Managing Building Adaptation

A Sustainable Approach

Contents

TU Delft

Sustainability Challenges

Adapting existing buildings can assist in contributing to a more sustainable built environment. Hereinafter, various environmental, economic and social sustainability challenges that building adaptation could help deal with are explored.

Environmental challenges

Cities and buildings worldwide face enormous sustainability challenges. The built environment for instance contributes to 45% of greenhouse gas emissions. Also, there are impacts from water and resource consumption within buildings. With just 1-2% new buildings added to the total (real estate) stock annually, much of the built environment that will exist in 2050 already has been built. So, human kind needs to adapt its existing buildings, and quickly, to meet climate agreements. Existing buildings therefore intrinsically can have a profound positive and negative impact on dealing with climate change.

There are some positive signs though. For instance, in most developed countries, more is now spent on building adaptation (including maintenance, repair, retrofit and reuse) than new construction. This represents a gradual but consistent change from decades of investment dominance in new-build projects. Adapting the existing building stock can potentially cope with several built environment related sustainability challenges, and is considered the most critical aspect of improving sustainability of the built environment. Sustainability in this case constitutes of the three main pillars: environmental, economic and social sustainability. Hereinafter, for each of these three pillars an explanation is given about the contribution building adaptation can make to deal with sustainability challenges.

The negative aspects of the buildings on the natural environment are degradation of habitats, altered ecosystems, reductions in biodiversity due to land use, reductions of air and water quality and so on. The most significant environmental impact of buildings is the greenhouse gas emissions associated with its energy use. In general, the contention is that building adaptation is inherently environmentally sustainable as it involves:

- Less material use (e.g. resource consumption);
- Less transport energy (e.g. during construction);
- Less energy consumption (e.g. during building operation);
- Less pollution (e.g. during construction).

Economic challenges

In addition, there are strong economic arguments for building adaptation. Adaptation should be economically viable to be successful, although economic costs can be traded off against social and environmental gains. A compelling economic argument is that it is often cheaper to adapt a building rather than demolish or build new. However, where new build is straightforward, construction costs are

often lower than adaptation. Another argument is that construction periods are reduced because less or no demolition is undertaken, thereby reducing the financing costs. In addition, there is evidence that adaptation increases property value, which is a strong driver for adaptation.

However, not all projects are economically positive and adaptation costs can surpass a comparable new build, especially in the case of original listed buildings and buildings with poor build quality. Nevertheless, costs remain a powerful driver for adaptation. A 2005 study of 2250 UK projects showed that adaptation cost was around 66% of new build. Another UK study showed that post-adaptation buildings had lower operating costs than prior to the adaptation. Overall, building adaptation is inherently economically sustainable as it involves:

- Less investment capital (e.g. finance);
- Less material and labor cost (e.g. during construction);
- Contributing to achieving a circular economy (e.g. re-cycle, re-use of building materials, parts and systems).

Social challenges

Finally, building adaption can contribute to achieve social sustainability in our built environment. A key argument is that building adaptation allows society to retain the social and cultural capital embodied in buildings. For instance, historic listed buildings are a means to protecting architecturally or socially significant buildings for the wider benefit of society, which is a component of social sustainability. More broadly, adaptation can be part of urban regeneration with aspirations that future generations gain from the protection of buildings. It can deliver social goals such as social and affordable housing or employment opportunities, which serve local communities.

On a building level adaptation can increase the user satisfaction. Because accommodation needs of users change all the time, it remains necessary to intervene how the functional life of existing buildings can be extended. For instance, to allow office workers to interact which each other adaptation could contribute to the phenomenon of flexible working. Also, adaptation in buildings, for instance the replacement of installations (better air circulation) and a new façade (better insulation) could dramatically improve the inner building climate of and improve the well-building and health of its users. In essence, building adaptation is inherently socially sustainable as it contributes to:

- Sense of place and belonging (e.g. recognition of history);
- User interaction and satisfaction (e.g. improving working/living conditions);
- Well-being and health (e.g. improving climate conditions).

