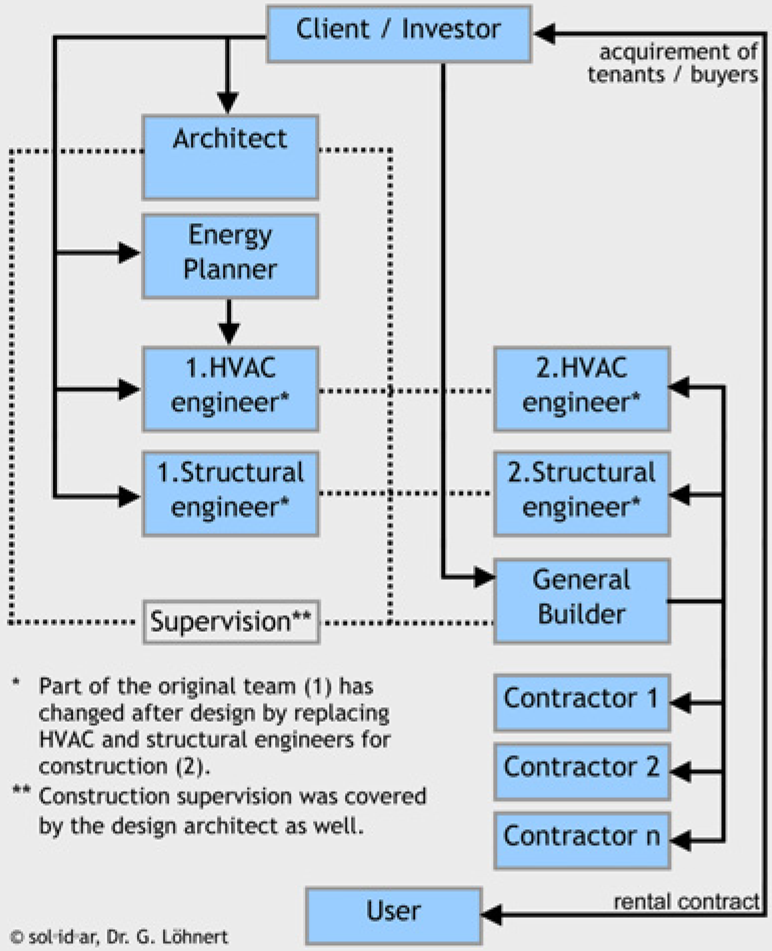


Figure 7: Actors Relation Chart. Contracting relations (arrow line) and workflows (dotted line) of actors involved are different in each project. Both relations should be transparent to all design team members during process. (This example: Case Story of Landis & Gyr "Grafenau").

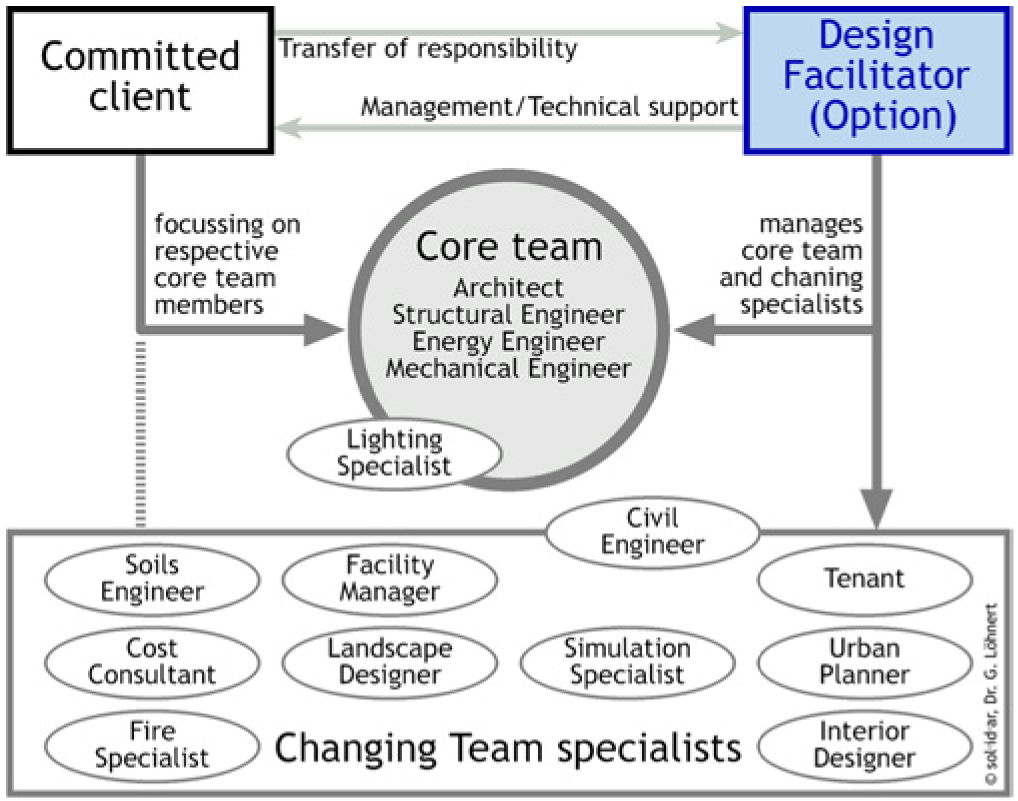
Figure 8: A **responsible** Process Facilitator should manage specialists and core team based on technical knowledge.

An Integrated Design Process especially affects the design team:

- the client takes a more active role than usual,
- the architect becomes a team leader rather than the sole form-giver,
- mechanical and electrical engineers take on active roles at early design stages
- the team always includes an energy specialist.

If these qualifications cannot be ensured or if there is additional need for support of energy and integrated design process management, then the support by an experienced Facilitator (see Figure 8) is recommended.

In contrast to the role of the quite commonly involved project manager the Design Facilitator should be a specialist in architectural and technical energy design solutions and integrated process co-ordination, and should also possess outstanding skills in communication, team management and mediation.



REFLECTION

The consideration on different approaches in design methodologies of designers and engineers is to improve the mutual understanding and communication.

COMPLEXITY

Building design and construction is characterised by the working hypothesis that the task designation is difficult to define and interrelates with many factors.

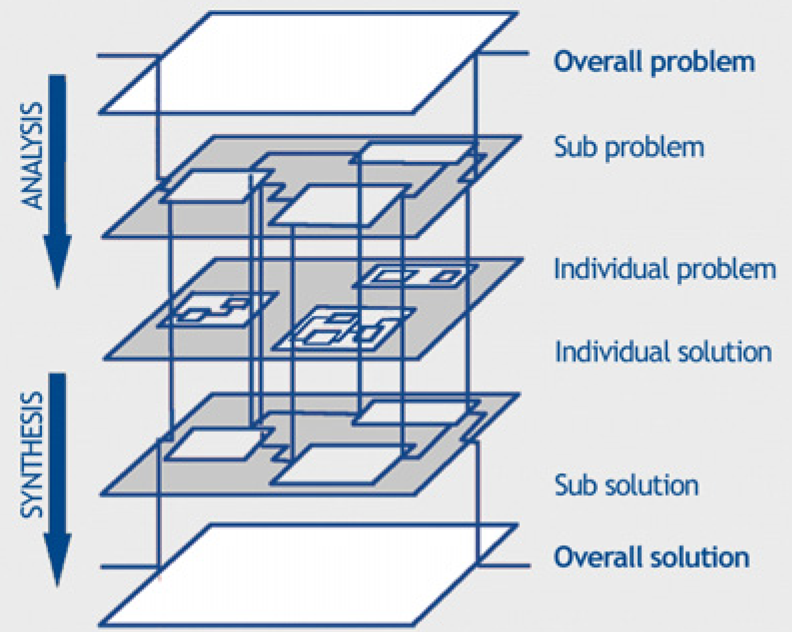


Figure 9: The fundamental need of continuous and quickly changing perspectives between solution and problem on the one hand and between the totality and particularity on the other hand illustrates the multi-dimensionality and complexity of the design workflows embedded into the entire design process.

2.2. Notes on Design Methodologies

Differences in the professional development, scope and depth of actors' qualifications will lead to a changed understanding of one's role within the design process. In principle, this approach to building design is connected to the respective actors and their tasks, but more than just these objective criteria must be taken into consideration. Organisational structures and individual "preferences" also influence in principle the chosen procedures. In addition, the predetermined influences of prescriptive and legal basic conditions have an impact.

2.2.1. The engineer

Given a precisely defined problem as a starting position, and a closed system containing the expectation of a solution, the engineer conceives of the process as a series of work steps leading from interim results to overall results comparable with the production process of industrial goods. With the emphasis being placed on development and production, the design is transformed from the general or abstract to the specific or concrete. This way, the entire problem is disassembled into clear partial problems for which partial solutions can be found, which then in turn can be merged into a final solution. Problem analysis and solution is characterized by an almost exclusively mathematically-shaped system of logic and understanding: The intention is to create an efficient organisation and direction of the work steps, but the need for developing simultaneous alternatives is often neglected in consequence.

2.2.2. The architect

Starting with a scarcely-definable problem and a complex variety of open structures as possible solutions, the architect visualises the main character of the work process as being more a series of circular movements than a linear sequence already established for the defined main phases of the process. These will take him/her from a preliminary idea based on his individual experience through an analysis of related impacts and their iterative consideration of the given circumstances. The main feature of this working method is not just the acceptance of solution assumptions as a work hypotheses but rather the understanding of a necessary entry into an actual design process. Within the circle of hypothesis and analysis, the solution and the problem will be investigated simultaneously.

KEY STATEMENT

Architectural quality is a concept of value that depends on the intuitive, cognitive and aesthetic factors and must be applied at various levels of detail.

EXAMPLES ON CONCEPT LEVEL

- Architectural competitions allow different solutions for conceptual approaches
- Modelling of variants, i.e. the formation or development of alternative concepts

EXAMPLES ON CONSTRUCTION LEVEL

- The efficient utilisation of solar radiation potentials presupposes a consistent solar-geometrical optimisation of building and installation components (orientation / inclination)
- The inclusion of the prime structural building mass in the total energy concept prohibits thermal separation of floor, wall, and ceiling constructions (suspended ceilings, etc.)

EXAMPLES ON DETAIL LEVEL

- Low temperature heat emitters with the same capacity are considerably larger and need carefully detailed integration
- Control elements such as sensors, air outlets, service components, etc. often create a challenge when detailing the design

2.3. Importance of Architectural Quality and Integration

The integration of the buildings structural components such as envelope or technical systems represent the most essential challenge for the integrated design approach. Some criteria can be described relatively clearly as design factors related to limit and target values. The dimension of ▶architectural quality however, leads to an almost insoluble problem, since this requirement is exclusively based on project-specific evaluations and is therefore very strongly dependent on the intuitive, cognitive and aesthetic factors put forth by the individual participants. This is true for the architect and the client above all. Additionally, architectural quality is a concept that must be applied at various levels of detail.

2.3.1. Concept Level

The concept level describes different and often competing architectural concepts that solve design tasks in accordance with different principles. The architectural language of design authors and their individual "architectural philosophy" plays a crucial role, as do certain design trends and fashions. On this macro level, architectural quality means the quality of a design that is convincing as a consistent and completely conceptual “whole building” integration including considerations on energy and environmental performances. In all cases there are several possible solutions.

2.3.2. Building System and Construction Element Level

This level describes the compatibility and the integration of such measures and systems that have already been established on the whole building level. This includes energy conservation, passive and active solar techniques, daylighting, etc. which have to be synchronized with the physical and construction elements of an architectural design in their totality.

2.3.3. Detail Level

This level describes design materialisation and construction-related implementation for building executability, addressing user acceptance in functional and aesthetic terms, which are not always easy to reconcile.

A KEY FOR UNDERSTANDING

A point for understanding and applying the guideline correctly is the familiarisation with the ▶Design Process Development Model, which has been created simultaneously to the development of the NAVIGATOR.

A STRATEGY HOW TO DEAL WITH COMPLEXITY

A possibility of considering complex design aspects lies in reasonable **reduction**, which means to address only those answers relevant to particular questions and to "tune out" non-essential aspects. This was applied by **selection** and **simplification** methods when developing the interrelation structure. However, such an approach assumes presence of a suitable model, which describes a process with its basic components comprehensively.

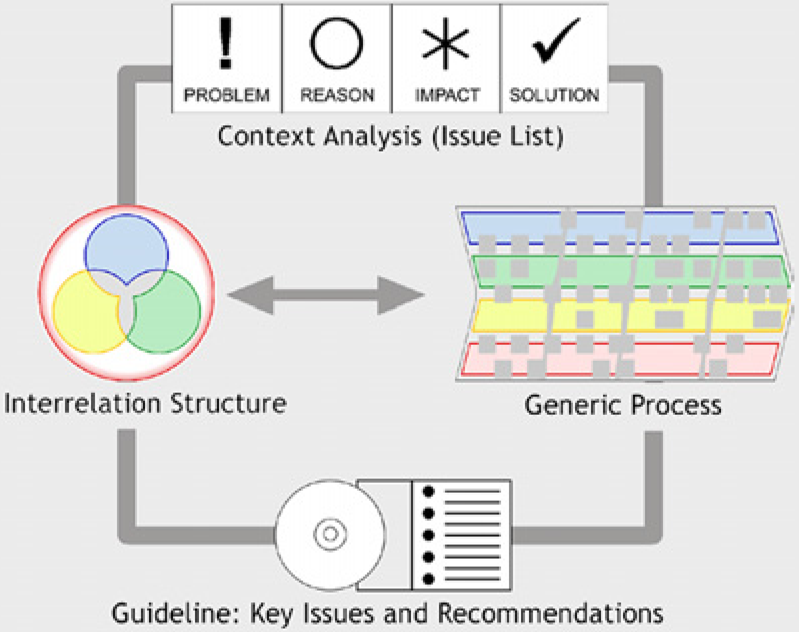


Figure 10: Strategic approach of the development model.

3. Design Process Development Model

During the course of a design process, individual aspects can begin quite rapidly to take on a life of their own. When fundamental relationships can no longer be maintained or are no longer upheld, the danger of planning chaos becomes very real. Thus, structural and contextual prerequisites must be defined in order to succeed in guiding architects and engineers through the complexity of design:

- First of all, issues are to be identified that necessitate an analytical framework. **That's why** a method of context analysis was chosen for launching the process.
- Among design participants there is no common language that ensures proper communication and understanding particularly not in terms related to process and sustainability.
  That's why structural elements as the first dimension of this model developed will enhance the understanding of design process participants.
- A structure, which is needed to logically collect and organise and communicate the huge quantity of process-relevant information in a way making flexible access and overview possible, does not yet exist.
  That's why the guide addresses the process consideration as the second dimension aside from its structural elements.
- In design practice there is no forum where various disciplines can work together within a framework of collaborative problem identification and solving. A structured support would help launching the discussion and help close this gap. **That's why** this model of the guide is a two-dimensional platform combining structure and process and reflecting against each other in order to create both Key Issues and Recommendations necessary for a meaningful process support.
- Maintaining an overview of design activities and participants is sometimes difficult and often an additional burden to designers alongside their original tasks. **That's why** this model has been developed not as stand-alone product but in tight connection with the NAVIGATOR. Designers and engineers should be supported with the aid of this tool when facing networked design tasks, in order that they be able to concentrate their efforts on their central tasks.

INTERRELATION OF ELEMENTS

The identification of major elements, their structure and interrelation create one of the two main parts of the Design Process Development Model.

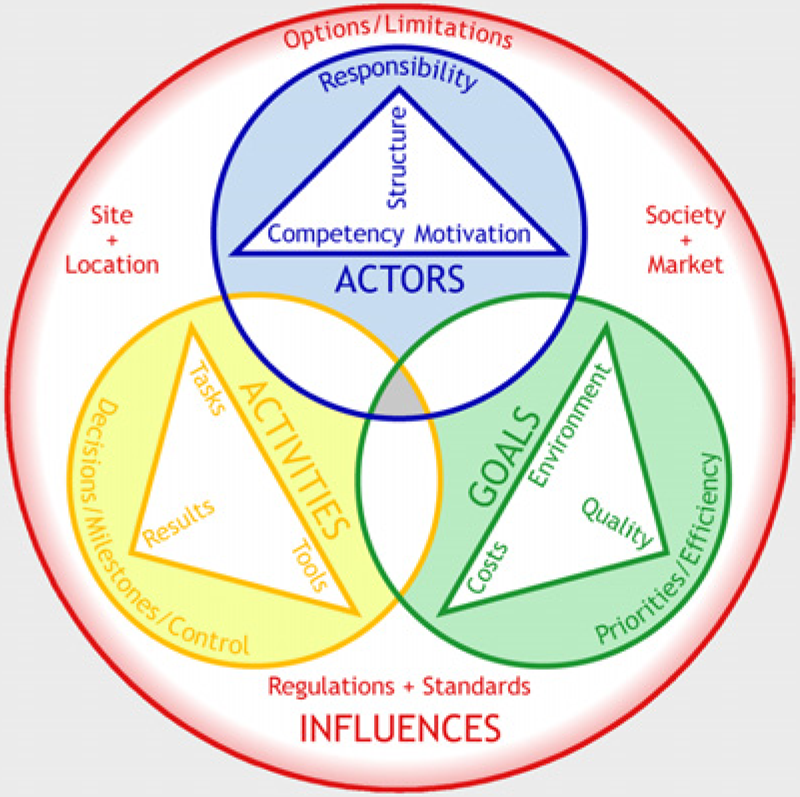


Figure 11:
The superimposition of structural elements reflects both their interdependence and their interrelationships.

Figure 12: Navigation table to explore the content and the structure of the main integrated design process ELEMENTS, FEATURES and KEY ISSUES.

3.1. Focus on Structural Elements

The building design is determined by different design factors - the number of constellations and their multiplicity distinguishes the individuality of building projects from serial consumer goods of industrial mass production. Thus, a building is always comparable to a prototype which is to be refined continuously in early design phases.

First of all, it is necessary to identify and to describe these factors in order to adapt them to the individual building project. Behind each of these abstract terms there is a more detailed sub structure.

▶ELEMENTS	▶FEATURES	▶KEY ISSUES
ACTORS (Responsibility)	Structure Competency Motivation	Team Formation Risk Assumption Goal/Interest Collision Allocation of Responsibility Payment Structure
GOALS (Priorities / Efficiency)	Costs Environment Quality	Economy versus Ecology
ACTIVITIES (Decisions / Milestones / Control)	Tasks Tools Results	Quality Management
INFLUENCES (Options / Limitations)	Location + Site Society + Market Regulations + Standards	Site Potential Trends and Market
Related to all ELEMENTS and FEATURES		Communication Continuity Goal Conflicts

Figure 13: Project responsibility lies in the hands of actors.

FACES OF COMPETENCY

Competency is decisive in connection with the design team's composition and it involves different levels:

- **Technical** knowledge: to meet ambitious requirements in the respective design disciplines and building industries for "high-performance buildings" with innovative design and building concepts through knowledge and skills, experience and abilities.
- **Communicative** capability: through problem-oriented constructive confrontation and intervention willingness, particularly in conflict-prone goal-design phases as well as in the acceptance and participatory willingness to apply communication-promoting applications and techniques such as conflict analysis, mediation, etc.
- **Integrative** spirit: Interest across disciplines, agreement and adaptation of results worked out collectively and loyalty within the design team through an open and global approach concerning design goals, while remaining in contact with goal conflicts.

3.1.1. Actors

Every building project is characterised by its uniqueness due to varying constraints and project participants. Independent on different building delivery methods the qualities of a project directly reflect the individual and collective responsibility of actors involved.

3.1.1.1. Structure

The structure represents the relationship among the participants in the project, such as legal form, order relationship and inter-dependence as well as contractual and organisation structures. It describes the type of project, e.g., whether it is a public or private client, whether the intention has a political momentum and/or which total structure of the decision-makers is configured behind the client (structural transparency). And there are further decisive influences such as procedures already established at the very onset of the project course.

3.1.1.2. Competency

Competency includes the scope of the professional and technical accomplishment of the participants, i.e. knowledge, qualification, experience and abilities. The ability to qualify for an integrated design process are related to proficiency, mental disposition issues and resources such as business situation in general and technical and man power capacities in particular.

3.1.1.3. Motivation

The motivation of the individual project participant and with it of the entire design team is one of the most important prerequisites in the design process and for a goal-directed design result. It is the architect in particular who must also be able to impress his own motivation onto all other design members in his function as a project co-ordinator and team leader to increase their motivation and willingness to cross the boundaries of their own disciplines. This also includes the creation of an atmosphere of trust in all phases of the project process, contracts with the client / builder for all the participants, and accomplishing linked reimbursement of design and building tasks as well.

Figure 14: The ambition on high-performance ▶goal-setting requires the correlation of **quality**, **environment** and **costs** for establishing priorities and sustainable efficiency.

GOAL-SETTING PROCESS

This refers to a parallel transformation of abstract ideas and individual demands into methodologically-viable limit / target values during the design process.

TYPICAL RISK FACTORS FOR INCREASING COSTS

- incomplete or rapidly changing user's requirements
- uncertainties in building permission or lacking design security
- insufficient time for design
- partial or even non-allocation of a complete design phase - executive design, for example
- Inappropriately brief design periods and tendering based only on concept design
- detail design implementation of individual building disciplines at the beginning or even during the current construction phase of the building

3.1.2. Goals

Building design not only addresses reductions of environmental burden and minimised energy demand during construction and operation. The focus of ▶goals is particular on increased comfort for the user in terms of light, air, acoustics and thermal performance as well as utilisation quality and the application of healthy building materials. The key concern remains, of course, functionality, which provides the basis for a long and useful life expectancy for buildings through the multi-functionality and flexibility of decisive structures.

3.1.2.1. Quality

Qualities of use and comfort include the entire spectrum of physiological, physical and psychological determinants which ensure a healthy and agreeable user quality in high-performance buildings. This objective should not only address users, but has to be a crucial design goal as well. Quality takes up a key position in the area of sustainability-related project goals and usability on one hand and in terms of long-term economic benefit interests on the other.

3.1.2.2. Environment

No overview of buildings entire life cycle can be considered completely unless it takes into account efforts to reduce harmful effects on the environment caused by the project. The exploitation of resources and the decisions made regarding the resulting mass and energy flows thus become a focus of design efforts and durability-oriented design goals. This also influences the use of regenerative energy potentials as well as the utilisation of components and building materials that are less harmful to human health and to the environment.

3.1.2.3. Costs

Cost optimisation attained by the life-cycle assessment of a building considers above all the costs dedicated for a long-term perspective of the building:

- Opportunities provided by total cost consideration and assessment
- Acceptance of cost shifting strategies by clients / investors
- Different relevance of cost considerations related to individual design phases
- Clear and correct representation of cost alterations

Figure 15: Activities address how actors perform a project including necessary decisions, milestones and control.

A COMPREHENSIVE TOOL DEFINITION

In this guideline tools include all strategic, methodical, procedural and technical aids that are helpful for performing tasks and questions as well as for preparing decisions. Procedures, tools, strategies and methods such as the holding of workshops, analyses and calculations are tools in a comprehensive sense.

RESULT EXAMPLES

- decision for an (already pre-selected) building site
- confirmation of a design for the prospectus of a real estate investment trust
- submission of building documents for permits as well as building confirmation
- conclusion of tender records, agreements with design and building contractors and users
- commissioning, building hand-over and occupancy

3.1.3. Activities

This chapter deals with ▶activities and resulting tasks that have to be analysed for achieving sustainable project goals. They include collectively-identified and agreed-upon task designations with the purpose of bringing them into the goal-setting, decision-making and design optimisation process. Design activities include the description of how workflows and milestones are to be reached; also included are the so-called crucial points, which are project shaping interfaces, indicating where and when irreversible decisions will have to be made and the timing and means of quality assurance and control.

3.1.3.1. Tasks

Tasks describe real work and the disposition of defined work steps for the attainment of (interim) results, input of further processing and/or concluding documents and preparation for decisions. They refer to the entire process as well as to the individual phases. The workflow represents the visual rendition of the design process.

3.1.3.2. Tools

Today, the experienced designer can benefit from various tools that support to refine opportunities, quantify first-cost and life cycle cost savings, and optimise design trade-offs between different building systems. It is crucial for the designer to know what is the correct and effective tool to use at various stages of the design process. Moreover, he/she must be able to assess the interactions and consequences of the use of different tools.

3.1.3.3. Results

Final findings and decisions in the form of agreements create the binding basis for further progress. They lead to milestones which reflect “Moments of Truth” at times of the project course, after which a certain "point of no return" has been passed, or when additional alterations would cause unforeseen cost increases. Moreover results include the consequent reporting of the activities in order to guarantee a thorough and complete documentation of decisions and outputs during the entire design process starting from establishing goals through quality assurance to user education.

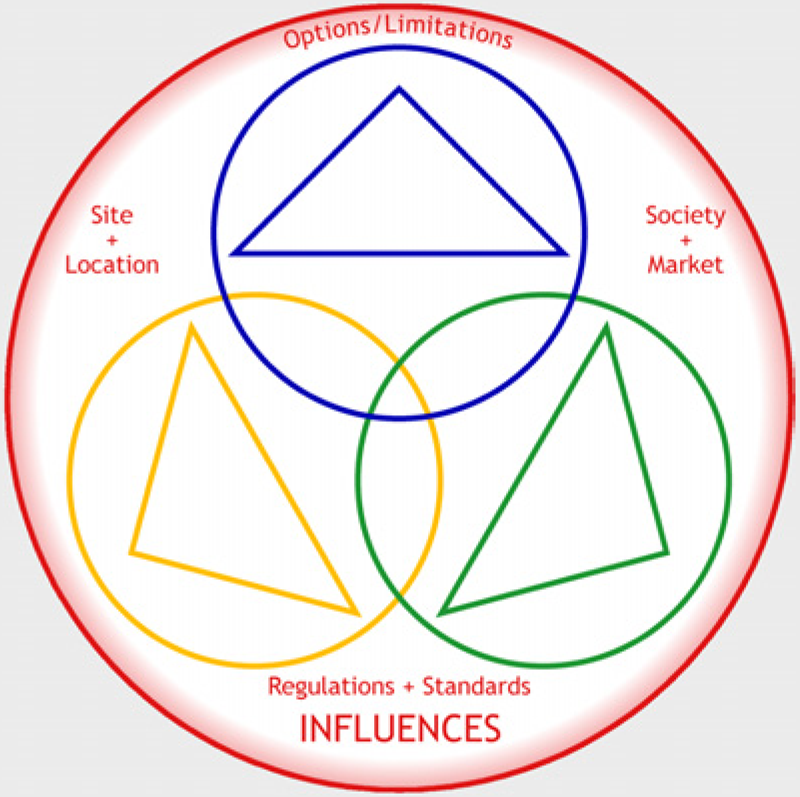


Figure 16: Influences represent prescriptive issues and potentials that affect projects from the “outside” by limiting the spectrum of possible solutions and/or by providing individual options.

SITE INSPECTION MATTERS

- the ecological/technical inventory relevant to sustainability goals
- the timely discussion and clarification of legal design restrictions, especially regarding questions of urban integration, energy supply, structural, technical and funding-related potentials

3.1.4. Influences

Every building project is exposed to more-or-less important ▶influences that can effect the realisation of the project design goals and the quality of the project results. The element “Influences” in this model deals with the different fields of the project environment which are described as follows:

3.1.4.1. Location and Site

Site constraints identify the spatial situation of the physical components and involves influences upon the situation and quality of the project, including its structural, infra-structural, technical, natural and social surroundings.

Selecting the building lot or working with an already chosen site means that project-decisive conditions are largely fixed. It is incumbent on the architect to appraise the effects and/or potential restrictive determinants at a very early date in the project design process.

3.1.4.2. Society and Market

Apart from structural aspects such as regionally-typical building traditions, historic restrictions, etc., socio-cultural backgrounds and socio-economic planning issues and limitations determine the supply and demand structure of the market. The nature of building industry is characterised by a high degree of specialisation and time pressure, a rapid development and overload of information, an extending range of performance criteria and others. Some of these features may contradict or put constraints on the integrated design process.

3.1.4.3. Regulations and Standards

The legal starting points are necessarily interconnected with regulations and ordinances. Each designer and engineer will find the corresponding framework conditions in such regimentation, which may often contradict or support sustainable project goals.

Regulatory constraints could represent a considerable conflict potential in terms of the risk or could be interpreted in a positive way as a basis for long-term goals.

PROCESS CONSIDERATION

The consideration of the design process characteristics creates the second of two main parts of the Design Process Development Model.

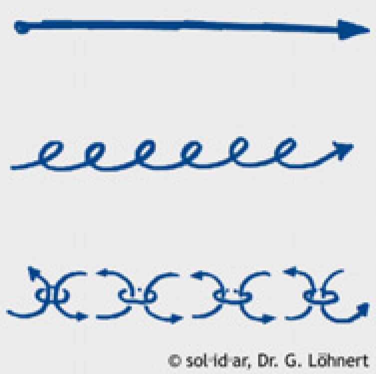


Figure 17: Linearity – Iteration - Integration.

Traditional design as simplified linear procedure mostly excluding design optimisation. Alternative design needs iterations to be assessed and optimised. A combination of both approaches by qualified management and evaluation of interim results leads to whole building consideration.

Figure 18: Iterations during design process.

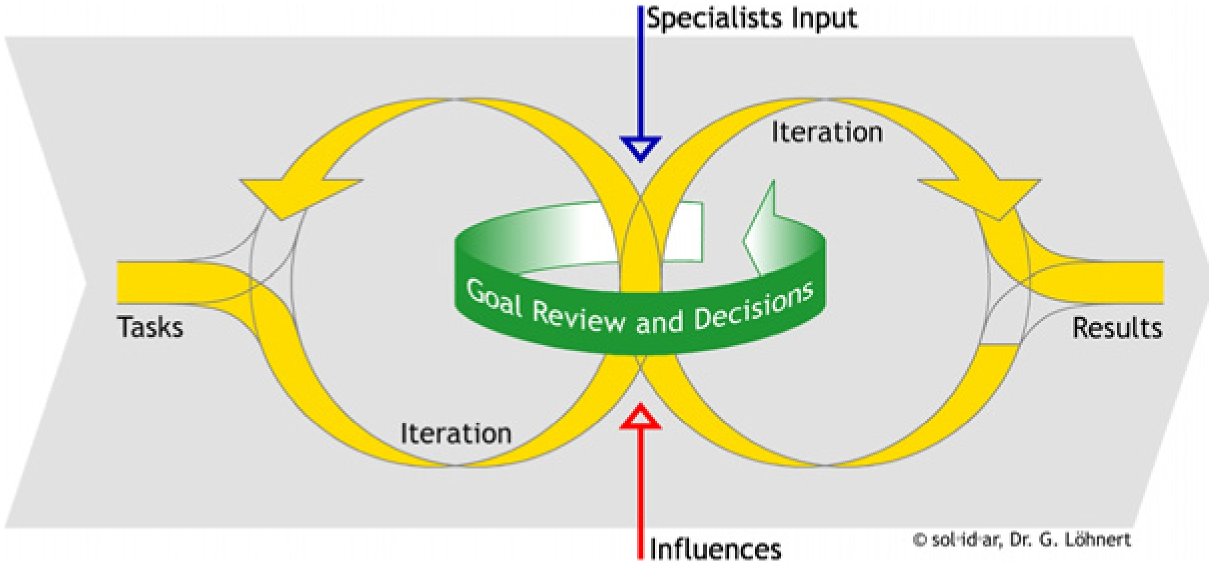
PHASING - INTENTION AND PURPOSE

- Structuring the design process into clearly-defined sequences to improve the overview of actors during the whole process.
- Definition of an internationally agreed-upon framework for a variety of national adaptations.
- To have a valid point of contact if problems, recommendations and others are named.

3.2. Focus on Process

3.2.1. From Linearity to Iteration

A linear backbone marked by ▶milestones reflecting a series of rough ▶phases should be understood as a necessity in terms of both the organisation of collective decision-making and the efficient division of tasks and work. In this view, the sequentially linear backbone is an organisational prerequisite, which is why building design is logically structured into chronological sequences.



In addition to these rough phases of design, the earlier project preparation (Basics) and the subsequent occupancy (Operation) also influence building design and are not inferior to them.

It is important to consider the whole process and to switch in a timely and content-based manner, because the roots of many problems can frequently be traced to faulty or inadequate preparation. The performance quality achieved will often be diminished or unsuccessful due to improper building operation.

In contrast to this linear backbone, the intermediate workflows of involved actors can be identified in each rough phase, and they are far from being linear. Such workflows can be characterized by ▶iteration loops. They provide problem-oriented analyses of design alternatives and optimisation.

CONSEQUENCE: INTEGRATION

Process continuity is a main prerequisite for any quality assurance and control including the continuity in terms of tracking primary high performance goals and actors motivation.

3.2.2. From Iteration to Integration

As part of design optimisation, iterations have to take place during the various design phases including Pre-design, Concept design and Design development. Typical iterations vary by the depth of problem consideration from macro to micro and are characterized by shifts between problems and corresponding solutions, in accordance with design progress.

The cyclic character of the ▶iterations of a virtual optimisation step during the design process in Figure 19 illustrates the superimposition of both individual and teamwork inputs. Correction and control mechanisms by team management, in addition to external influences, affect this process and influence its further progress. Designers need to be mindful of the interfaces between the iterative workflows, which are characterised by initial tasks, (interim or partial) results and findings at the end. These transitions, acting as interfaces between two design phases, need to be organised by a qualified project management, which uses clear decisions and careful process documentation to prevent any losses of information.

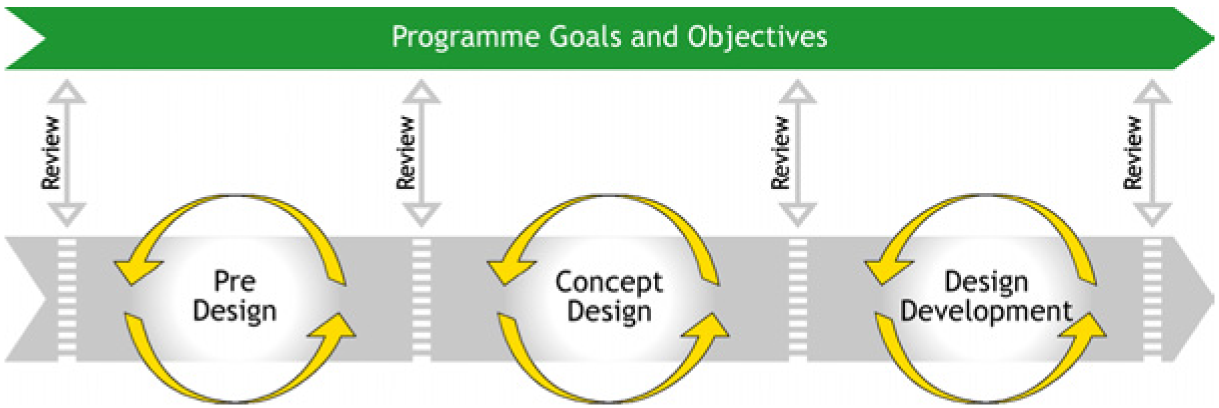


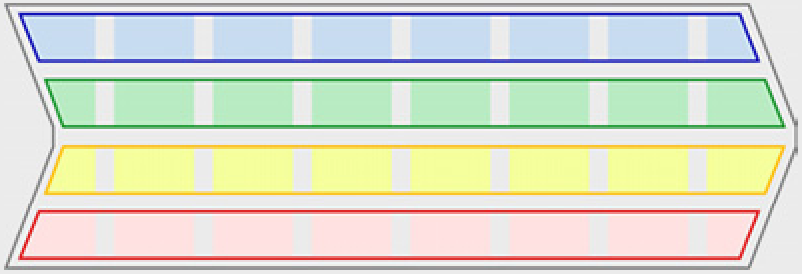
Figure 19: In simplified terms, the actual design is made up of three roughly-defined phases which demand for individual iterations on corresponding levels: **Pre-design, Concept Design,** and **Design Development** accompanied by a permanent review of project goals and objectives which serve as a “roadmap” throughout the entire design process.

TRANSITIONS

It is not only the ▶phases themselves which have to be considered: even the transitions between represented by the vertical grey lines in Figure 20 are of interest and importance in terms of continuity.

DESCRIPTION AND INTERACTION

A complete description of the process diagram in full extent and detail is contained in the NAVIGATOR as well as in the separate user manual.
Interactive functionalities connected with the database structure of this workflow chart can be accessed using the NAVIGATOR tool.



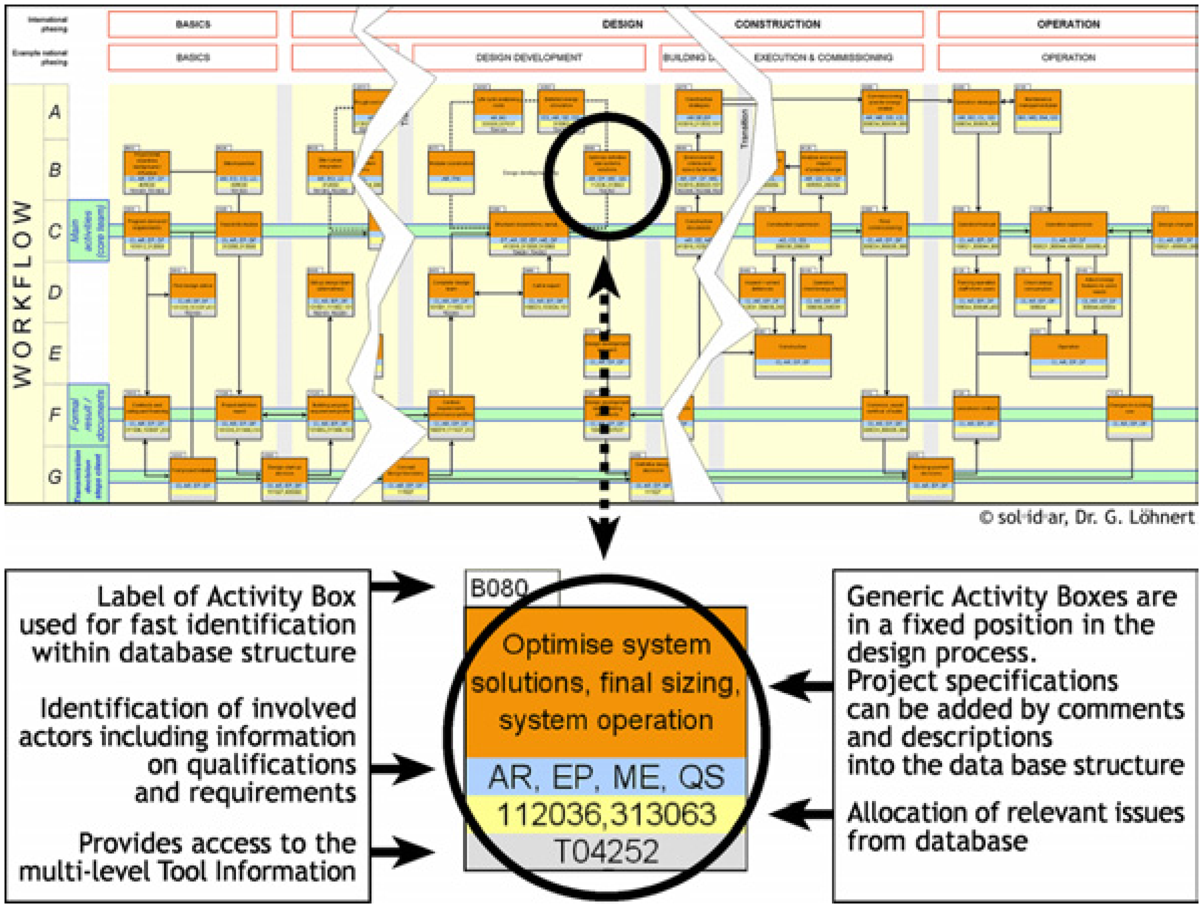
FOR ENTIRE PROCESS CHART CLICK HERE

Figure 20: The whole course of a design project can be visualised by a workflow similar to the one to the side. It shows what is referred to as a ▶generic process. At the top you will find both rough and detailed phasing and activity / subject boxes containing the identified process elements (indicated by colour).