Managerial challenges

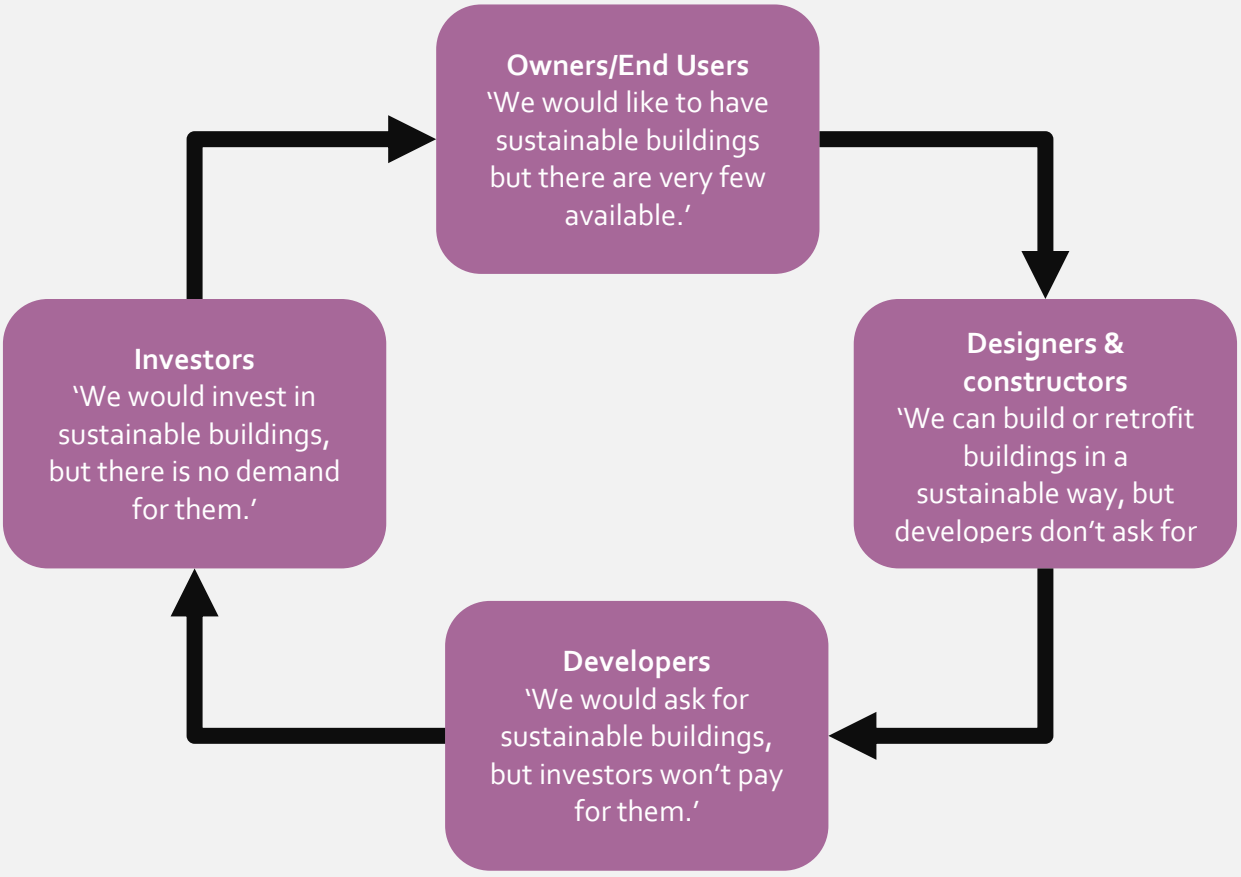
Even though there are strong sustainability arguments for building adaptation it is not easy to realize. The greatest challenge is the

development of effective strategies for adapting existing buildings. In other words, effective decision-making and management of building adaptation is critical. Therefore, this section explores the main organizational, legal and financial managerial challenges building adaptation faces.

Organizational challenges

Building adaptation decision-making is complex, because there is a variety of stakeholders involved, each representing different and often conflicting interests, goals, values and perspectives. Typical decision-makers are owners, occupants/users, investors, producers, developers, regulators and policymakers. An additional complexity is that these actors make decisions at different stages in the process of building adaptation and each has different degrees of influence.

Moreover, to cooperate or collaborate which each other stakeholders often face a vicious circle of blame. In that case, owners/users, designers and constructors, developers, and investors look at others to blame for the fact that sustainable buildings do not commence (fast enough). Without collaborating in an open dialogue, looking for win-win solutions, adapted sustainable buildings will not be delivered easily. This requires inter-organizational decision-making next to decision-making at a company level.



In summary, organizational managerial challenges faced in building adaptation involve:

- Wide variety of actors (e.g. decision-making complexity);
- Conflicting interests, goals, values (e.g. win-win difficult);
- Vicious circle of blame (e.g. ineffective collaboration).

Legal challenges

There are various legal and regulatory challenges to cope with when adapting buildings. Buildings have legal issues attached to ownership and transfer of ownership and regarding leasing. Adaptation is affected by tenure and whether the person undertaking the adaptation is the owner of a lessee. Property owners can be either institutional or private, who seek to maximize the return on investment. They might have different degrees of involvement and engagement with a property, which potentially limits their ability to decide about building adaptation. Also, the way buildings are occupied, either with single or multiple tenants, plays a role in terms of building adaptation opportunity. The more tenants or users the more difficult it often is to agree on building adaptation measures.

Furthermore, regulatory aspects related to land use or zoning plans constituted in planning law have a severe effect on building adaptation. The existing land use (plan) affects the potential for a new or changed land use to some degree, for example, an office to a residential change of use. This might mean that owners willing to adapt their buildings need to collaborate with local planning authorities to allow for a change in land use. In addition, building, fire, access and safety codes applicable to a building might limit opportunities to adapt buildings. Meeting the rules attached to these codes normally forms the basis for securing or refusing construction permits for the adaptation.

In summary, legal managerial challenges faced in building adaptation involve:

- Property ownership situation (e.g. rights and fragmentation);
- Tenant situation (e.g. single or multiple tenants);
- Land use / zoning plans (e.g. allowance of change of use);
- Securing construction permits (e.g. building codes).

Financial challenges

Finally, there are many financial challenges to be overcome when managing building adaptation. Finance must be secured before commencing with any building adaptation. Often money comes from owners or investors who commission it. Investors will only invest in a building adaptation once it generates a return on investment in the long run. Developers also need to make a decent profit with the adaptation, and are always searching for minimizing risks like unforeseen costs such as contamination. Therefore, they will only purchase a building once the financial risks involved are manageable. For instance, poor build quality of existing building can drive up adaptation costs to the point that new build

becomes more viable and interesting for owners, investors and developers. Therefore, sometimes government grants or tax breaks can assist in making building adaptation possible. Such public financial and fiscal measures, to be granted under certain conditions, decrease the costs and risks associated with building adaptation for the private sector.

The fact that a sustainable building adaptation is not always financially preferable has to do with split incentives. This phenomenon can be best illustrated by an example. Split incentives for instance occur when those responsible for paying energy bills, often the tenants, are not the same entities as those making investment decisions, often the building owners. Therefore, owners often lack the incentive to invest in an energy-efficient building.

In summary, financial managerial challenges faced in building adaptation involve:

- Upfront finance (e.g. securing capital);
- Grants and tax breaks (e.g. securing public funds);
- Profit-making (e.g. minimizing costs, risks)
- Return on investment (e.g. maximizing long term income);
- Split incentives (e.g. benefits not necessarily for investors).

This section has given an impression about the many challenges involved in building adaptation. The following section deals with the reasons for building adaptation to be considered.

Building obsolescence

Building adaptation involves any work to a building over and above maintenance to change its capacity, function or performance. In other words, any intervention to: adjust, reuse, or upgrade a building to suit new conditions and requirements. But when is it necessary to adapt buildings?

As a rule, the usefulness of building for its original function diminishes overtime. This process is known as building obsolescence, or lack of utility. Building obsolescence can take on several forms, such as:

- Physical (structural): buildings or their component parts wear out, resulting from deterioration;
- Functional: the original function of the building becomes redundant, resulting from changing ways of working;
- Economic: the economic rationale/reason for a building is removed, resulting from a mismatch between costs and benefits;
- Locational: location of the building is no longer suitable, resulting from functional obsolescence and image issues of the location.

Other forms of building obsolescence often mentioned in literature are:

- Aesthetic (visual): resulting from outdated appearance;
- Legal: resulting from new legal standards or regulatory rules;

- Social: resulting from image issues or increasing demands from occupiers and users;
- Tenure: resulting from dis-agreements between landlord and occupier;
- Environmental: resulting from environmental changes;
- Site: resulting from a misbalance between site value and building value.