3.2.3. The Entire Process

A generic workflow of the whole process was developed, based on the inter-relation structure of elements and the concept of iterations. This generic representation can be transposed onto different design tasks and can be modified for country- or project-specific considerations.

Starting with the very beginning of each individual project, a "simulation" of the integrated design process can be achieved in advance, to include continuous control and documentation of decisions during subsequent progress.



BACKGROUND KNOWLEDGE

The guideline for the Integrated Design Process describes this superimposition in order to develop solutions for the resulting individual process activities.

When the architect or engineer incorporates the respective abilities as well as the background knowledge, he draws corresponding conclusions through an analysis of the project situation for the purpose of further design activities.

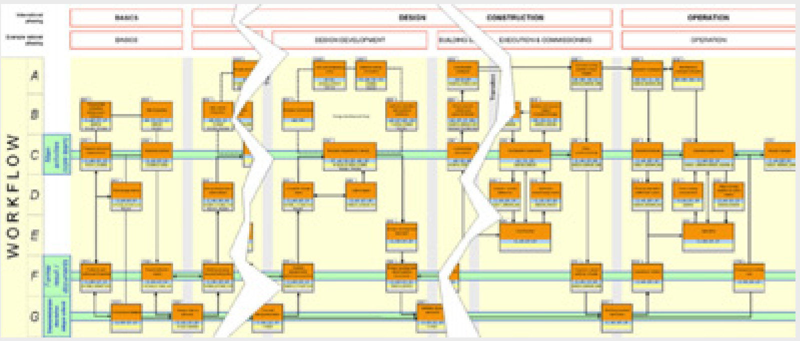
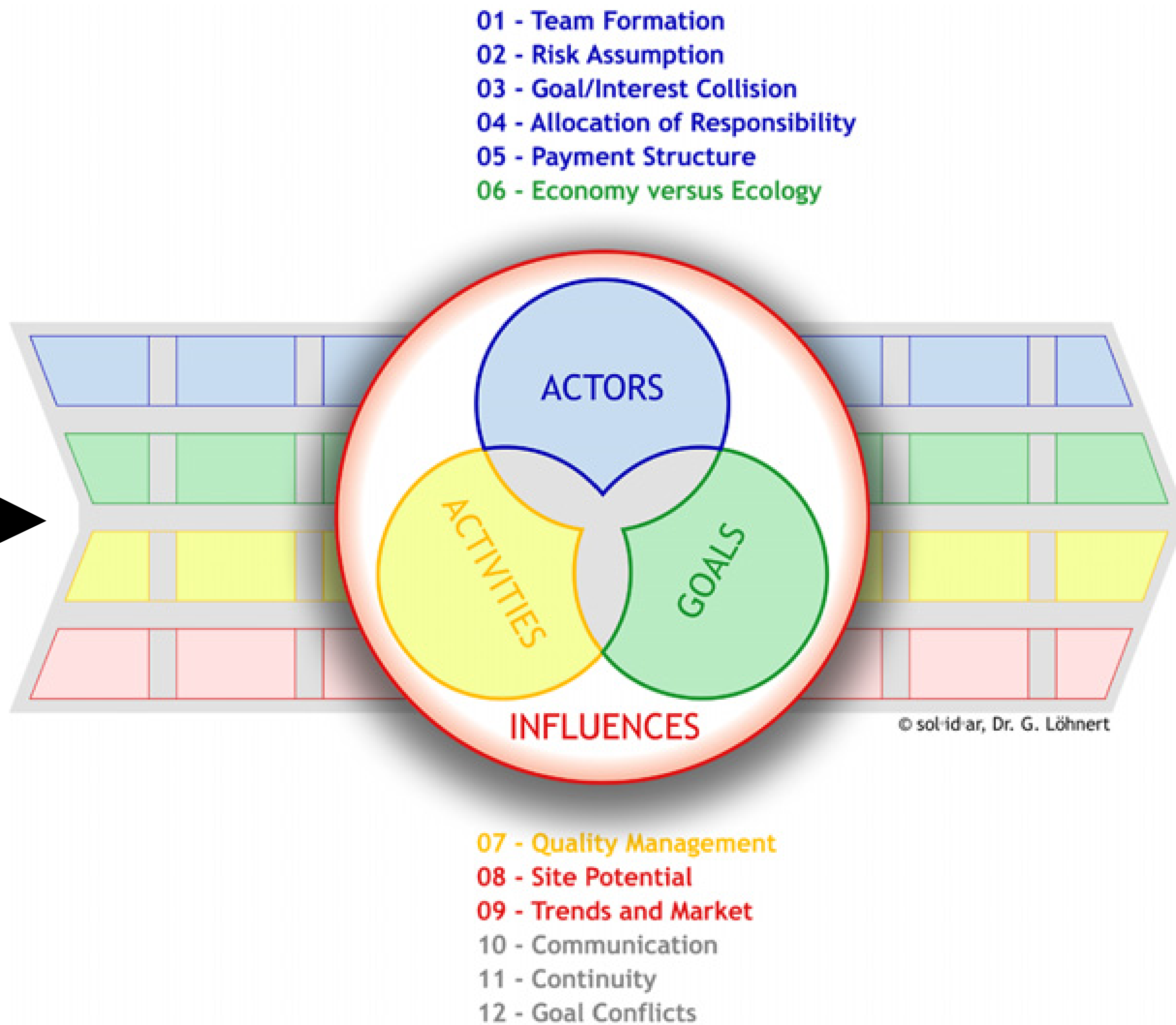


Figure 21: Entire Design Process Development Model integrating both the ▶Interrelation Structure and the ▶Generic Design Process.

3.3. Superimposition of Structure and Process



The entire Design Process Development Model is created by the overlay of the two main parts STRUCTURE and PROCESS. By this way design interrelations and design phases have melt to one unit that allows to identify Key Issues (01-12) and Recommendations for an Integrated Design Process.

NATURE OF KEY ISSUES

Key Issues represent major aspects to be considered independently and individually during design process. Their nature is related to and based on conflicts and concerns that arise typically in design phases while the occurrence and importance may vary in each project.

CHECKLIST OF KEY ISSUES

To keep it short: Key Issues are explained by a one-page checklist format. In order to clarify their meaning they are described by a set of criteria including

- A **Key Issue Title** matching the element colour
- A **Link** to other interrelated Key Issues
- A **Brief Definition** of the Key Issue below the title
- Challenges and Recommendations for the process
- The **Context** for background of the issues providing information about interrelations
- **Typical Issues** within this Key Issue
- **Potentials** if Key Issues are treated seriously

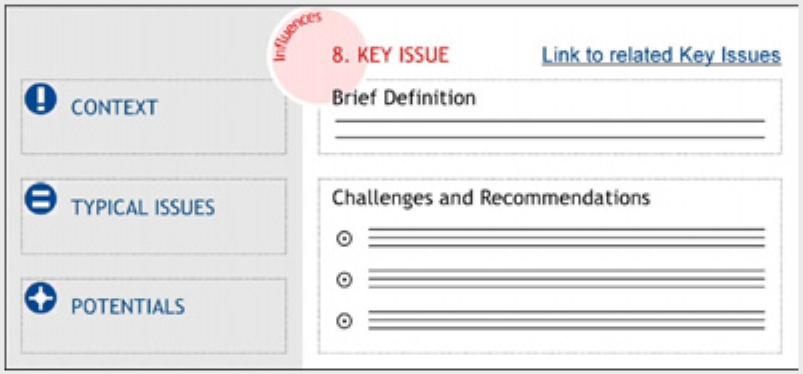


Figure 22: The checklist format of the Key Issues.

4. Key Issues in Design Process

Findings with key problem character, called ▶Key Issues represent mechanisms, contexts and interactions that have an essential influence on the achievement or non-achievement of sustainable goals and progressive building design. Key Issues have been identified by analysing the issues gained by the method of context analysis and experiences from different building projects. They include

Team Formation

Risk Assumption

Goal/Interest Collision

Allocation of Responsibility

Payment Structure

Economy vs. Ecology

Quality Management

Site Potential

Trends and Market

Communication

Continuity

Goal Conflicts

By taking notice of Key Issues and their network, designers should be able to process projects in an integrated and strategic way just-in-time. Above all, Key Issues will help architects and engineers to:

- recognise the right starting points and indicators for an optimisation strategy
- analyse and assess building designs
- structure the whole process for better overview.

Actors

CONTEXT

- Synchronisation to the schedule
- Communication and interaction
- Competency and motivation
- Preparation for decision making
- Goal-finding and priority-setting process

TYPICAL ISSUES / CONCERNS

- For cost reasons or due to the lack of design security the client assigns the architect exclusively to the initial design assumption for too long a period.
- The integration of additional design disciplines takes place too late.
- Communication problems and different work routines of the actors may be caused by different background experience and knowledge.
- Performance criteria for actors' competence are often difficult to determine for the individual case.
- Different vocabulary, understanding and interpretation among the actors involved.
- The client is often represented by people with incomplete expertise.

POTENTIALS

- The realisation of complex and advanced projects is improved.
- A more flexible response to unforeseen developments and impacts is made easier.

→Communication →Continuity

4.1. [1] Team Formation

The selection of a design team where it is intended to use the IDP process to produce a high-performance design involves several special considerations with respect to team structure, skills and formal or informal relationships.

CHALLENGES AND RECOMMENDATIONS

- A fundamental requirement is that the team should include members with specialised skills, in addition to the normal complement of architect and supporting engineers. Specifically, an energy specialist is always required and, depending on the nature of the project and its goals, there may be a need for one or more other specialised team members.
- The IDP process involves the close collaboration of team members with different professions and skills from the outset of the design process. In view of this, all potential team members should be screened for their willingness and interest in following the process and in crossing normal professional boundaries.
- An interest in IDP process is clearly most crucial with respect to selection of an architect by the client. Therefore, an architect should be chosen on the basis of a willingness to work in a team format, interest in the IDP process and a better-than-usual understanding of environmental performance issues. Because the architect has to work very closely with other team members, he or she should be consulted on the inclusion of others in the team prior to their engagement.
- If a design team follows the IDP process, team members will have unusual roles in a somewhat innovative process. Each team member should therefore have expectations clearly explained at the beginning of contract negotiations.
- Consideration should be given to the inclusion of a Design Facilitator on the team, especially in cases where the architect lacks a full knowledge of environ-mental performance issues or where the project has especially challenging performance goals. A facilitator may report to the client or by the architect, depending on circumstances.
- Finally, consideration should be given, within the contract(s), to providing some form of financial incentive to the team related to the achievement of performance targets. If such a course is followed, experience indicates that a determination of the achievement of such a target should await the completion of commissioning and two years of operation.

Actors

4.2. ## [2] Risk Assumption

→Goal Conflicts

Judgement of risk has to take place within a particular context. It involves the areas of legitimisation, motivation, responsibility and liability with which actors are confronted as part of innovative design approaches. However, there are opportunities and benefits implied by innovative solutions for each individual actor willing to face a risk.

CHALLENGES AND RECOMMENDATIONS

- Risk analyses should be executed early in order to make the risk evaluation possible at as early as the first design conception stage.
- The fear of restricted feasibility, unexpected additional costs and rights to compensation represent essential motives for the refusal of risk assumption. Warranty issues connected with innovative building concepts must be the subject of discussions between the client, designers and builders frankly in early design stages and must also be anchored in binding fashion in the building documents.
- It is imperative that thoughtless or even wilful passing on and/or delays of risks over several stations (between actors) be prevented.
- Risk management can be motivated by supporting innovation, by political decisions or also through safeguarding measures such as contracts and insurance.
- A timely staff reinforcement of the team – when one's own competency is insufficient - will help to discover or to minimise risks effectively.
- Risks of innovative concepts are subjectively felt to be more significant than is justified. With a 'standard solution' however, only a mediocre building performance can be expected from the start.

CONTEXT

- Inadequate decision bases for design development
- Economic viability
- Safeguarding of actors and definition of interfaces
- Technical feasibility

TYPICAL ISSUES / CONCERNS

- Clients designers and construction builders balk at unconventional design concepts
- Clients fear unexpected additional costs for subsequent improvements or rights to compensation on the part of the user or occupant.
- Designers fear legal claims for unsatisfactory performance of innovative systems.
- Contractors demand surcharges on unfamiliar building concepts, construction elements and technical systems or components.
- Risks also can be overrated due to ignorance and lack of experience!
- Risk for the refusal of building permission in case of new developments when necessary authorizations/ certificates for systems or components are missing.

POTENTIALS

- Realisation of unconventional solutions with sustainability effects and with it the creation of actual innovations.
- Integrated design avoids clearly possible risks: imponderables in the traditional design are therefore a sign of design deficits.

Actors

CONTEXT

- Project schedule and contracting
- Qualification of actors and external specialists
- Performance effort and definition
- Cost considerations and calculations

TYPICAL ISSUES / CONCERNS

- When ACTORS are contracted for both design and building performances an engaged accomplishment in at least one of the sectors may be prevented.
- The interest of the CLIENT in short-term economic exploitation of the building competes with long-term and sustainable project goals.
- With innovative projects, the DESIGNER must weigh the additional performance often required against the designer's fee actually available.
- CONTRACTORS prefer to orient themselves to profitable standard solutions, thus hindering the execution of innovative concepts.

POTENTIALS

- Emerging goal/interest collisions can uncover weaknesses of the concept and help eliminate them.
- Enhanced qualification of the project can arise from the varied views and constructive criticism of the project participants.

→Team Formation

4.3. [3] Goal/Interest Collision

The differing interests among the actors involved emerge with the task and problem treatment and become part of the task to be solved. Goal/interest collisions within one and the same actor however is a concealed disruption factor. Disadvantageous effects of the conflict are hard to prevent.
Goal/interest collisions lead to a situation where the individual goals of the participants are not completely in line with the project goals.

CHALLENGES AND RECOMMENDATIONS

- Design and construction functions should be undertaken by separately actors. The extreme concentration of design and delivery performances in one hand, as for example in the case of contracting a general contractor must be questioned in individual cases just as critically as extreme decentralisation among too many individual building/supplier contracts.
- The client must be convinced of the advantages of long-term considerations
- Indications identifying goal/interest collisions must be recognised and interpreted by experienced actors and heterogeneous individual interests must be reshaped into homogeneous "project interests" using suitable measures, especially by contract agreements.
- A decoupling of the designer's fee structure from quantities such as building costs and masses in favour of a quality-oriented honorarium such as a lump sum and providing incentives by bonus will reduce conflicts of interest.
- It must be ensured that designers do not profit from products which are utilised as a result of their design participation.
- Foreseeable conflicts must be discussed and considered as a criterion for the selection procedure at the time of team composition and the awarding of contracts.
- An independent "moderator" or facilitating experts should be appointed as preventative measures for the early recognition and elimination of conflicts of interest, for example a competent architect or an external mediator.

Actors

4.4. ## [4] Allocation of Responsibility

→Team Formation

The allocation of responsibility describes the process of transferring responsibility to the actors involved, to include mandating activities and decisions for the optimum performance of allocated tasks.

CHALLENGES AND RECOMMENDATIONS

- To ensure an appropriate management structure and roles, experienced members of the team should provide clear and open explanations of the process and its inherent issues.
- A meaningful combination of expertise and responsibility is required of the important decision-makers.
- Interfaces between design tasks have be defined clearly in connection with responsibility allocation, both horizontally across disciplines and vertically in terms of an in-depth knowledge.
- A general designer contract may support an adequate allocation of responsibility in favour of a powerful core design team development. However, subcontract specifications should be transparent for the team in the same way and defined carefully and to avoid interface problems.
- A rigid task separation of different construction/suppliers responsibilities can be reduced in favour of more powerful partnership networks, such as “construction teams” that cover works across construction disciplines.
- A clear allocation of competence to actors must correspond to a clear allocation of responsibilities by expressing liabilities/warranties on the design and building performance. This particularly concerns experimental design and construction approaches.

CONTEXT

- Actors structure
- Independent control
- Multi-disciplinary interactions

TYPICAL ISSUES / CONCERNS

- Deficient qualifications and competencies in the field on the parts of decision-makers
- Information losses with the delegation of tasks
- Friction losses at the interface of building trades and components, e.g. wall, roof and glass facade
- Deficient training and qualifications of craftsmanship and construction workers

POTENTIALS

- Fast response to changes and effective problem solving
- Economic safeguarding of all project participants
- Basis for the development of a relaxed work atmosphere of mutual trust

Actors

CONTEXT

- Liability and guarantee questions
- Dynamic market developments
- Quality concept of clients, architects, engineers

TYPICAL ISSUES / CONCERNS

- Inadequate design fees will burden the actors motivation for innovative approaches and will lead designers to solutions that are easily modelled, well-known and well documented
- Effect of budgetary infringements lead to reductions of the quality and consistency of the design concept
- An exact "forecast" of design expenditure and costs in early project phases is difficult with innovative concepts / technologies as well as with long design time periods
- Lack of clear standards for judging the quality of the design

POTENTIALS

- Increase of motivation of actors
- Optimisation of design and cost performance through cost postponements

→Risk Assumption →Continuity

4.5. [5] Payment Structure

Payment structure illuminates the central question of adequate payment for design and construction work by means of the delegation of responsibility and corresponding competency. In addition to the time pressure in early design phases, it is not unusual that the design fee will be cut to less than 10% of the total project budget. However, inadequate design fees will make it difficult or impossible for designers to spend enough time to explore new options for whole building considerations. Thus, they will revert to solutions that are easily modelled, well-known and well documented.

CHALLENGES AND RECOMMENDATIONS

- Uniform legally binding contracts and acknowledgement by all participants should be assured in time to avoid vagueness for early design stages.
- The client is to be convinced that investment for a qualified intervention in early design phases yields advantages for the entire course of the project.
- The payment of design performances should be arranged on a quality-oriented basis and not on a purely budgetary or building-cost basis as it is common practice in most fee structures.
- Optimisation potentials must be assessed at all times during the process and any resulting shifts within the cost structure should be accepted.
- The commitment of a main/general contractor does not necessarily guarantee cost benefits. The client should be enlightened concerning incorrectly expected or pre-supposed cost advantages.

Goals

4.6. ## [6] Economy versus Ecology

→Goal Conflicts →Team Formation

Environmental impairments have to be sustained by the community and not by the originator as long as the costs-by-cause principle is not established. This relation describes the critical link between what are usually short-term simplifying cost considerations and a long-term, integral sustainable under-standing and assessment - especially for the factors of costs and benefits interrelating TIME HORIZON-COST // COST-BENEFIT // BENEFIT-TIME HORIZON

CHALLENGES AND RECOMMENDATIONS

- At the start of the project, the question "To build or not to build" is to be discussed seriously: Dispensing with a new building – for example in favour of the reconstruction and/or redevelopment of existing buildings - often represents the most sustainable and advantageous solution.
- Short-term partial benefits should be relinquished in favour of long-term goals.
- The economic evaluation of concepts must take into account all accruing costs including external environmental costs.
- The evaluation of a building has to be considered in the context of its life-cycle. Short-lived approaches must not become prejudiced by functional programmes representing solutions which are too strongly tailored to exclusively meeting individual and current demands.
- Multi-functionality and appropriate flexibility are to be integrated into the building design concept as elementary sustainability goals.
- The application of building evaluation and assessment tools in the design and construction fields should be encouraged in order to bridge economic and environmental viewpoints.
- Designers themselves must get a deep insight on cost interrelations in order to evaluate the impact of design alterations during the design optimisation.
- Make it clear that ecology is not a contradiction to economy as it is an integral part of sustainability.

CONTEXT

- Evaluation scales, benchmarking, system boundary
- Definition and interpretation of quality concepts
- Goal definition and pursuit

TYPICAL ISSUES / CONCERNS

- Lack of serious willingness to adopt a truly long-term consideration/attitude on part of the clients.
- Missing or insufficient integration of sustainability requirements into binding regulations and standards
- A short-term perspective impedes the understanding and meaning of many sustainable measures such as CO_2-reduction, the ageing of materials, recycling-friendly construction systems, etc.
- Life-cycle-oriented building data and values should be investigated and integrated into systems and standardised workflows and routines.
- Too-rigid cost structures lead to over-hasty decisions, creating a potential for expensive and disruptive corrections later

POTENTIALS

- Contributions to development and strengthening of a sustainability-oriented design/construction culture
- Protection of resources and environment
- Valuable and long-term basis for business strategies and marketing concepts

Activities

→Communication →Continuity →Team Formation

4.7. [7] Quality Management

Quality management **includes** measures and strategies that make it possible to judge the design and realisation progress by quality assurance and control and results qualitatively and quantitatively at any time. This makes it possible to recognise any premature endangering of the project goals and to bring about corrective intervention in time.

CHALLENGES AND RECOMMENDATIONS

- Design and quality management's philosophy pursues the claim of actively defining the quality of a performance early and of then pursuing it. This requires a dependable exclusion of any inferior interim result at any stage of the process.
- A prerequisite for an effective design and quality management is the continuous documentation of progress and decisions during the process.
- Coupling and coordination of competencies in the area of building design and management must be striven for.
- The establishment of control intervals and the detailing of the extents related to workflows, costs and schedule must take place earlier if necessary and in higher quality than stipulated by common regulations - if the complexity of the project makes this necessary.
- The optimisation potential of the design performance should first be exploited in accordance with traditional fee and payment structures in order to better identify the need for additional support by external specialists.
- An external specialist should be assigned if the competencies of the process coordination and control of the progress are not available within the design team (with the client being included).
- In contrast to classic project managers, the facilitator is above all dedicated to content-related coordination and design and process management in order to optimise sustainability-oriented goals.
- Quality control during construction does not substitute an efficient quality assurance during design. Poorly executed construction operations are a result of poor design and management quality in most of the cases.

CONTEXT

- Objectivity and Independence
- Interdisciplinary Design Performances
- Workflow and Management Methods

TYPICAL ISSUES / CONCERNS

- With strongly-centralised design management (main builder / general builder) the objectivity and influence of individual actors such as clients and architects is very limited or even eliminated. This often has a negative effect on the design result.
- Synchronisation and timely feedback between design and management is often very insufficient.
- Relation between design and management tasks, particularly in connection with very differentiated allocation practice (partial performance contracted to specialists, allocation in stages, etc.)
- Design and construction performance/responsibilities are not entirely covered or stated not clearly.

POTENTIALS

- Optimisation of the cost-benefit relationship in reference to sustainability.
- Reduction of problems and conflict, bringing with it psychological relief for all project participants.

Influences

CONTEXT

- Use or reconstruction of existing buildings
- Assessment of future neighbourhood developments

TYPICAL ISSUES / CONCERNS

- Poorly developed or missing consciousness for the long-term structural and spatial effects in the urban context.
- Location parameters such as neighbourhood development, technical supply and traffic infra-structure, future structural developments in the surroundings, etc. can hardly be influenced and are difficult to calculate.
- The need to gather and interpret ecological data from the project site can be expensive, and this fact often leads to inadequate locational studies being carried out

POTENTIALS

- The site selection includes long-term utilisation perspectives on the basis of an entire evaluation.
- Minimisation of over-development and reduction of land consumption
- Completion and revitalisation of urban functions and developments

→Goal Conflicts

4.8. [8] Site Potential

Potentials of location and site involve opportunities and limitations resulting from the urban environment and the effects of specific site conditions on the project as well as from the expected effects caused by the intended project. A careful site analysis must precede each building project.

CHALLENGES AND RECOMMENDATIONS

- The biggest environmental potential is often represented by the conversion and redevelopment of existing buildings (To build or not to build) which should always be examined and assessed for their potential integration into the intended project strategy.
- Location criteria are to be developed and documented comprehensively. They simultaneously form the checklist positions for the site selection procedure and for the evaluation process in cases of realistic site alternatives. For any given property, the site analysis must comprise all aspects of sustainable design by using an environmental inventory checklist or similar methods.
- The existing natural environment is to be assessed for its potential integration into the project. This involves an in-depth survey of all micro-climate indicators such as solar exposition and control, wind and precipitation characteristics and topographical conditions, among others.
- Local site opportunities related to climate conditions have to be evaluated in terms of system selection, energy opportunities and control of thermal and daylighting comfort.
- The site inspection also addresses necessary expenditures for the realisation of the building, such as site access, soil and groundwater characteristics and precautions and potential impairments during the construction period.
- Investigation of existing conditions and assessment of opportunities for and restrictions against alternative strategies, e.g. by legal regulations for compulsive lining to supply and discharge service networks.
- Long-term effects on the structural and spatial environment are also to be included consciously and extensively in the design concept.
- If necessary, the site should also be questioned and reconsidered in time.

Influences

CONTEXT

- Local structure of supply and demand conditions
- Socio-cultural / politically superior conditions
- Building codes, laws, regulations and standards

TYPICAL ISSUES / CONCERNS

- Superficial approaches based on short-term utilisation interests become more and more accepted.
- Economic pressures are often used as an alibi and are either not or only insufficiently well-founded.
- Optimisation of the design concept normally occurs unilaterally, covered exclusively by a market-related financing concept and not by long-term perspectives of sustainability including new market developments
- Lack of compatibility for the procedures concerning integration of public support between the funding contribution and the real project course.

POTENTIALS

- Economic pressure can promote innovation willingness on the part of the client and can open up new markets / market niches.
- Innovative building concepts set new standards and promote the image of the client as well.
- Market advantages may be created by long-term secure low operating costs.
- New ideas can persist in penetrating the market.
- Credit financing is secured more readily for the long-term when future operating costs are more favourable.

→Overall Relation →Economy versus Ecology

4.9. [9] Trends and Market

The project intentions of the client are always influenced by the demand-oriented influences of the market. These are based on economic conditions and are generated by the implicit socio-cultural conventions of society. Project goals are coupled with overall trends and developments of the market and the building industry and their interdependence. For both public and private clients, and independent on the method of building delivery these issues may influence considerations of time horizons, financing, public funding, among others.

CHALLENGES AND RECOMMENDATIONS

- Attempts should be made to influence the client towards seeing the long-term advantages of a high level of environmental performance. A presentation of life-cycle costing implications is one of the most effective ways of leading a client away from a focus on short-term profit and a style-based approach to design.
- Methods of building delivery (traditional, general builder, design/build, turnkey, etc.) have an essential impact on project goals and overall process. They represent different levels and qualities of design and construction phase integration, with the allocation of responsibilities also being completely different.
- The frequently-argued so-called "economic necessities" and "pressures" are to be questioned critically, since often they serve as strategic knockout criteria for stopping valuable concept discussions on design variations.
- The elimination of components or conceptual considerations due to financial limitations should not be permitted to endanger the spirit of the design and/or must lead to a meaningful alteration of the building design concept.
- Especially in public projects, the design team must strive to stay within the allocated budget in all phases of realisation in order to avoid cost deficits which would otherwise have to be covered by a reduction of quality standard in later project phases.
- The increasing diversity and development of new products and technologies available as well as the fluctuation of market prices have steadily to be traced.

CONTEXT

- Professional and communications competency
- Motivation and open-mindedness
- Team management, mediation, external specialists
- Compatibility of hardware and software

TYPICAL ISSUES / CONCERNS

- The design intensity of environmental projects results in a demand for a high level of successful communication that does not meet with the undivided approval of all actors.
- There is a lack of communication at some level or of a common "language" as the result of different knowledge, experience, work methods, etc. on the parts of the participants.
- There is a frequent lack of mutual understanding and balanced personal esteem and respect between design participants that can hardly be affected.
- Design partners usually get a flood of information during the design process, of which only a small part may be important to them, while, on the other hand, significant information will not always be transmitted.

POTENTIALS

- Efficient problem avoidance and resolution
- The development of mutual trust and of a common language is promoted, by means of which a successful and efficient solution of the design task is also supported.

→Overall Relation

4.10. [10] Communication

Communication refers to the human and technical requirements of a qualified and structured exchange of information between the actors of the design team and external participants as an essential basis for interdisciplinary cooperation.

CHALLENGES AND RECOMMENDATIONS

- First, elementary prerequisites - communication competence, openness and interdisciplinary team ability - must be secured for all design team members. A “▶kick-off” workshop in the early design phase will explain the nature of the integrated design process and will support the team spirit.
- Open-mindedness of participants towards an integrated design approach and interconnected requests are to be tested carefully. In most cases it is advantageous to have actors know one another personally.
- Regular workshops executed by a competent moderator should take place in concert with important decisions, transitions or design course milestones. Practice experiences favour two-day workshops which transmit and consolidate social communication and trust, as well as qualified work efficiency.
- The integrated design process must be accompanied and guided by a professional designer with moderator competency. If this is not achieved by the project architect, an external specialist (facilitator) is to be introduced. An external mediator should be brought in when "insoluble" conflicts arise.
- Transparency and topicality of the information for all actors is to be ensured at all times. Problems and reservations must be communicated immediately and fully within the team at all. This implies a competent team management expressing clear workflows including roles and responsibilities in the collaboration among all team members.
- An suitable communication infra-structure between actors must be arranged. This includes technical means (systems, software, formats etc.), appropriate actors competency and the test of communication channels right in time.
- Tests of the communication channels, tools and file transfer procedures should be executed in design sections which are non-critical in temporal terms.

All Elements

→Overall Relation

4.11. [11] Continuity

Continuity represents one of the most elementary quality features of the design process: the goal-oriented, consistent and continuous pursuit of sustainability-oriented project goals on all levels and throughout the entire process.

Discontinuity in the design process and the pursuit of design goals, for whatever reason, may have a disastrous impact to the final quality of project performance and results.

CHALLENGES AND RECOMMENDATIONS

- Project goals must be established with long-term perspective. Pre-determined objectives and conceptual approaches on the part of the client are to be questioned for possible insecurities and goal conflicts. In the event of incompatibilities, corresponding alternative scenarios are to be developed collectively.
- Meaningful coordination of design steps should take place on a continuous basis and at the different levels of the design concept (macro to micro).
- Continuous documentation is the prerequisite for guaranteeing content-addressed continuity, even with staff discontinuity. This includes comprehensive plans and reports documenting the relevant phases adequately.
- For projects expected to be developed over a long period a basic long-term management scenario should be established, comprehensible to actors appearing later in the process as they can review only major decisions already taken.
- Minimisation of designer changes is to be striven for. This can be achieved mainly by clear objectives and contract structures appropriate for the project. In particular, the important transition phases of performance transfer need to be intensively prepared and elaborated.
- During the construction an accurate realisation of the design goals will be guaranteed only by a continuous construction supervision and quality control much more frequent compared to less ambitious projects.

CONTEXT

- Information preparation, delivery and management
- Transfer of work status (transition)
- Change / replacement of participants involved
- Long design time periods
- Goal pursuit and quality assurance

TYPICAL ISSUES / CONCERNS

- The goals and with them the chances of realisation of the client's intention are not guaranteed. This situation will promote "half-hearted" activities and mistrust with respect to original goals and will lead to inadequate design fundamentals.
- Changes of the actors during the process disturb communication structures and continuity and cause information and quality losses.
- The decision makers on the side of the client are replaced during the design process.
- Dependence on external factors and committees

POTENTIALS

- Long-term partnership between client and designers creates mutual interests and increases the performance potential already existing in the design and construction phases.
- Attainability of sustainability related goals with economically reasonable expenditure.
- The transmittal of design/building data into Facility Management systems after building construction becomes possible without considerable expenditure.

All Elements

→Overall Relation

4.12. **[12] Goal Conflicts**

Goal conflicts refer to competing design intentions that prevent the integral realisation of all goals due to the complexity of a project. Goal conflicts emerge from the same or different design disciplines resulting from the superimposition of effects.

CHALLENGES AND RECOMMENDATIONS

- The emergence of goal conflicts can be reduced through iterative revision of the priority-setting established by the previous goal-finding process.
- Minimise the likelihood of goal conflicts arising through efficient communication and continuous documentation. Development of alternatives makes possible contradictions between and within goals visible and understandable in order to confirm decisions in consultation with the client.
- The consequences of design decisions are to be pursued further in an interdisciplinary manner and to be checked for overlapping.
- Check the intended measures for the resolution and attenuation of goal conflicts for their economic and temporal compatibility with the current design process.
- Put critical questions to "subjective" or "emotionally-coloured" solution approaches such as architectural philosophy, fashionable materials and favourite construction systems and elements.

CONTEXT

- Contradictory requirements
- Competing technical systems

TYPICAL ISSUES / CONCERNS

- The experience of key players, for example architects or traditional project managers, is often insufficient to recognise and solve goal conflicts.
- Lack of acceptance of an elaborated order of priorities leads to goal conflicts.
- Different project participants claim for unrealistic or contradicting solutions and preferences.
- Deficient determination and continuity in a project increase susceptibility to goal conflicts.
- Motivation of the actors for disclosing and overcoming goal conflicts is low or completely absent.
- Goal conflicts cannot be resolved by participants obstructing reasonable solutions.

POTENTIALS

- Friction benefits instead of friction losses
- Reduced time spent on resolution of goal conflicts
- Open and constructive exchange of views will lead to a durable synthesis of mutual project objectives.

RATIONALE

This section contains results of earlier work that were examined in a consistent manner for the recommendations that can be derived from them. The material thus consolidated has been compiled with an emphasis on user-friendliness for easy adaptation. With this in mind, the respective items have been summarised according to their meanings and to the amount of detail at two levels and have been generated top-down with respect to applicability. This will permit users of this guideline to be able to select hints or advice according to the complexity of the question at hand.

ISSUE IDENTIFICATION BY CONTEXT ANALYSIS

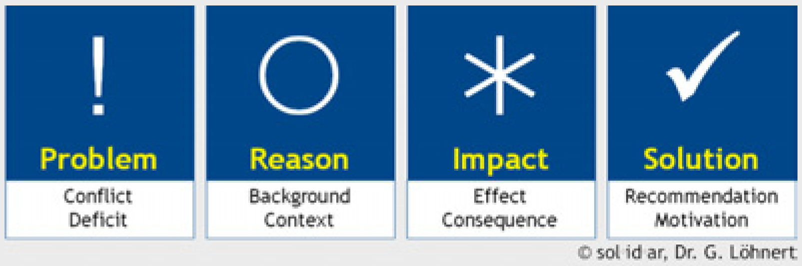


Figure 23: Structure of the ▶Context Analysis. This method is a suitable way to identify design process issues in a broader context from conflict potential including their impact on the entire process and resulting solutions/ recommendations. The method has been used for the development of the guideline and is recommended to be used in an individual design process as well.

Figure 24: Interrelations between Recommendations, Key Issues and ▶Issues in the Generic Process:
The Key Issues as main aspects represent the focus in certain process areas. Aspects affecting the entire process as well as recommendations concerning individual design phases are based on the totality of Issues identified.

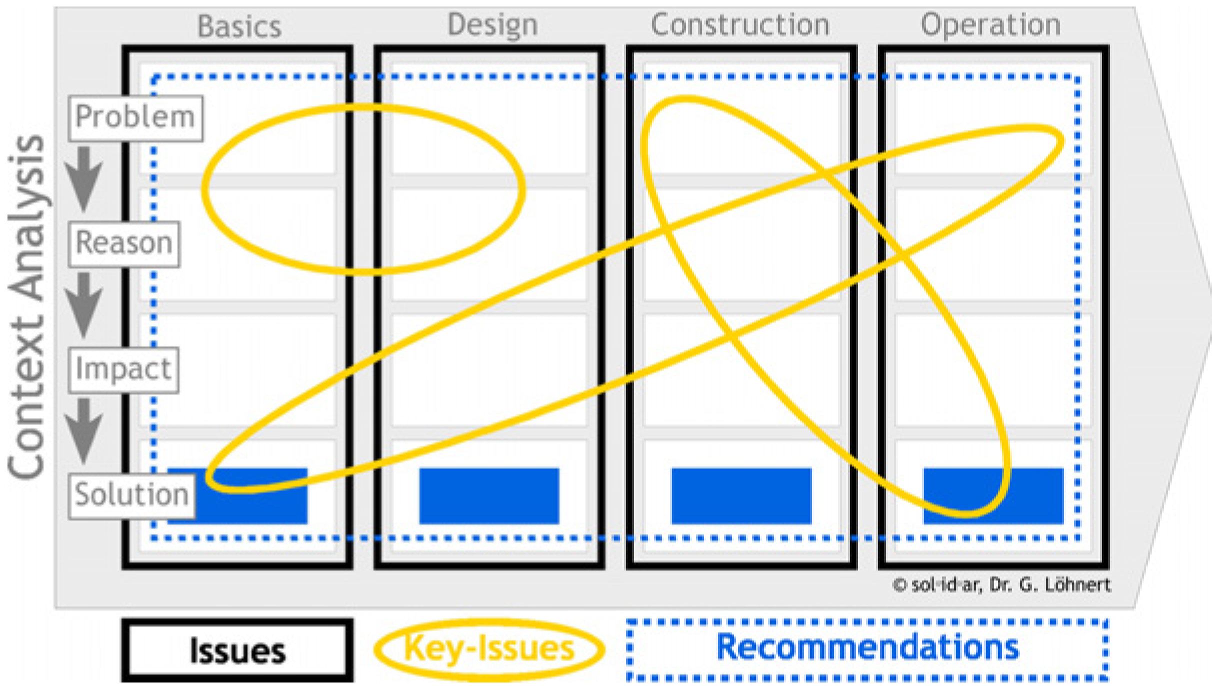
5. Design Process Recommendations

Once possible solution approaches are identified, adequate responses to different problems can be provided. This becomes possible through the proposed context analysis, which describes in detail the interrelation between problem and solution.

The recommendations derived from this method are directed at all key actors in the design process. Constructive implementation assumes that there will be consistent and well-functioning teamwork.

Recommendations related to the entire process address superimposed strategies and can be implemented in design strategies and assigned to individual projects.

Recommendations related to design phasing focus on separate stages of the design process. These can be classic design phases in the sense of design or construction as well as clearly definable processes such as commissioning.