Obsolescence can affect any building at any time during its life cycle and can trigger an opportunity for building adaptation. This primarily depends on the building's lifespan situation.

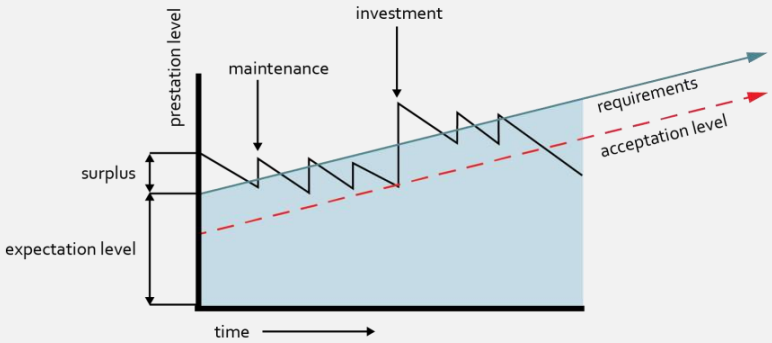
Building lifespan

The building's lifespan is closely connected to the state of obsolescence of the building. The three types of building lifespans are explained hereinafter.

Technical lifespan

The technical lifespan is the length of time during which a building can meet the necessary technical and physical demands that are needed to be able to use the building and protect the safety and health of the users. The technical performance of buildings can diminish because of the following influences:

- Influences from outside or climate (sun, wind, rain);
- Intrinsic aging of materials (chemical processes within);
- Usage (wear-out and loss of quality);
- Legislation (tight requirements in building regulations);
- Wishes from owners and users (decreased acceptability and satisfaction).



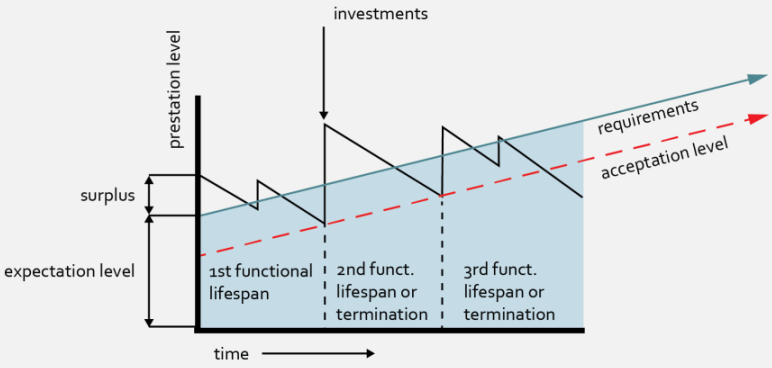
The technical lifespan can be prolonged by building maintenance. Maintenance is defined as repairs that are needed to ensure or restore the original functionality of the building, but does not include measure that improve the initial technical quality of the building. However, there will be a moment at which the technical quality sinks below the level of acceptance. When this happens more far going measures than maintenance need to be taken. For instance, new elevators or glass insulation can be applied, which clearly improve the technical quality of the building. This process can be repeated a couple of times. However, the technical lifespan of a building ends when the owner is not prepared anymore to carry out the necessary technical interventions. This moment often correlates with the functional or economic circumstances.

Functional lifespan

The functional lifespan is the period during which a building complies with the functional

demands of the user. This means that the building is of such a nature that the activities of the user are spatially and constructively supported. This is linked to the type of use that is situated in the building, and is therefore dependent on the specific user of the building. The functional performance of a building can diminish because of the following influences:

- Legislation (tightened requirements with regards to ceiling heights, space norms);
- Wishes from owners and users (appearance, size, amenity level, accessibility, parking facilities).