5.1 Recommendations Related to the Entire Process

5.1.1. To Build or Not to Build

Restrained employment of resources is a central issue of sustainability. In light of the discrepancy between the viewpoints "To build or Not to build" - reuse, extend, restore, renew should be given more weight – in fact, should be the first design choice. For that reason, it takes time to discuss this topic at crucial stages and requires correct decisions, appropriate development perspectives as well as understanding, willingness and cooperation of the client and the approving authorities.

5.1.2. Assurance of Long-term Utilisation

The requirement of longevity and consequent long-term utilisation is linked with high multi-usability and flexibility in terms of future requirements. The prerequisites for this are fundamentally determined by the inclusion of urban integration of existing structures and the development of future potentials. In order to assure durable existence, the advantages of multi-functionality must be steadily maintained at a high level. The building must be understood in light of its function and life expectancy as an organism with three subsystems: load-bearing structure, technical infrastructure, and finishing structure.

5.1.3. Separation of Design / Delivery Performances

This addresses the avoidance of Goal/interest Collisions which are likely to occur when an actor takes on several tasks central to the design and realisation process. The risk is that project goals already agreed upon by the team are no longer supported by this actor. Clear design sections and partial performances would therefore be helpful in such cases.

5.1.4. Clear and Complete Responsibilities among Actors

Design projects committed to the high performance of sustainable goals require a particularly "just-in-time" decision management which is based on technical preparation and the perspectives of the design team. It is necessary that the delegation of Responsibility and decision-making be transparent to each actor to guarantee flexible and rapid reaction capabilities on the part of the design team throughout the entire design process.

5.1.5. Continuity of Quality Assurance

A basic measure of process-accompanied quality assurance consists of safeguarding of Continuity, including the transmission of all relevant information to the right actors and the abridgement of process-conditional interruptions. Thus, the continuing management of risks, costs and time is a key component.

5.1.6. Establishing Communication Quality and Application of Tools

Today technical qualifications alone are not enough for managing complex design tasks. A deep fusion of competencies in the fields of design, communication and management is demanded. This requirement can be best fulfilled through the overall qualifications of individual actors working together in an interdisciplinary team. An essential challenge for the leaders of the design process is conscious control and influence of an extensive information flow. Innovative applications such as Internet platforms to support this purpose will increasingly gain in attraction. Computers can link different design and construction disciplines so that drawings can be created from a common database of information that can be shared. In each phase, visualisation and simulation tools explore, document and support decisions related to design, performance, and cost. Close design collaboration supported by advanced computer tools enables easy refinement of opportunities, quantifies cost savings and optimises given design trade-offs. Issues of energy, indoor environment, and cost can be viewed together rather than independently, so that a design solution that optimises one (energy) does not adversely affect another (comfort or IAO).

5.1.7. Quality Protection through Design Optimisation

Environmentally-oriented design goal priorities should be established at the very beginning of every project. During design and construction, continuous checks must be carried out to determine whether mutual interactions between these partial goals remain in agreement with the original intention.

5.1.8. Optimal Inclusion of the Client

The role of the client is crucial for the realisation of sustainable project goals. An essential requirement of the designer is to point out quality-crucial milestones in the design process in a timely fashion, although this also depends on the identification of technically different opinions, points of view and goal conflicts. The architect should enable his client to make the correct decisions at the correct time by providing a technically-supported point of view concerning the design process; on the other hand, it is also necessary that the client then provide the architect with adequate freedom of action.

5.1.9. Avoidance of Construction-accompanying Design

Although it has become more the rule nowadays, fast-track construction should be avoided as far as possible by an optimal preparation of the construction phase; otherwise, design mistakes, weakness and sub-optimal solutions will inevitably emerge. New forms of contracting should be accompanied by proper quality / sustainability control mechanism.

DIRECTING OPPORTUNITIES

The following sections summarise important considerations to be applied during different phases of design and construction.

The **Challenges and Recommendations** in the Key Issues checklists are also to be taken into consideration as supplements to these phase-oriented recommendations.

NATURE OF THE RECOMMENDATION FORMAT

Due to the static nature of this guideline, these recommendations can be assigned only once each to a particular phase. In everyday practice for project-specific cases, however, other allocations will also prove to be possible or meaningful, e.g. team set-up will be followed in sequential phases by continuous development and completion of the team.

Remember that process phasing is more a support mechanism for structuring than a dogma, since it is difficult to identify the true beginnings and ends of process phases, due to flowing phase transitions. However, the necessary dynamic functions are only practicable when using the basic structure of the NAVIGATOR tool.

5.2. Recommendations Related to Design Phasing

The following section contains detailed notes concretely related to individual design phases for the purpose of expanding and supplementing the expositions regarding the recommendations concerning the overall process. The user of this Guideline can implement them directly as a practice-oriented checklist.

Nevertheless, it must be taken into consideration when following these recommendations that they relate to a process which is generic and thus idealised, which means the following for project-specific applications:

- The recommendations must also be allocated to other design phases as necessary, because the sequence and number of different national design phases can occasionally differ considerably from one another.
- The recommendations must be adapted in terms of content to the individual project, because not all notes need be relevant to every construction project and not address sustainable related issues exclusively.
- The compatibility of individual recommendations with one another needs to be tested when several different ones are selected and/or implemented, because a measure which makes sense in itself may lead to negative effects when implemented in combination with others.

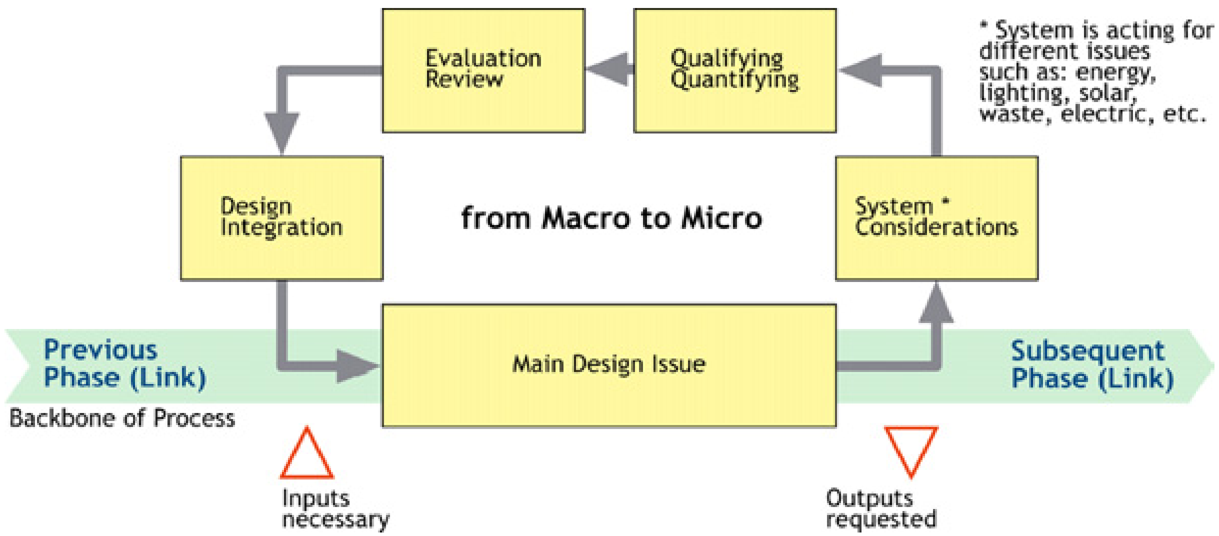


Figure 25: Rationale of the design phases illustration.

In addition to the actual recommendations, important optimisation steps for each design phase are presented in graphic form as ▶"iteration loops". Necessary input and output dimensions for the iterations are also described at this point.

5.2.1. Basics

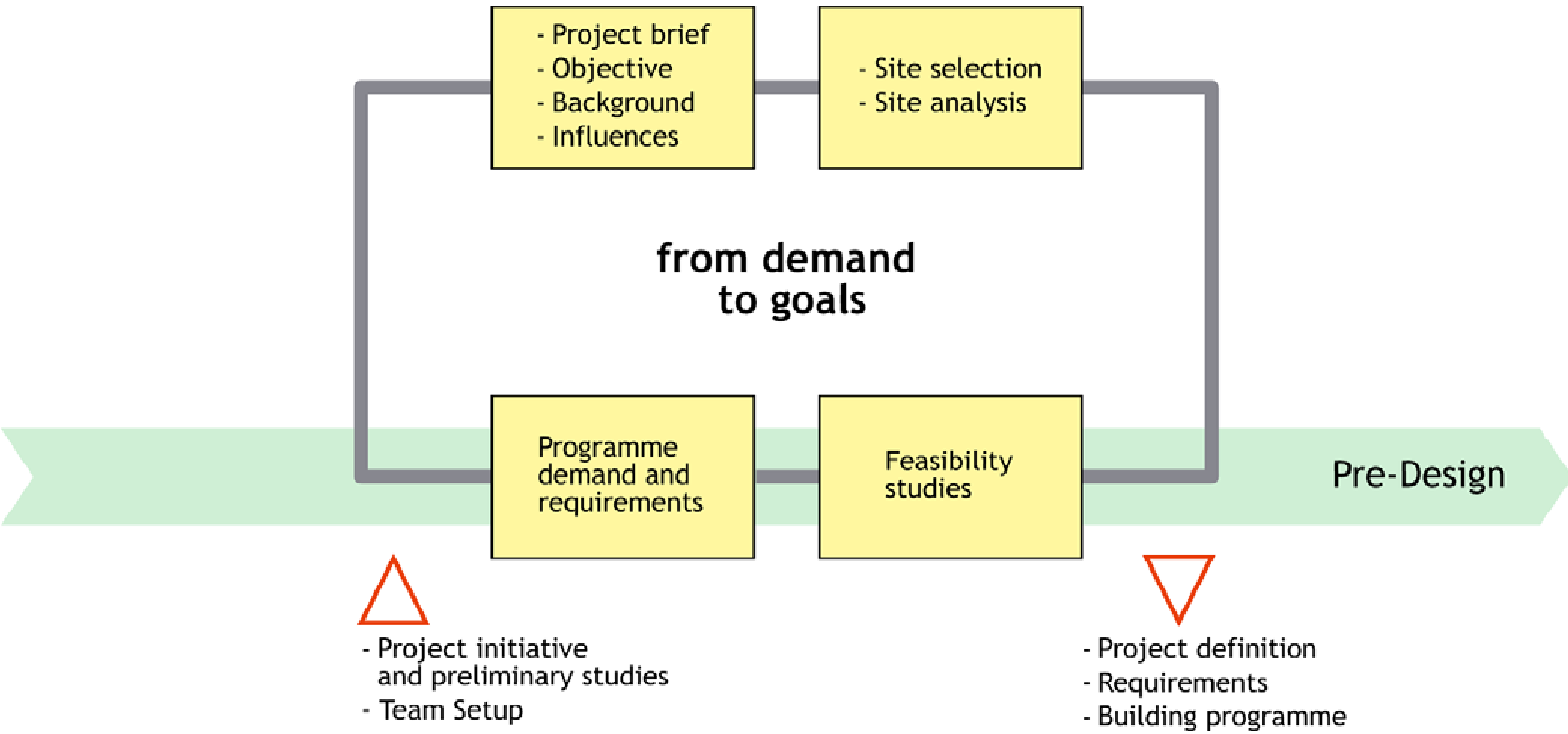
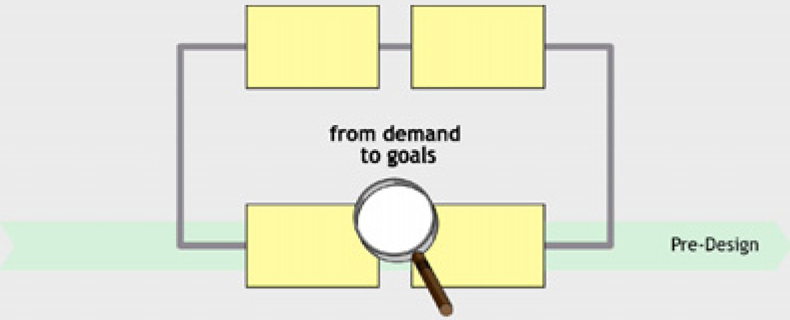


Figure 26: Objectives of BASICS: from clients` requirements to design goals.



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Ultimately, it is the responsibility of the client to choose and/or approve the project team members, but it is the responsibility of the entire team to consider the energy and environmental and communication capabilities of each member.

KEYWORDS

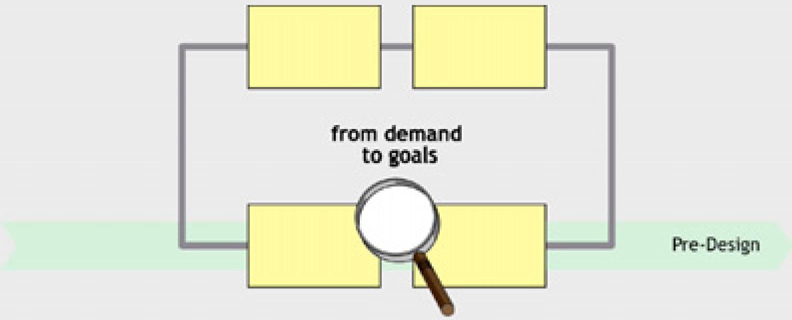
- Team Set-up and update in time
- Consider competence and communication qualities
- Ensure share of mutual goal commitment
- Develop partnership strategies
- Consult external experts in case of demand
- Integrate occupants and building operator if possible

RESULTS AND DOCUMENTATION

- Actors Relation Chart of the entire design team members including “hidden” decision-makers of key players and institutions involved

5.2.1.1. Team Formation: Set-up and Development

- For each project, regardless of the project delivery method, an individual team set-up must be developed and adapted in accordance with the specific project conditions and preliminary goals defined by the client or project initiator.
- The team should be set up as early as possible to insure broad input and advisory support during the initial design phase of the project. As time is an often under-estimated value, many costs could be avoided by proper installation and timely completion of the design team.
- Especially for "turnkey"-type or design/build projects, the design team set-up is crucial, as the client will select the general contractor responsible for selecting designers and construction trades (subcontractors) and for process management.
- Criteria for selecting individual design team members are actor's competency, energy and environment-related capability in accordance with sustainability goals. Everyone must share the commitment to high performance building objectives and participate in the process. Otherwise, they may undermine it.
- To overcome the dangers and difficulties of a design process, it is necessary to develop partnership strategies in a powerful team.
- Design know-how which is necessary from a design point of view, but which is not yet to be found among the actors, must be obtained as part of an appropriately far-seeing team-formation process in the context of already-existing ideas, concepts or handicaps contained in the goal-setting process.
- The possibility of the development of alternative concepts (by self-selecting teams) in a competition or in the context of a limited multidimensional study should be examined in the beginning stages of the project.
- Additional consultants (design facilitator or subject specialists) with specific energy environmental expertise and process management/moderation qualities should be considered if suitable capabilities are not yet covered by the team.
- Advice by potential occupants and future operators is useful if they are already known.
- An essential prerequisite for good cooperation, sensitisation of the actors has to be carried out to communicate the advantages of a team-oriented integrated design process. A structure of collaboration should include roles and responsibilities among team members, conventions on communication systems and should describe the hierarchy and means of information transfer and compatibility.



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Though often vaguely defined, typically the client formulates the objectives for a building project. But it is the design team who must translate broad demands into programmatic requirements, performance goals and design criteria.

KEYWORDS

- Inspect project brief carefully
- Investigate suitability of existing buildings
- Support mixed use approach
- Check project budget assumptions for realism
- Synchronize goal setting and design
- Establish benchmarks target values for goals
- Define goals clearly and review frequently

RESULTS AND DOCUMENTATION

- Project definition and building programme reflecting a profile of requirements including consensus goals, benchmarks and performance target values.

5.2.1.2. Project Brief and Goal-Setting Process

- Client wishes and objectives are to be checked for feasibility and completeness.
- The functional programme should be flexible and capable enough to support mixed use requirements and expectations in design and performance.
- The consideration of using existing building potential should be part of the functional programme discussion and assessment.
- Restrictions and options of fundamental importance to the project already identified in this stage must be analysed and weighted against one another. Arising goal conflicts should be discussed and documented carefully.
- As a main focus, an analysis of the building site should be performed. The client or project manager and possible users should be actively involved at this stage.
- The use of innovative technologies should lead to an investigation of relevant norms, standards and guidelines in order to be able to better assess the scope of the project in organizational and technical terms.
- Basic structures, milestones and methods of communication have to be co-ordinated as a basis for efficient co-operation between actors including the review of energy and environmental goals at appropriate times.
- Financial limits or budget reservations should be fixed after careful feasibility studies or (at a minimum) after comparison studies with comparable reference projects (case studies) have been performed.
- Client commitment to supporting measures required for high performance should be translated into measurable benchmarks and confirmed by target values.
- A clear definition of sustainability-related goals should serve as a roadmap and may only be carried out by synthesising project-related aspects (risks and chances). A review of goals and objectives along with the program requirements for the project must be taken over by competent team members and can be assisted by assessment tools to ensure compatibility of design criteria.
- As key player, the client must be involved in the goal-defining process and has to be convinced of the meaning and complexity of this process. Working together, client and architect are responsible for synchronising the goal-defining process between individual actors and the entire design process.
- Appropriate selection of priorities and main focuses makes for an early definition of quality and influences throughout the course of a project.

5.2.2. Pre Design Loop

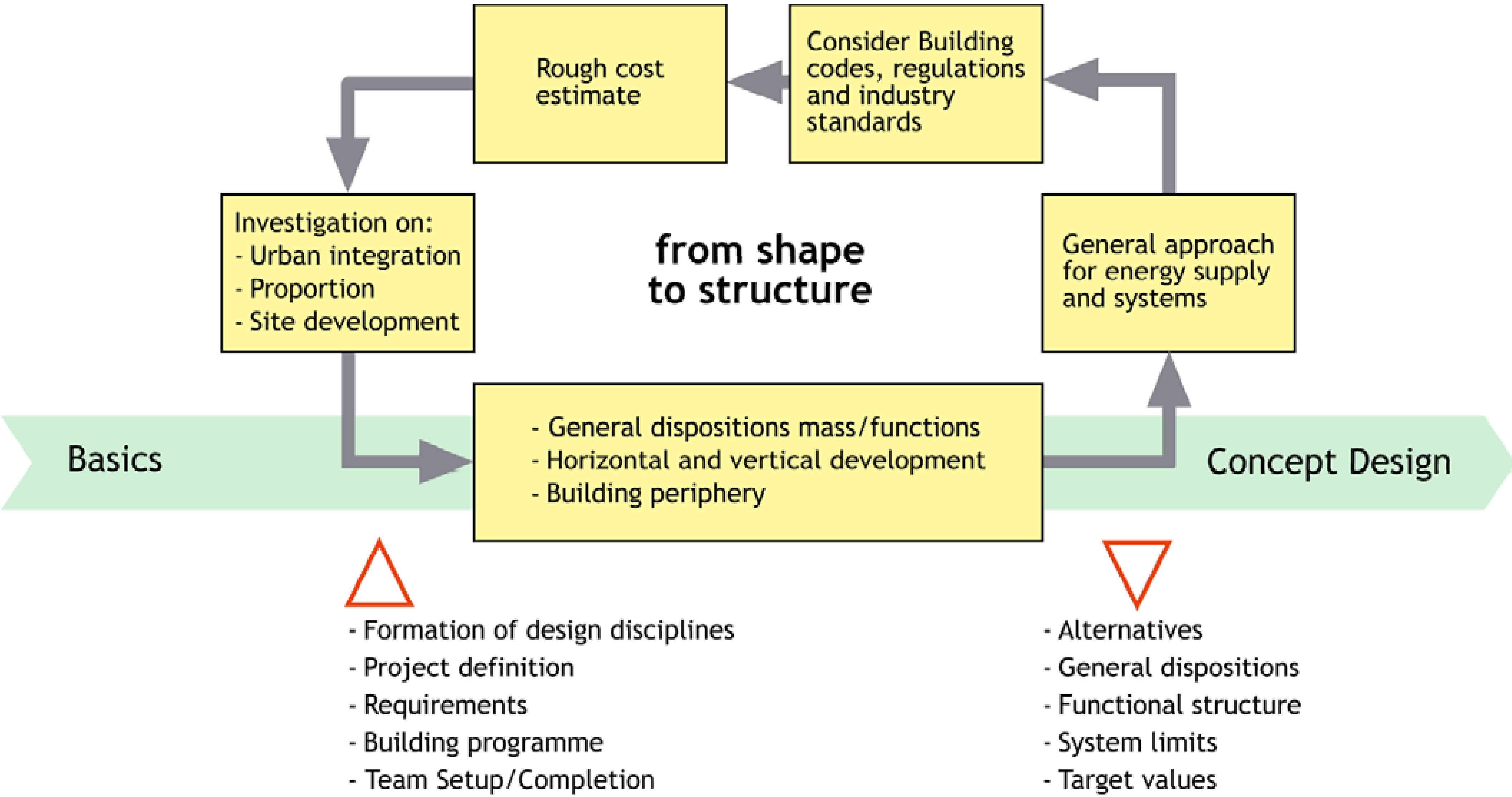
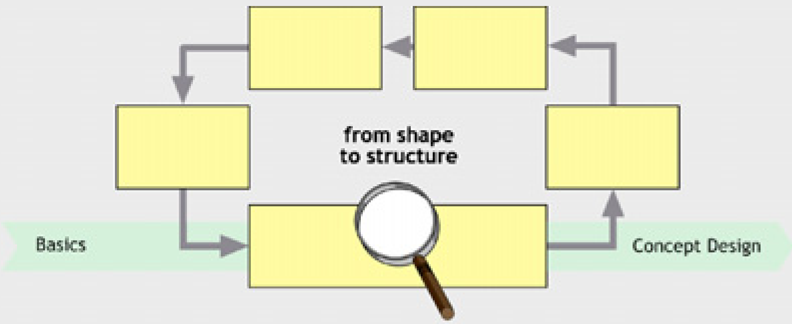


Figure 27: Objectives of PRE-DESIGN: from shape to design structure.



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It is the client who establishes the financial criteria for initial building cost, return on investment, operation and life-cycle cost. But it is the design team who develops and controls the project budget, cost breakdown and cash flow.

KEYWORDS

- Launching the project with a "Kick-off" Workshop
- Consider site potentials and development
- Ensure a joint agreement on basic design strategies
- Create a "roadmap" of design strategies
- Check completeness and competence of design team
- Develop alternative design/construction scenarios
- Establish high performance benchmarks
- Consider cost scenarios for each design variant

RESULTS AND DOCUMENTATION

- General dispositions including alternative design strategies, functional structure and target values.

5.2.2.1. Pre-Design

- A "kick-off" workshop is recommended for the entire project team, including the client, all design disciplines, financial experts and, if possible, occupants or operators to discuss and concretise specific sustainable goals.
- Climate and local site opportunities have to be identified and evaluated in order to exploit site potentials for energy strategies, system selection and control.
- During pre-design, the client and design team need to develop a strategy for sustainable and high-performance building to serve as a "roadmap" for the project and for the subsequent design and construction phases of the process.
- The overall goals and the building programme for the project have carefully be examined for completeness and contradictions. Subsequently, the design team has to transfer clients' needs and demands into programmatic requirements, prescriptive and performance criteria and benchmarks for the design progress.
- All actors should agree on basic objectives and technical strategies regarding sustainable design, construction and operation performances. This presupposes that even different perceptions of the building concept on the parts of the actors are considered seriously and are discussed adequately.
- In addition to technical aspects, initial cost estimates must be included in basic discussions on alternative design concepts and technologies.
- The project budget and costs are set by the client, but it is the design team who has to recommend cost allocations for building and energy systems, equipment and individual construction trades based on qualified estimates and evaluation.
- To make subsequent cost shifting possible, there must be flexible positions within the project budget and a long-term understanding and consideration of costs development.
- Assumptions concerning perspective bidding and tendering procedures are imperative at this early stage for quality assurance aspects of innovative projects.
- In cases of general contracting / construction management or design/build type projects, the client must provide specific energy and environmental goals that are translated into performance benchmarks by the project design team.
- Project schedules must be based on realistic assumptions. Optimised schedules can only be set up following agreement within the design team, in compliance with the procedures and technologies chosen.

5.2.3. Concept Design Loop

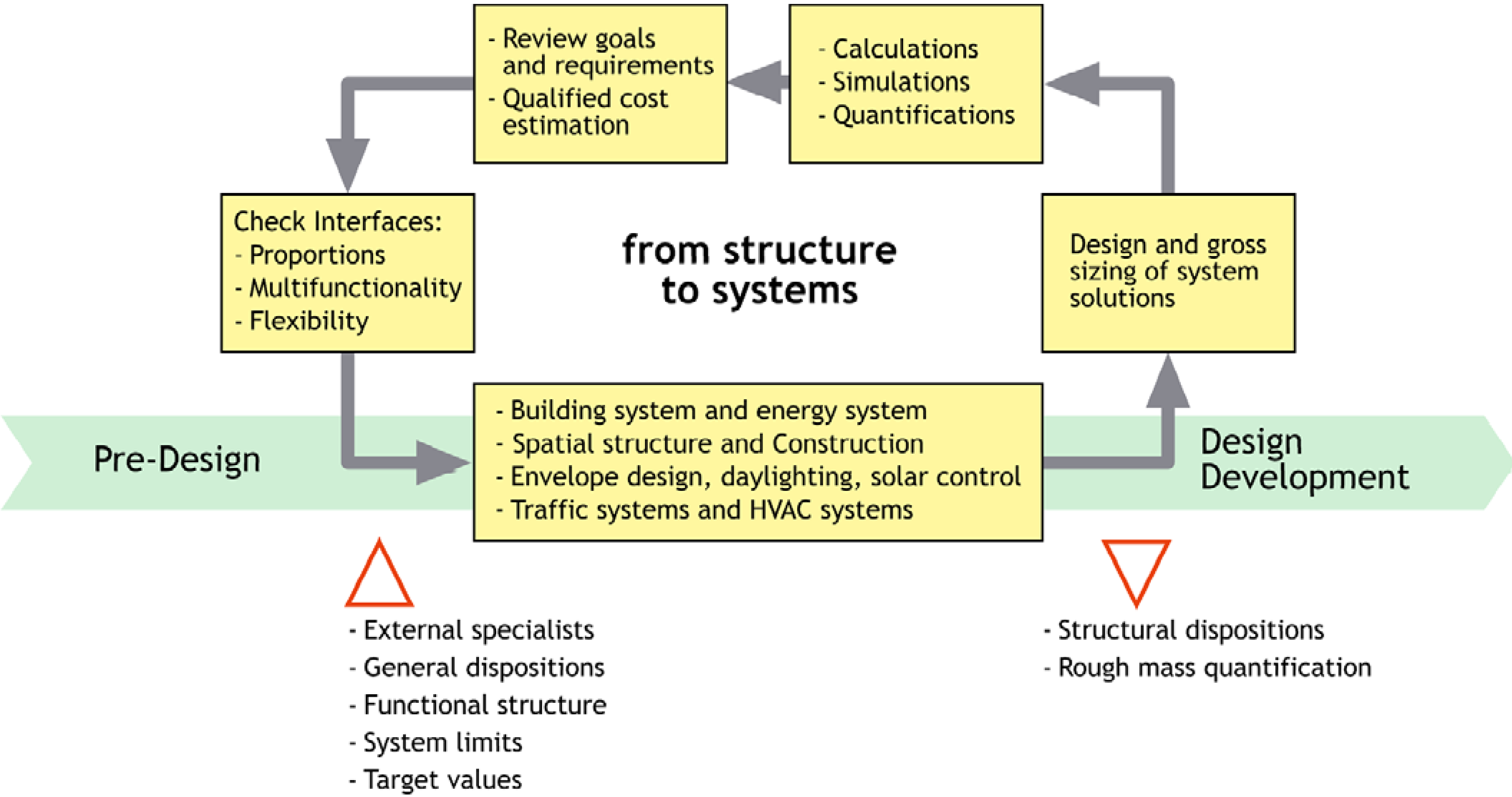
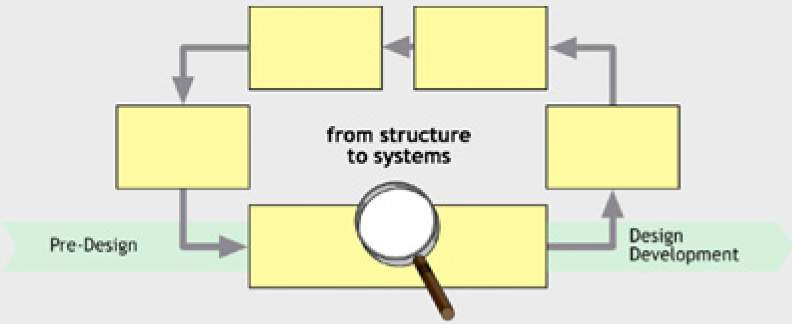


Figure 28: Objectives of CONCEPT DESIGN: from design structure to systems design



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Concept Design has the major potential for achieving an optimised building design by investigating design alternatives and variants and continuously checking and harmonising dynamic requirements against high performance project goals and objectives.

KEYWORDS

- Identify climate and local site potentials in detail
- Develop and evaluate design variants
- Introduce and discuss possible LCA-methods
- Anticipate future changes, reuse and adaptability
- Consider team completion by (external) specialists

RESULTS AND DOCUMENTATION

- Report including structural disposition, rough mass and cost quantifications, reviewed benchmarks and project goals.
- Cost calculation including life-cycle consideration
- Checklist on building materials pre-selected

5.2.3.1. Concept Design

- Climate and local site opportunities have to be identified and evaluated in order to exploit site potentials in terms of energy strategies, system selection and control. The detailed site inspection includes orientation, prevailing winds, shading and sun control, daylighting opportunities, water and energy resources.
- Alternative plant and system design should consider natural space conditioning, renewable energy sources, and alternative means of comfort control strategies.
- An optimised and environmentally-conscious building concept requires the development of design variations and their assessment on different levels. The decision for the concept favoured among the variations examined should be supported by appropriate design assessment and simulation methods and tools.
- The early availability of information and parameters concerning the building operation and utilisation represents a crucial component of design optimisation. The effects of design optimisations must be scrutinised simultaneously in terms of cost development, opportunities for reducing capital costs and saving operating costs, which represent most crucial key issues for design decisions.
- Owner-builder projects and investor projects have such widely-differing general frameworks that design concepts must address themselves explicitly to these in order to achieve optimum building performance.
- Alternative design and system options have to be evaluated in terms of overall energy and environmental implications by identifying opportunities to take advantage of diversity in the initial design and sizing of equipment and controls.
- The development of different scenarios include a reference building, different owner/tenant requirements, already fixed and still “open” building elements. An anticipated future expansion or change should also reflect the possibly contradicting requirements between owner occupied and institutional or public developments versus speculative investor type project with unknown users.
- Environmental and energy goals have to be reviewed at appropriate points during design phase and verified against specific performance benchmarks identified in earlier stages.
- Preliminary assumptions have to be developed for building envelope, natural lighting, water supply and disposal, acceptable building materials, etc. and capacities for mechanical systems (heating/cooling, ventilation and heat recovery) should be approximated with regard to reliability, flexibility, and costs.

5.2.4. Design Development Loop

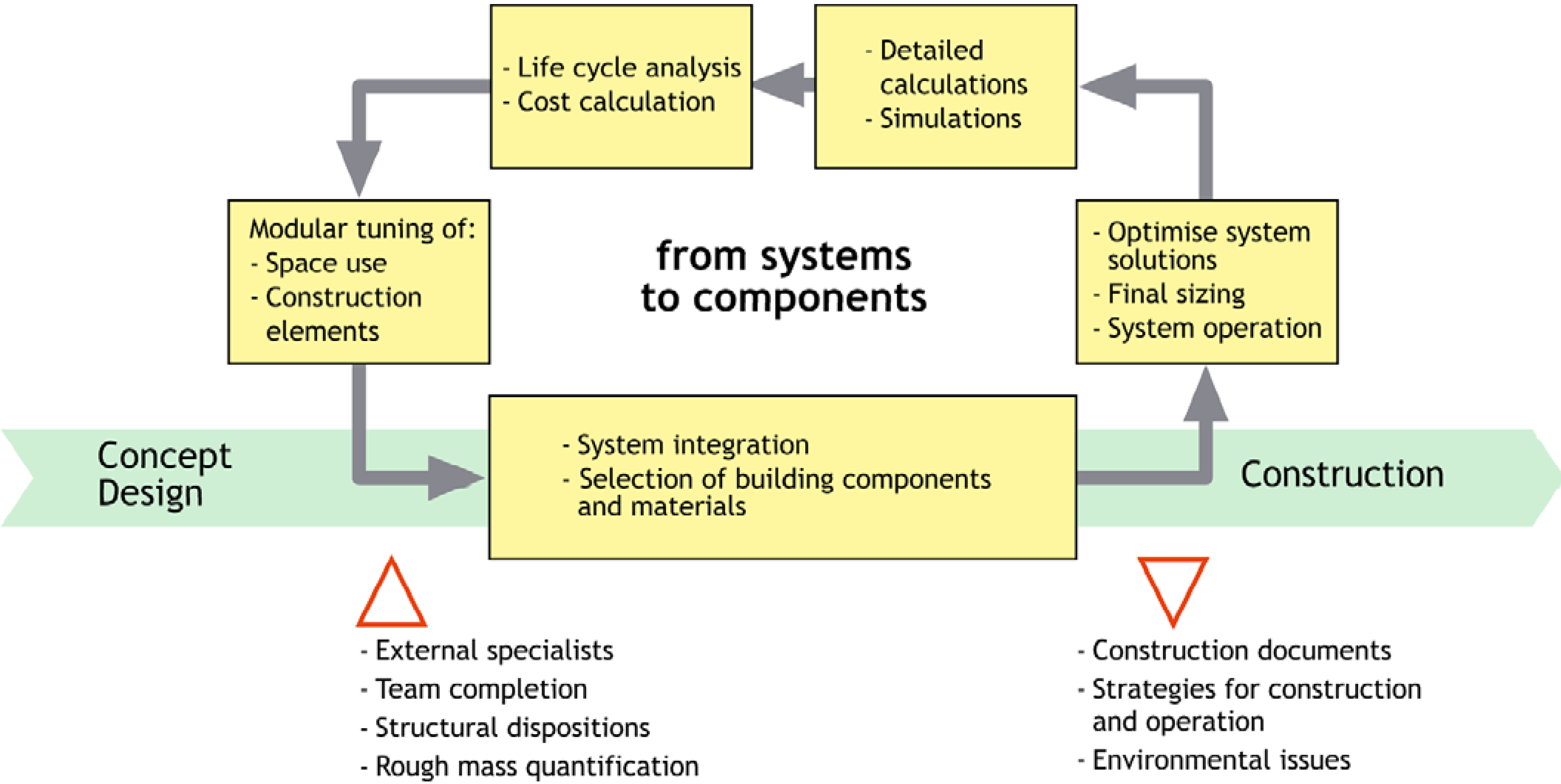
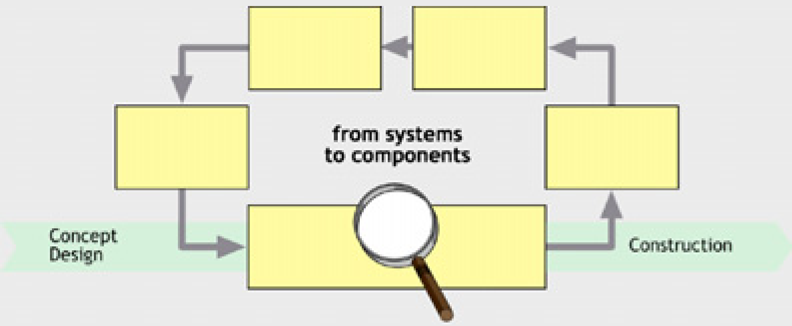


Figure 29: Objectives of DESIGN DEVELOPMENT: from systems design to building components.



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High performance projects require a thorough design of all elements and systems in detail. Unequivocal descriptions and specifications support a smooth operation of subsequent phases, decrease disruptions and extra cost/expenditure during construction.

KEYWORDS

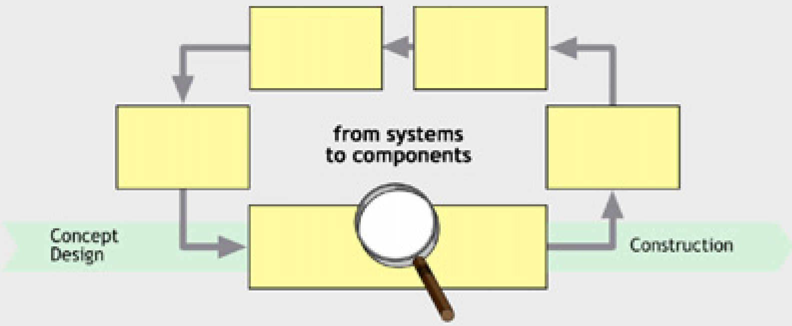
- Define interfaces between individual trades
- Optimise systems by detailed simulations
- Analyse cost/performance of strategies in detail
- Final system sizing and cost calculation
- Modular spatial and physical integration

RESULTS AND DOCUMENTATION

- Final design and performance report
- Catalogue on building materials finally selected
- Revised and final cost calculation
- Commissioning and monitoring base-line concept
- Specs for construction and operation strategies

5.2.4.1. Design Development

- The requests for components and materials pre-selected in previous phases are to be defined in accordance with the agreed-upon building structure and system. The development and use of innovative components should be examined in particular, to include possible simulation and testing.
- Specifications of materials must be checked separately for environmental performance, such of high recycled content, easily recyclable or renewable. Additional information should be requested from producers.
- Building assessment systems can serve as a guideline for optimisation strategies.
- Potentials originating from a simplification of HVAC systems should be examined and identified in terms of their positive effects on building operation, maintenance, and utilisation.
- System optimisation includes fine-tuning of system components and evaluation of energy/cost efficiencies and performance of the entire HVAC equipment.
- Final design and sizing of technical plants and installation systems include efficient technologies that decrease the use of potable water such as rain water supply and grey water systems.
- Detailed drawings, calculations and distribution plans include mechanical, plumbing, electrical systems and define building thermal and electrical loads.
- Alternative designs (tradeoffs) for glazing strategies for solar control, daylighting and visual comfort have to meet energy saving and cost performance demands.
- Materials and details have to be evaluated in terms of energy and environmental implications. This includes detailed construction drawings on thermal performance of individual elements of the wall, roof and glazing, thermal resistance and thermal breaks, tightness of building envelope, vapour barriers and control of condensation, etc.
- Potential damage to surface ecology as well as to subsurface ecology and aquifers of the facility during construction has to be avoided by a qualified concept for subsequent construction supervision and quality management.
- Finally the high performance building strategies have to be analysed with regard to their energy and cost performance in order to review the environmental and energy goals and to check against specific performance benchmarks and target values identified early in the project.