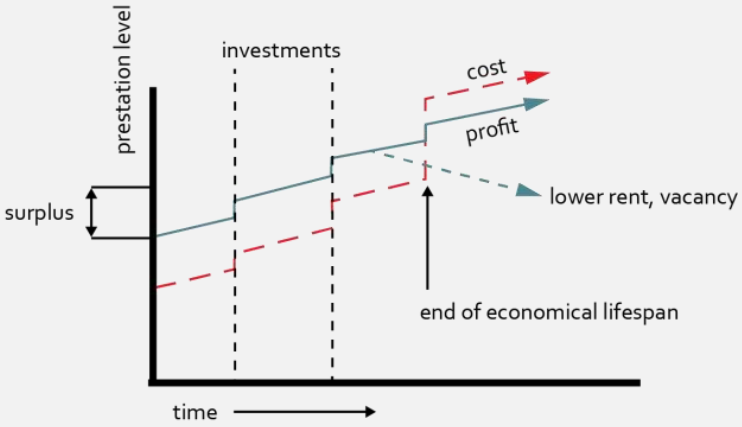
There comes a moment when the functional quality of buildings is not accepted any longer. The functional lifespan ends when the building limits the user or organization in performing its activities. In this case, several options can be distinguished to increase the functional quality. Owners can decide to prolong the function by renovating or rebuilding the building (e.g. new façade, layout, furniture), or increasing the volume of the building (horizontally or vertically). Another option is to change the function (e.g. from office to residential), or to end the function (e.g. demolition or sale). Now, the question rises why not every user or organization is accommodated in a building which generously meets the functional quality, for instance by over-dimensioning the building and its facilities. This of course brings higher costs, which brings us to the economic life span.

Economic lifespan

The economic lifespan is the period during which the building generates more income than costs. This is the period in which all the present value of all future income is higher than the present value of all future costs. The incomes a property can generate depend on the price, quality and competition in the market. For instance, owners of offices will ask a certain rent price from the tenant, which generates income. The costs depend on what is needed to maintain and operate the building. The income and costs combined result in a building's cash flow over a certain period. The economic performance of a building can diminish as a result of the following influences:

- State of the economy (economic downturns in general result in less demand for space/buildings, and lower rent prices);
- Legislation (environmental law requirements like mandatory insulation to improve energy performance of buildings);
- Wishes from investors and users (investors seek buildings that generate

a high/decent yield; users want to pay the lowest possible rent for a certain



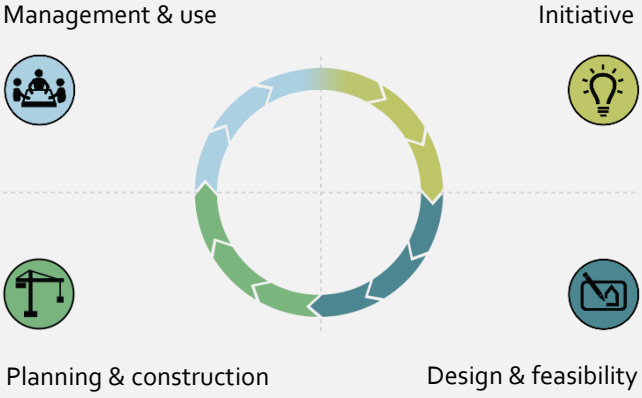
quality level).

The economic lifespan of buildings ends when the owner can no longer see the possibility to generate more income than costs with the building,
In other words, when the cost-benefit ratio is (permanently) negative, or when the building has a negative value. This means that the costs of different alternative interventions can no longer be recouped with financial benefits.
Often, owner-users can prolong the economic lifespan, as they can define benefits a bit broader than just financial ones, including immaterial benefits like the support of primary organizational processes or company image etc.
The three types of lifespan are interrelated. For example, if the functional lifespan has ended, this usually implies that the economic lifespan also ends. Then, for instance it is no longer possible to find a tenant for the building, which means that the building no longer generates income to cover the exploitation costs. Also, the end of the functional lifespan may be caused by the technical lifespan. However, it is often the case that a building is still in a technically good condition when the end of the functional lifespan has been reached.

Despite the fact that owners always strive for extending the lifespan, at a certain point one or more lifespan(s) might thus end. In the case of building adaptation, the owner of a building still sees opportunities to prolong one or more lifespans of building.

Building life cycle

Buildings cannot only be considered as end products but also as processes. A building life cycle forms a representation of the different consecutive phases a building can be in. We distinguish four building lifecycle phases: the initiative; design and feasibility; planning and construction; and management and use phase. Hereinafter, a brief explanation of each of the building life cycle phases is given.



Initiative phase

A building comes into existence because of new or changing needs from organizations, groups or individuals in society. Buildings cannot be considered as a goal, but as a means to meet the needs of people. Therefore, constantly initiatives are undertaken to build new buildings and urban areas, and adapt and redevelop existing buildings and urban areas. Not all built environment initiatives area realized though. This might be because benefits from (re)development are lower than costs involved, or because the existing supply in the real estate market easier meets the user demand for space. This supply-demand relationship forms the base for any decision about real estate. On the one hand, there is the demand-side perspective of users or organizations that need accommodation. On the other hand, there is the supply-side perspective of real estate owners that are in need of letting or selling their building.

The reason for a building initiative often is a mismatch between real estate demand and supply. Typically, users can experience the following accommodation mismatches:

- Quantitative: too much or less space to carry out user activities;
- Qualitative: the technical, functional, financial, or aesthetic obsolescence of the building not suiting user needs;
- Locational: the building suffices, but user activities require a different location;
- Financial: accommodation costs for the user exceed the benefits.

Once a user experiences an accommodation/building mismatch he has four choices:

1. Adjusting user activities to better using the existing building;
2. Adjusting the building so it better meets user needs;
3. Search for a new building in the existing real estate stock, that better meets user needs;
4. Commission a new building to meet user needs.

Note that building adaptation involves choice 2 and partially also choice 3. In both case existing buildings require reconstruction or redevelopment activities. In that case users and organizations need to collaborate with real estate owners, which represent real estate supply.

However, in the initiative phase it is crucial for users and organizations to first explore and define its accommodation needs, before they approach real estate owners:

- Specifying accommodation needs in a general brief of requirements;
- Considering accommodation needs in a future perspective;
- Formulating various accommodation alternatives for the brief or requirements;

- Mapping the global costs and benefits of each alternative (qualitative and qualitative);
- Making a preliminary decision on the most effective alternatives.

Once these steps have been taken users and organizations can decide to approach their current real estate owner to find a solution for the accommodation mismatch, search for possible accommodation solutions in the existing stock with real estate owners, or look at new build options.
This brings us to the supply side perspective in the initiative phase. Real estate owners, and potential real estate owners, can have the following motives for an initiative:

- Opportunity: possession of a building or piece of land that could potentially meet user needs/demand;
- Solution: current state of owned building mismatches with current use;
- Prevention: chance that current owned building will deteriorate, and will mismatch with future user needs.

In general, each of these motives are financially-driven: they might generate new income, higher income, secure future income, and thereby minimize (financial) risks.

Equal to users, real estate owners within the initiative phase will decide or take action to mitigate an accommodation problem:

- Directly decide to sell the building to other agencies;
- Take action first and then sell the building;
- Take action and remain owner.

In the case of remaining the owner of the building, the following four alternatives apply:

- Doing nothing;
- Finding a new user that does not experience any problem with the current state of the building;
- Solving the current mismatch by a structural building intervention;
- Finding a new user and making a structural intervention to meet new user needs.

Hence, in the initiative phase there is a relationship between the user and the owner, the building, and the location. There are various decision-making factors that users and owners need to consider, to make the right accommodation match decision. Once, the choice has been made to for instance adapt a building, users and owners enter the design and feasibility phase.

Design and feasibility phase

In the design and feasibility phase of the building life cycle, users and owners decide which alternative they want to translate into a building concept and design, while simultaneously calculating the feasibility of the design. Sometimes this phase is also called the preparation phase, in which the actors prepare

all necessary steps for the realization of the work in the construction phase.

The steps to be taken in the design and feasibility stage correlate with those activities in the initiative phase, albeit more specific and more detailed:

- Specifying accommodation needs in a detailed brief of requirements;
- Formulating scenarios for different futures;
- Detailing and specifying accommodation alternatives into designs, maps, plans;
- Calculating costs and benefits of the alternatives, and determining risks in relation to the scenario's;
- Deciding about the most effective accommodation and design alternative.

The feasibility of a design primarily is concerned with financial and planning considerations. Does the building design or plan offer potential to accommodate user (future) needs at reasonable costs, and can it be delivered within a certain (required) time? The fine-tuning of design and feasibility matters can be considered as an iterative process that evolves into a final decision for a certain accommodation alternative.