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Establishing the design documents in detailed form is a prerequisite to make understand the objectives of the project. A comprehensive description is to deliver to tenderers for reasonable bids and avoid misinterpretations during the construction phase. construction people and to be transferred

KEYWORDS

- Check requirements for building permits and proofs
- Calculate and adapt fixed periods of time to process
- Describe relevant interfaces of trades very clearly
- Avoid future change orders by thorough descriptions

RESULTS AND DOCUMENTATION

- Comprehensive description of the entire project separated for construction trades and disciplines including clear requirements on construction process and schedule, control and commissioning procedures
- Report on final energy and environmental analyses.

5.2.4.2. Construction Documents

- This phase should be characterised by the establishment of the design documents including drawings and specifications, in detailed form. Open questions and unsolved issues are indicative of deficiencies in earlier project phases. Discussions and exchanges of information with building companies, suppliers, and product manufacturers are of high importance at this stage.
- Additional information about and descriptions of the construction processes will increase the quality of the design documents and prevent the possible misinterpretations, misunderstandings and aggravations which usually lead to cost increases and/or postponements.
- An efficient management of correspondence and building documents accepted and tested by the actors involved is imperative in the context of complex projects and will guarantee that all participants will be kept informed of current status at all times.
- Avoid future addendum claims / Change orders for by additional construction works caused by insufficient detailing of design and performance requirements and/or incomplete construction documents.
- Final construction documents and specifications have to include all criteria, measurement and validation requirements in detail as well as descriptions and explanations necessary for energy and environmental performance. Especially the bid documents have to ensure that high performance goals and execution procedures are translated into clear project requirements.
- Results of energy and environmental analyses should be prepared to affirm design performance, including energy simulations and calculations and cost/benefit investigations.
- A final commissioning plan for owner or contractor must be provided and should include all relevant building construction elements and technical systems.
- Coordination and quality control during construction must be ensured. The design intent, the scope of works and the specific requirements on the contracts with construction companies, suppliers and manufacturers, including contractors and subcontractors have to be examined.
- New developments of building components may require procedures on-site or off-site testing of energy performance and quality e.g. by testing prototypes (mock-ups) of building or construction elements.

5.2.5. Building Construction

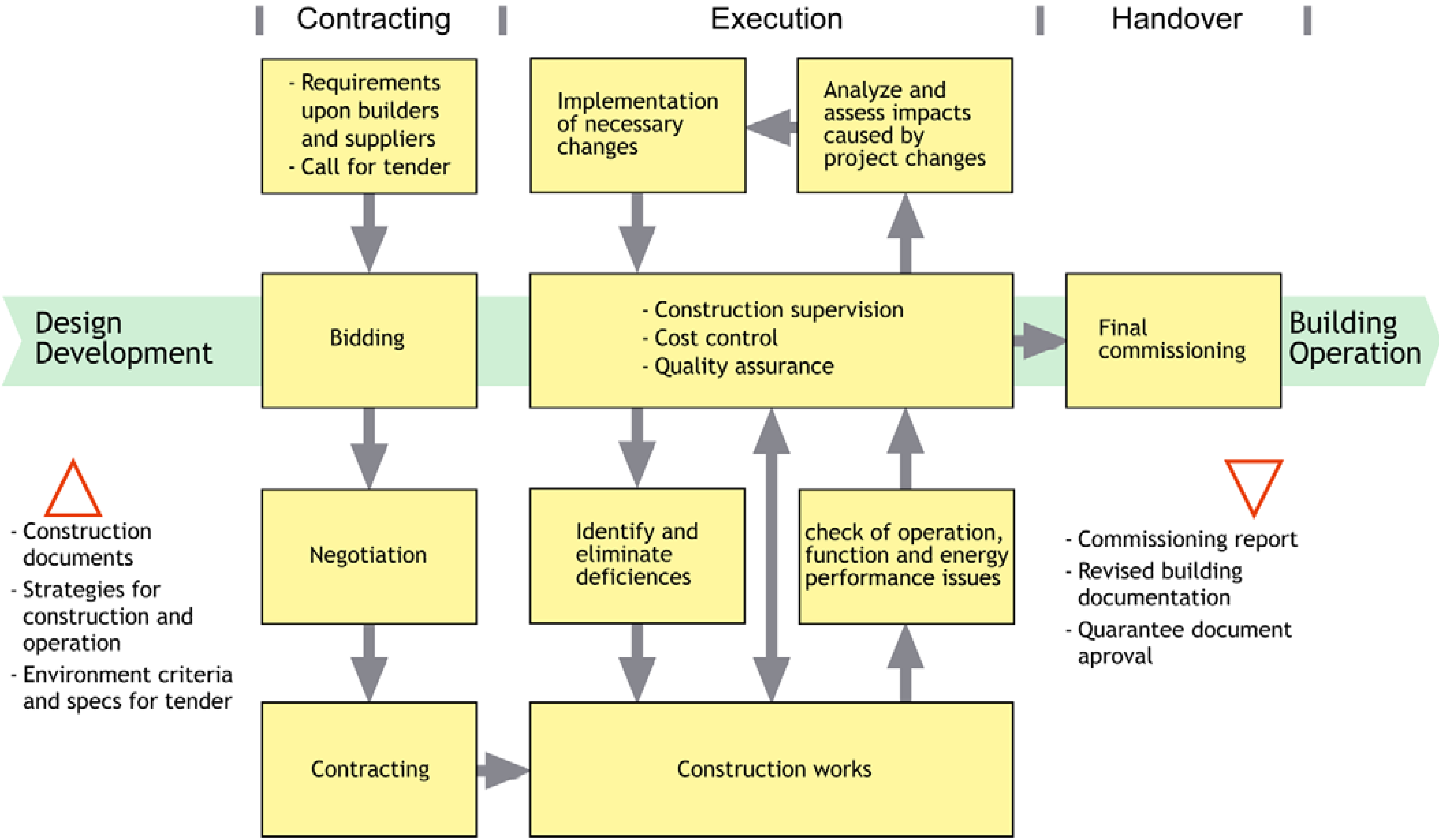
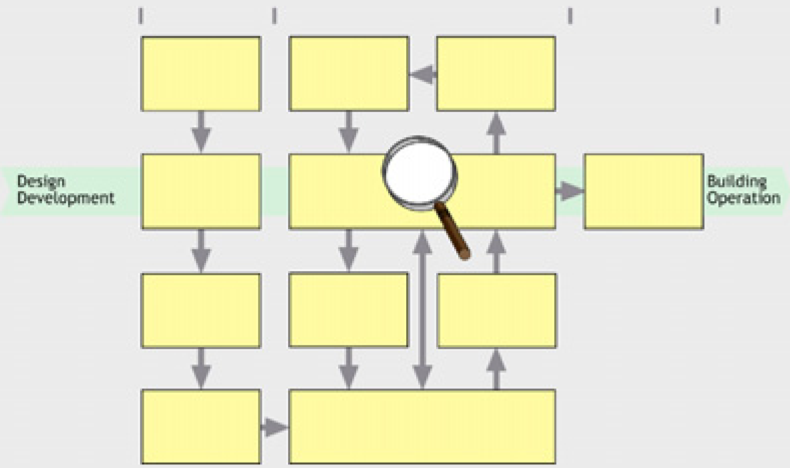


Figure 30: Interrelations of aspects of building construction.



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In any case, though the different building delivery methods may vary from project to project, the evaluation of bids for construction works should assess not only the cheapest but the best option with regard to quality criteria.

KEYWORDS

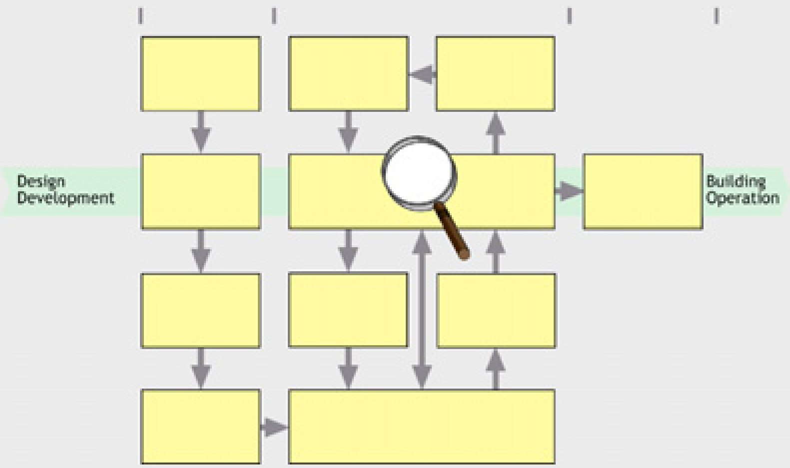
- Appraise and select bids on quality level
- Encourage partnership structures
- Consider flat hierarchies on part of contractors

RESULTS AND DOCUMENTATION

Report on submission procedure and selection and pre-construction report

5.2.5.1. Bidding, Negotiation and Contracting

- The pre-selection of invited bidders should include sustainability-related experience and references that exhibit the contractors capabilities and capacities to ensure an environmentally-oriented construction progress.
- Tender and contract documents should be developed in a procedural and problem-oriented language that requires contractors and subcontractors to verify and document specific high performance goals during construction.
- When contracts are selected and awarded, an appropriate reporting structure among the construction actors should be striven for to guarantee efficient communication and to avoid lacks on transmitting information and prevent chaos.
- Special requests for supervision, control and commissioning procedures, justified on the basis of energy efficient or environmental project goals, must be comprehensively defined as part of the call for tender.
- It is advisable to provide potential key players with information concerning the concept and the objectives of the project which are not necessarily contained in the building documents, in order to enable them to make more qualified bids.
- Alterations of the tender and building documents must be transmitted and incorporated completely into the design (contract) documents. All changes should be checked as carefully as the original design version was.



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Construction accompanying design is a guarantor for poor building performance. However, even a properly designed project cannot dispense with cooperative and carefully executed quality control on construction site.

KEYWORDS

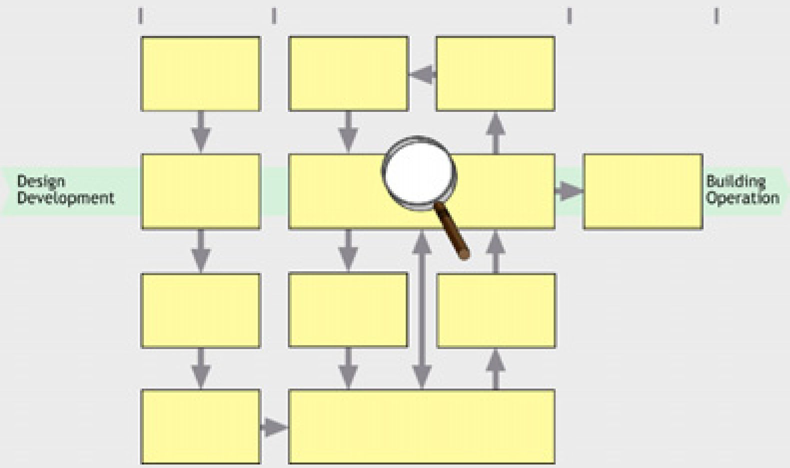
- Keep design architect in close touch with supervising architect/construction supervisor
- Perform quality tests and on time commissioning
- Track elimination of lacks and disruption of progress
- Verify contractors competency locally on demand

RESULTS AND DOCUMENTATION

- Building construction diary
- Reports and protocols of partial commissioning
- Update of drawings and building documents

5.2.5.2. Building Execution and Supervision

- All relevant drawings and building documents have to be provided on the construction site inclusively, continuously updated and available for all persons at any time. This concerns especially energy and environmental information.
- Natural resources of the site (trees, soil formations, ground water, open waters etc.) must be secured by means of suitable protection measures prior to and during the entire construction phase.
- Supervision should be done by persons instructed by the designer of the project to guarantee understanding and importance of energy and environmental issues and interrelations within real physical structures. A short period of information transfer is required to maintain the crucial points of building execution.
- Education of workers at crucial construction operations should also be ensured by a trustful cooperation of supervising people from parts of both project architect and builder.
- Quality assurance and control will be achieved by review of the fabrication and construction of all major building elements to ensure that initial design goals are attained in the range of the predicted and/or expected system performance.
- Spot checks and partial commissioning during construction phase with corresponding quality tests (blower door, thermal photographs) are recommended for the validation of energy or environmental performance at crucial points in the progress and in cases of unexpected incidents. Spot checks represent an effective means of enforcing enhanced energy-related requirements.
- The commissioning of partial systems, components or construction elements must be tailored to the proper point in time during the realisation and construction progress when control, e.g. of thermal quality of building envelope or air tightness, is still possible easily to avoid problems in a later stage.
- Every change and alternative should be checked on a conceptual level; the risk of introducing contradictory details or components should be carefully avoided.
- Construction supervision includes an ongoing control and assistance to contractors observing construction waste management and recycling instructions.
- After completion, an updating of the design data should be routinely performed in order to provide concrete information for future facility management and the optimisation of building operation.



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Building hand-over presupposes correct function of all structural and technical systems. To the client, this is to be guaranteed for a long time through an extensive and thorough technical acceptance and commissioning.

KEYWORDS

Involve commissioning agent if possible
Compare results with design intents and goals
Eliminate faults immediately to insure occupancy
Involve and educate users and operating staff
Encourage monitoring for early operation period

RESULT DOCUMENTATION

Final project documentation
Commissioning Protocols on all building systems
Post-construction Report

5.2.5.3. Commissioning and Building Hand-Over

- If an independent (third-party) Commissioning Agent is put in charge of the commissioning, then hidden deficiencies can under certain circumstances be eliminated at once which would otherwise not become evident until operation has actually begun.
- Guarantees of materials/components must be part of commissioning procedure.
- All tests described (air tightness, etc.) must be completed before the final commissioning starts. All defects must be eliminated.
- The facility manager should take part in the commissioning procedure in order to become familiar with the systems.
- Monitoring programs on experimental parts of the systems should be recommended to the client/owner. The different points necessary for monitoring should be incorporated during execution.
- In addition to a functioning building, the participating designers should submit to the building operator(s) and owner(s) updated project documentation in addition to information concerning their experiences to date with the project.
- Any elimination of faults that may become necessary needs to be co-ordinated in such a way that the start-up of building operations is not hindered.
- Technical performance parameters of core components relevant to energy matters (e.g. efficiency of the heat exchanger) must be documented because of their central influence on energy balance.
- If the operating personnel is included in the commissioning process, then the additional costs of familiarisation and training (which will be required in any case) can be reduced.
- The performance of each building system is to be evaluated according to the design intent, recorded together with the facility management agent / owner´s commissioning agent / building operator.
- Tests and re-adjustments of instrumentation and systems for measurement, validation and monitoring of energy and environmental performance / data are necessary to avoid start-up problems.
- Opportunities for post-construction evaluations on building performance and occupants behaviour should consider both representative occupied and unoccupied periods.

5.2.6. Building Operation

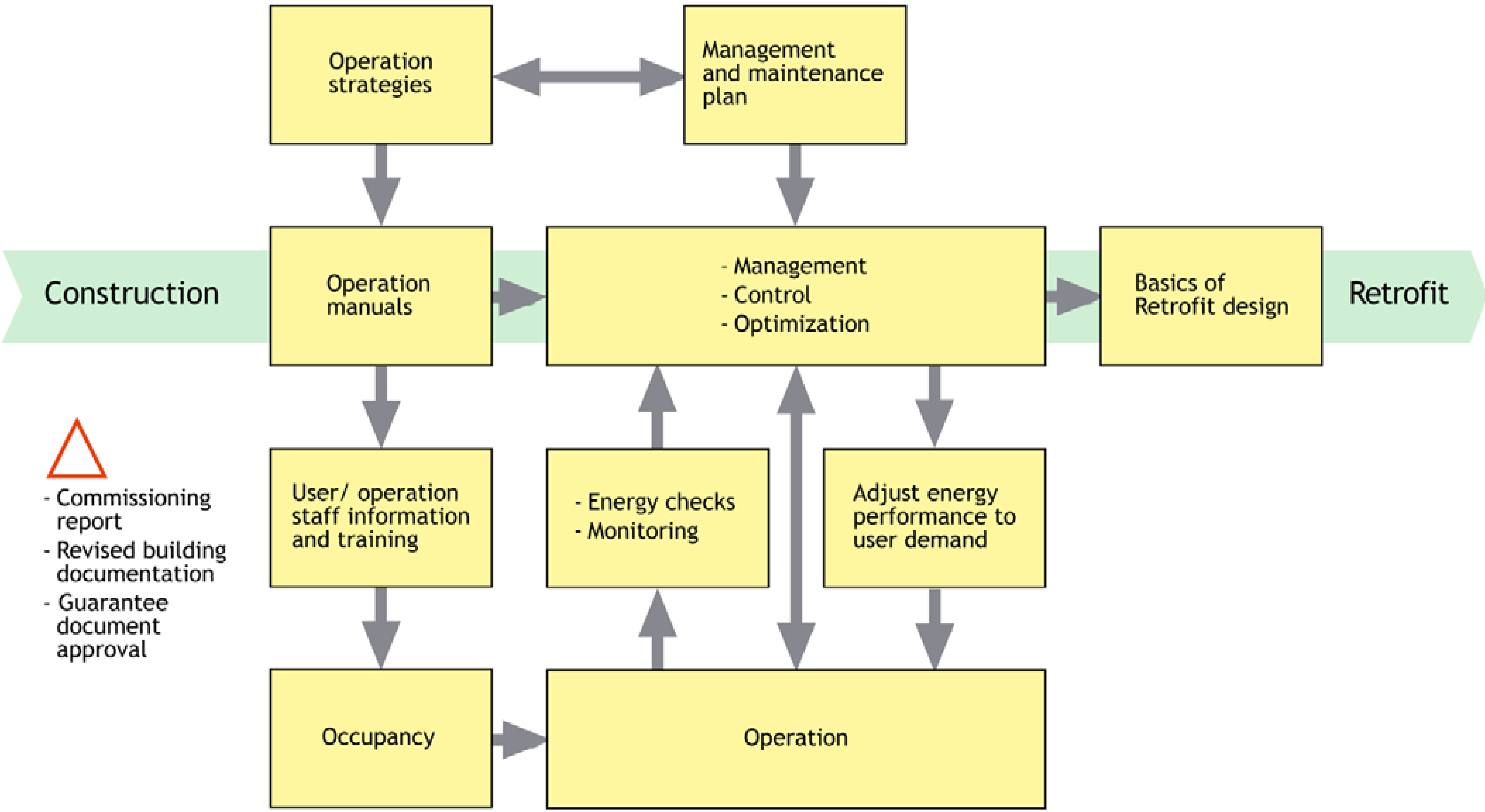
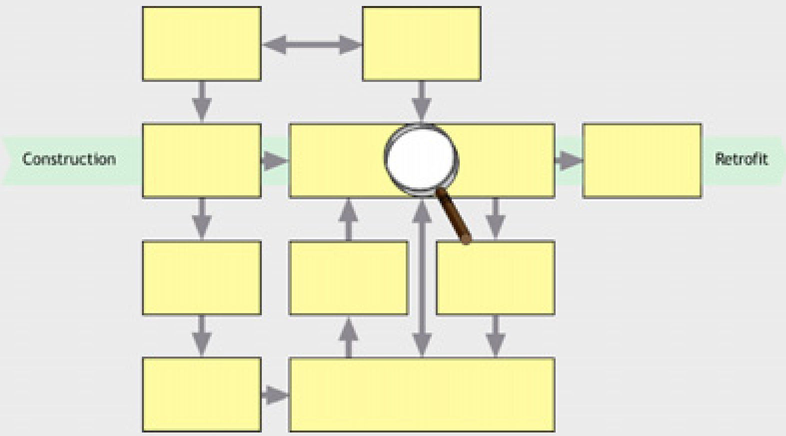


Figure 31: Interrelations during building operation.



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Long-term energy and environmental high performance requires an adequate building management, maintenance and responsibility of occupants and user behaviour.

KEYWORDS

- Develop quality assurance strategies for operation
- Provide operation and maintenance plan
- Treat failures seriously and immediately
- Monitor relevant building and system performance
- Re-commission major systems
- Perform post occupancy evaluation
- Document changes required

RESULTS AND DOCUMENTATION

- Final project documentation

5.2.6.1. Building Operation and Maintenance

- It is desirable that the architect and the energy advisor should be consulted on issues that arise during initial building operations.
- An operational plan should not only ensure a smooth-running building operation, but should also increase the degree of acceptance/understanding of occupants.
- Optimisation strategies can be formulated for ongoing building operations, based on monitoring plans and user interviews. During the warranty period the designers should be provided with full access to operating information.
- Evaluation of building behaviour according to original goals should be done at the end of warranty period. Failures should be analysed seriously and adjusted.
- In case of demand a guide for tenant/occupants should be provided including a set of proposals on adjustments, corrections and renovations permitted without disruption of the primary functions, systems and components.
- Building operation and maintenance methods and daily routines include a continuous review of energy and environmental performance. Energy efficient operations for changing climate and tenant demands must be refined.
- Documentation of construction alterations and changes (updating of building documents and drawings) create the basis for later renovation concepts.
- Preparation of environmentally responsible maintenance programmes, waste management and use of protective cleaning materials and surfaces treatment should be provided for operating staff.
- On a periodic basis the re-commission of major systems is to be scheduled in a post-evaluation plan. In accordance to building operations conditions investigations e.g. on temperature conditions, and air quality and lighting control in crucial areas and use of potable water should be implemented and reported.
- Execution of user surveys at reasonable intervals should be intended. This includes the documentation and regular evaluation of usage values by specialists and the discussion of excess consumption/irregularities with building owner, operator and users (possible topics: indoor climate, satisfaction).
- The development of strategies for optimisation of operating procedures (control/regulation), of upkeep (cleaning, repair, replacement) and the adjustment of maintenance and repair cycles should be coordinated to meet specific demands on the parts of the users or unusual construction features.

SUMMARY BENEFITS PROVIDED BY IDP

The implementation of the IDP provides a number of benefits which need to be examined during process:

ADAPTABLE BUILDING DESIGN

Improved adaptability to future changes of use
Lower cost of changes and/or additions
Reduced risk of future demolition
Enhanced control of energy loads

ENERGY AND COST EFFICIENCY

Appropriate sizing of plants and system capacity
Reduced capital and operating costs of systems
Better system design, performance and control
Rational energy use and operations
Reduced expense of waste removal and reprocessing

ENVIRONMENTAL PREVENTION / CONSERVATION

Less use of building materials and use of landfill
Reduced impact on natural habitats of flora/fauna
Reduced GHG emissions and air pollution

INDOOR ENVIRONMENTAL QUALITY

Improved IAQ
Improved qualities of thermal and visual comfort
Increased daylighting and efficient lighting design
More healthy and pleasant indoor environment
Higher productivity and reduced absenteeism

6. Implementation of Integrated Design Process

The Integrated Design process has been shown in many case studies to result in high levels of performance, a superior indoor environment and greatly reduced operating costs, at little extra capital cost.

Although there will always be individual designers who may design brilliant buildings in an individualistic way, the IDP approach will be of significant benefit to most designers and clients who are attempting to achieve excellence in building design and energy/environmental performance.

6.1. Methods and Tools to support IDP

Task 23 has produced methods, tools and other supporting products to help designers to implement the IDP process, including the following:

- The Introductory Booklet serves as an appetizer and highlights and summarizes the most important issues on the Integrated Design Process.
- The **IDP Guideline**, is a comprehensive description of the philosophy, rationale and features of the IDP process, and of the companion *IDP Navigator*. The Guide-line provides interactive access to background information, including key issues and recommendations in a check-list format.
- The IDP Navigator provides detailed support to users in identifying the elements and interrelations between steps in the Integrated Design Process, and to adapt the process to specific projects. The structure and contents of the Navigator is consistent with the Guideline.
- A Compendium of Case Stories characterizes the design process used in a number of high-performance projects. These projects formed part of the background information used by Task 23 members to develop IDP methods and tools.
- A collection of Demonstration Projects provide examples of design processes where some or all of the Task 23 methods and tools have been used to support the design process.
- A Blueprint for a Kick-off Workshop as a basis for the organisation of a design team workshop right at the beginning of the IDP. The main objective of the workshop is to create common understanding at the beginning of the design process with regard to three important notions:

1) knowledge about the integrated design process; 2) a clear perception of the design task; 3) a cooperative and open attitude towards the other members in the design team.

- The MCDM-23 method and tool is intended for use in normal design processes or competitions. The name reflects the fact that the evaluation of several design alternatives is a multi-criteria decision making process. The method supports the team to select and to prioritise amongst design criteria and to evaluate alterna-tive design solutions. In design competitions, the method can assist in developing the program and to select the best design amongst several alternatives. The MCDM-23 software tool automates many of the tasks involved in using the method, and also produces worksheets, bar charts and star diagrams.
- **Energy 10** is a user-friendly energy simulation system that provides predictions of operating energy performance and identifies the most effective design strategies in reaching this performance level. Energy 10 is being continuously improved and now offers users an economical and highly effective simulation process for early design support for the design of small buildings (< 1,000 m²).

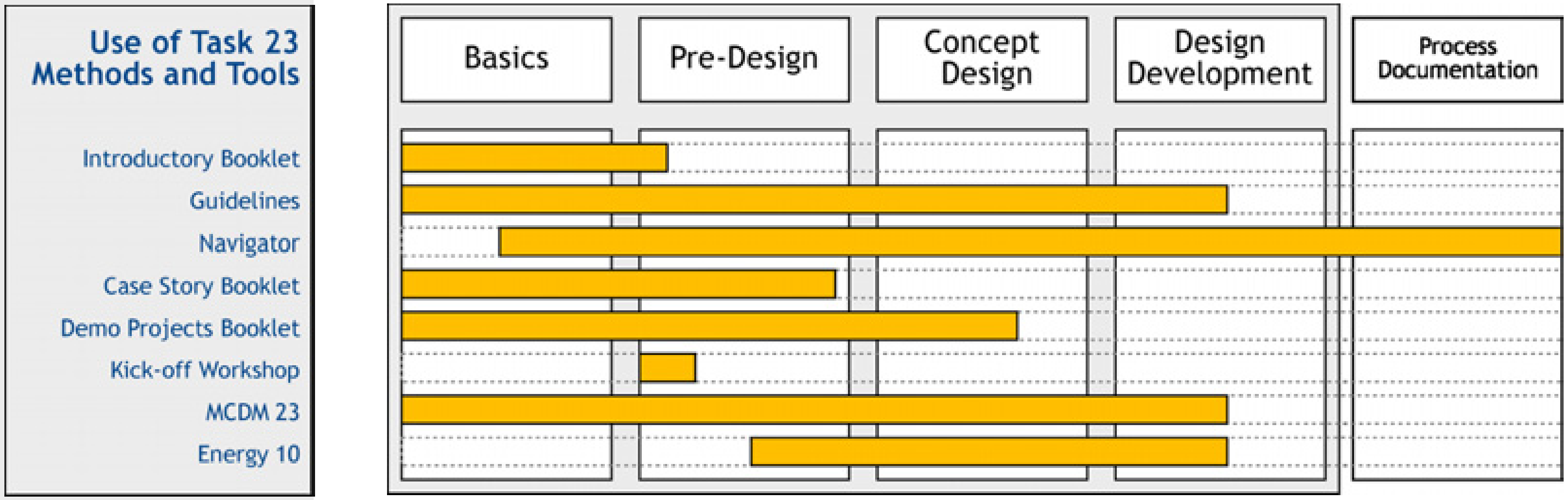


Figure 32: Use of Task 23 methods and tools related to the design process: The diagram provides suggestions for the most proper usage.

The exemplary process chart on the next page shows only some of the major decisions, building effects and external impacts.

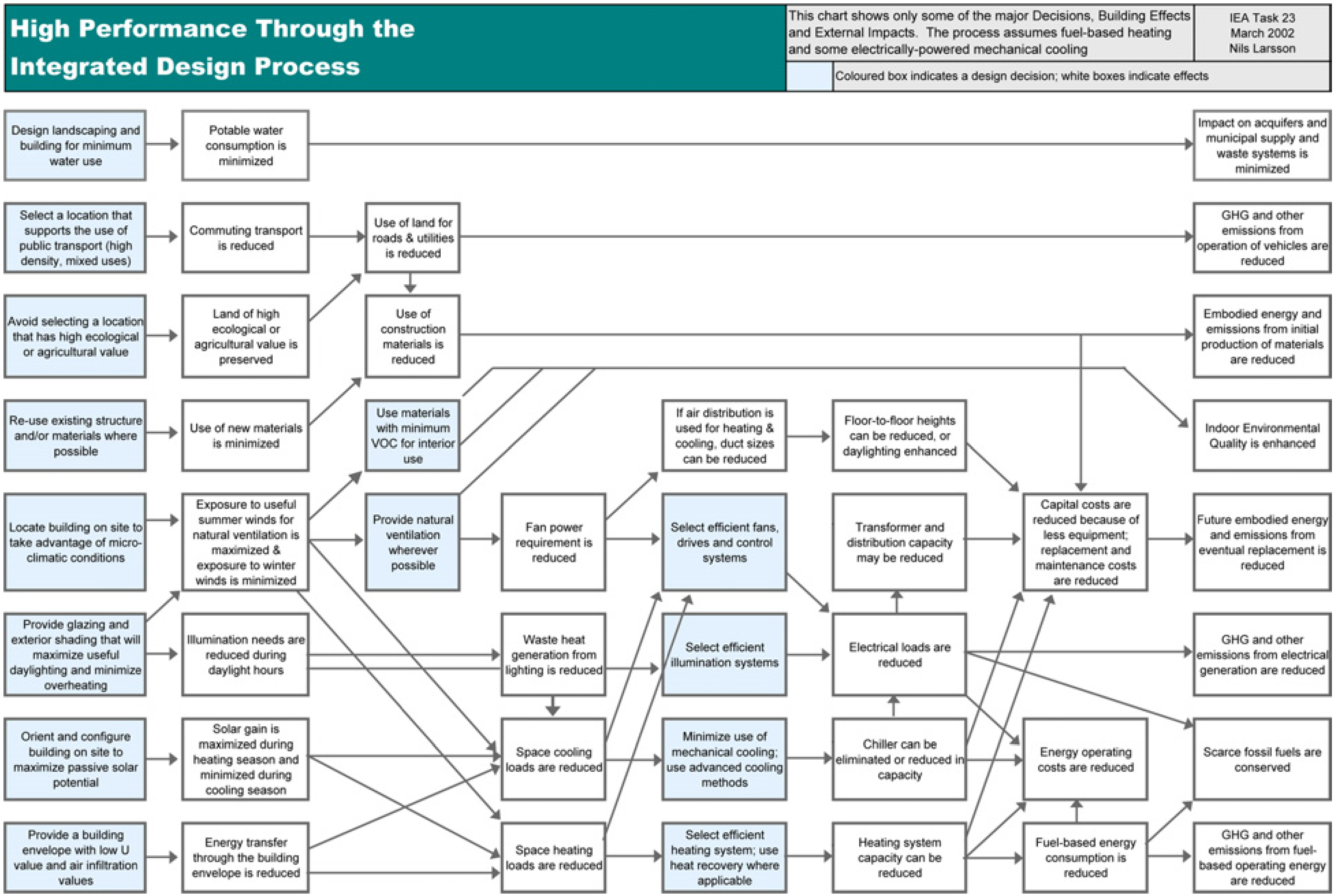


Figure 33: High Performance “road map” of major decisions, building effects and external impacts of Integrated Design Process implementation.

FEATURES OF NAVIGATOR

The final NAVIGATOR tool provides interactively

- guidance for actors with measures and issue-related recommendation catalogue on process
- flexible visualisation and structuring model (kit system) of design interrelation and dependencies
- open data base serving as "early warning system"
- support on optimisation and documentation

The NAVIGATOR does NOT serve as

- a universal collection of recipes
- an automated "design process simulator"
- a container for universal definitions or parameters

NAVIGATOR MANUAL

The description of the functions and features of the NAVIGATOR will be provided in a separate manual.

CURRENT STATUS OF NAVIGATOR TOOL

Complex information concerning an integrated design process can only be provided by the utilisation of a corresponding database. In its present stage, the NAVIGATOR tool should be regarded as a basic navigation structure on its way to becoming a practice-oriented professional tool requiring additional development in subsequent projects, both at the international level and on national or company levels, respectively.

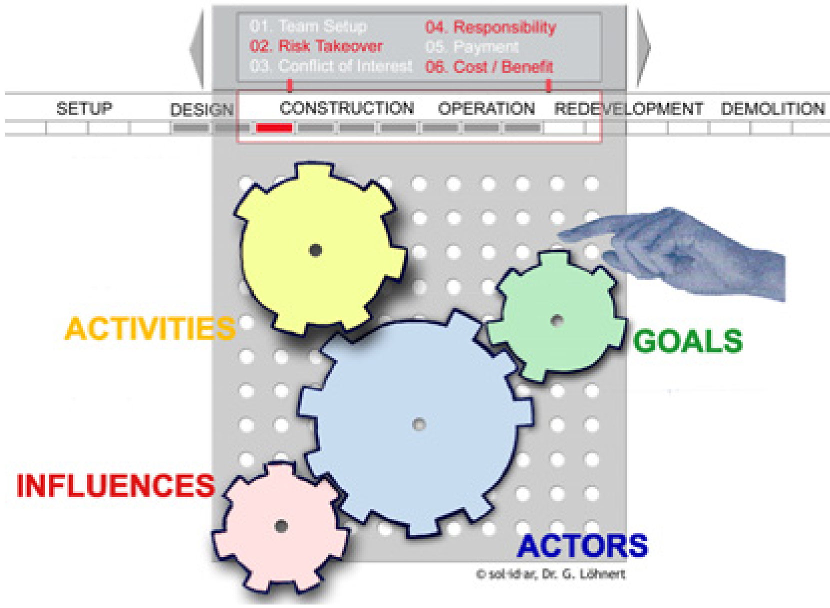
Figure 34: Illustration of the NAVIGATOR.

6.2. Process Support – The NAVIGATOR

To show the potential of the developed guidelines, they have been transferred into a database structure to facilitate their understanding and use. In order to adapt this structure for individual building projects this basic structure of a computer-supported NAVIGATOR has been finished.

By adapting the NAVIGATOR each country can now develop its own national level process support tool, based on individual local conditions. Professional clients and companies can adapt the prime structure according to their specific traditions and requirements, and the team leaders of individual projects can use the structure for the development of their design process and its documentation.

The NAVIGATOR serves as an information/management system providing recommendations for the design team. It is an early warning system, but also a control instrument and documentation tool. The NAVIGATOR strengthens insights into the necessity of an integrated design process and is intended to educate the user in the opportunities embodied in sustainable building design principles. The intent is not to provide recipes of standard solutions, but to provide an interactive support that promotes creativity and above all helps the engaged designer to open up new potentialities and market positions.



7. # Glossary

Activities — Design Activities cover "how" actors carry out projects. This includes the examination of relevant Tasks as well as the applied methods and Tools. Achievable results depend on proper decisions made just-in-time, coupled with appropriate control during the entire design and construction process.

Actors — "Actors" refers to all project participants who have a relevant influence on the content and course of project design and realisation. In addition to the client and all the designers, the users, operators, executing key players as well as external participants such as authorities and offices are included.

Architectural Quality — Architectural quality is the translation of the project goals into one culturally, technically and economically appropriate spatial structure and overall coordination of all spatial and physical systems. It represents the fusion of all elements into one entirety with a project-specific architectural power.

Design Process Development Model — A simplified description or presentation of the design process. For this, two elementary dimensions –the Interrelated Structure and the Generic Process - are combined to generate a systematic approach.

Context Analysis — A method of problem analysis including related background and corresponding impacts on design process in order to provide Recommendations and solutions.

Design Phase — Structures the whole process into clearly defined sequences. Rough phases represent divisions at the international level, while detailed phases are more precisely related to national adaptations.

Features — These represent the substructure, the "magic triangle", of structural elements.

Generic Process — This is a simplified illustration of the design process of a virtual and idealised building project. The process diagram contains the representative issues as well as the structural elements of this generalised design approach. It can be understood as an exemplary pattern for national or project-specific adaptations.

Goals — As a priori values or aspiration levels, design goals define some desirable level of achievement with respect to objectives which indicate preferred directions.

High-Performance Sustainable Buildings — High-Performance Sustainable Buildings are buildings which are optimised in multiple ways. They unite a high level of environmental performance, high comfort and quality in utilisation and operation in concert with architecturally appealing design.

Influences

Characterise possible impacts that affect projects from the "outside" in both positive and negative ways. Most of these impacts are beyond the control of the design team itself, which is why Influences can be very dangerous to project development.

Interrelation Structure

The Interrelation Structure clarifies the interplay of design process elements and the assignment of key issues in a graphic manner.

Integrated Design Process

IDP is the entire, multi-disciplinary processing of a design task for which a competent design team continuously pursues durability-oriented targets from the beginning and optimises them in terms of ensuring quality through the application of modern methods and tools throughout each individual phase.

Issue

An issue describes the context of a known problem in building design including its background through impacts on design process to possible solutions.

Iteration Loop

Indicates the most important things to do within a single design phase. It is a kind of special checklist for the designer and designer.

IDP NAVIGATOR

A computer-based tool representing a Generic Process structure to support the development, application , management and documentation of an integrated design process at the national and project adaptation level.

Key Issue

A Key Issue indicates major points within an Integrated Design Process. For this guideline the Key Issues identified result from the context analysis of a large number of different individual issues.

Kick-off Workshop

This is a workshop with the entire project team at the very beginning of a project to create common understanding on integrated design approach, a clear perception of tasks related to high performance goals and objectives and to promote a cooperative and open attitude towards all members of the team.

Milestones

They represent an important orienting function within the design phases and are characterised by one or more of the features as follows: They offer an orientation within the course of design and building and correspond to or even represent an important event. Each is unique and non-recurring during the process. They often involve most if not all of the project participants.

Examples of important design process milestones are: the decision on building site, the result of an architectural competition or the final building documents.

Structural Elements

ELEMENTS represent the main structural components of both the interrelation model and the generic process. Elements include ACTORS, GOALS, ACTIVITIES, and INFLUENCES. Each Element is characterised by an individual substructure.

Tools

A term for all strategies, methods, and tools that support the integrated design process. This not only includes activities such as context analysis, site inventories, conflict analysis, calculations and dynamic building and system simulations, but also the execution of workshops, goal setting, decision making and assessment procedures.

Transition

Transitions in the design process characterise the interfaces between design phases when a crucial "point of no return" is reached. Decisions in architectural competitions determining the design concept of a project or the transfer of the building documents into the hands of executing construction companies are some examples among many.

PROOF OF FIGURES

All figures provided by sol∘id∘ar architects + engineers Berlin, Germany, with exception of

[Figure 3] modified illustration originated by H.-J. Leibundgut, Amstein & Walthert, Zürich

[Figure 4] Direktion für Entwicklung und Zusammenarbeit (Hrsg.), Externe Evaluation – Arbeitshilfen zu Planung, Evaluation, Monitoring und Umsetzung, Bern 1999

[Figure 9] Cross/Roozenburg, Modelling the Design Process in Engineering and Architecture, 1992

[Figure 19] based on Damen Consultants, The Netherlands

[Figure 32] based on Damen Consultants, The Netherlands

[Figure 33] chart by Nils Larsson

8. Sources

8.1. Literature

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