Once the last choice has been made by the user or client, the following activities are carried out:

- Formulating a definitive brief of requirements;
- Detailing designs and drawings for the chosen alternative;
- Specifying a budget and global planning for the realization;
- Selecting companies to be involved in the realization.

Notice that this part of the design and feasibility phase involves collaborating with a lot of specialists like architects, developers, financial and technical advisors, municipalities, investors, project managers and contractors. Some of these actors are selected and/or commissioned by the client based on competition like architects (for the design) and developer/contractors (for the realization of work). Typically, in this phase the building owner and building user work closely together to find an accommodation match between demand and supply. This is particularly true in the case of building adaptation, as often user and owner are acquainted with each other.

Construction and planning phase

At the start of the construction and planning phase, preferably a specific building or accommodation design, plan, proposal is decided upon by owner and user, so work on the building project itself can commence. Sometimes this phase is referred to as the realization phase. This phase comprises of:

- Defining of tasks and activities;

- Selecting and contracting of various parties;
- Deploying financial resources;
- Planning, appointing and realizing foreseen activities;
- Managing the building process and project;
- Revising the strategic process design when necessary.

In the construction and planning phase, the following steps can be distinguished:

- Translating a global realization plan from the design & feasibility phase into a detailed realization plan;
- Commissioning specialists for the realization of work;
- Monitoring and controlling the brief of requirements, budget and planning during construction;

During the realization itself, building project managers often are appointed on behalf of the client or commissioner, who oversees the successful delivery of a building project. They must coordinate the work and activities of many other organizations like construction and installation companies. Ultimately, the construction and planning phase ends with the delivery or completion of the building (adaptation) project by the main contractor, and the client's acceptance of the building.

Management and use phase

The management and use phase can be considered as the longest building life cycle phase. In essence, this phase should cater for user needs and demand and satisfy the owner in terms of a good cost-benefit ratio. Nonetheless, during the operation of the building an accommodation mismatch can still occur. There are two reasons for this mismatch:

- Needs were not well defined in the project's initiative phase;
- The user or organization is more dynamic than expected.

As long as organizations change, their organizational needs in terms of space also change. In this case building owner and user might consider working towards solving operation issues. In the operation phase, the building owners, sometimes equal to or referred to as building operator, might take a passive or active stand towards operation and maintenance:

- Passive attitude: the owner waits for the user to stress accommodation problems;
- Active attitude: the owner constantly consults with users about changing needs, pro-actively steering towards solutions.

The management and use phase is stretched over a very long period of time. In this phase,

several smaller adjustments to the building can be made to keep it functioning for current needs. These activities sit beside daily building maintenance and operation activities. This phase ultimately ends once a new initiative is taken by the owner or user to initiate plans for a new or adapted building in order to accommodate new and future needs. Then the building life cycle start again, hence its cyclical nature.

Building adaptation management

The process of initiating, preparing, realizing and using buildings necessitates different forms of management. Management in the built environment involves the development of management theories, models and methods within the building process. Why is there a need for building adaptation management, and what does it consist of?

The founding of the Department of Management in the Built Environment (Faculty of Architecture and the Built Environment, Delft University of Technology) has several reasons. Building and construction has become a multi-disciplinary practice with a high degree of professional specialization and need for integration and innovation. It has evolved into a complex undertaking, with various types of buildings, disciplines and actors involved. And management has become more professional over the last decades.

As a result, management in the built environment has evolved into a multi-disciplinary practice and science. These disciplines have a close relationship with one of the building life cycle phases. What kind of management disciplines can be distinguished, what do managers in the built environment do, and what types of management tools do they apply in practice?

Urban development management

Urban development management, in relation to building adaptation, typically involves taking into account aspects related to the wider urban area before commencing on a building (adaptation) or urban area initiative. Urban development managers adopt process management principles, to analyze the possibilities for initiating the development of urban areas. Exemplary management tools these managers use are: policy analyses, real estate market analyses, SWOT-analyses, and stakeholder analyses.

Design management

Design management in the built environment is all about making decisions about the most preferable and feasible design alternative for building adaptation. Design managers assist in understanding the functional and financial feasibility of building plans, design, maps and concepts. Typical tools these managers use to influence decision-making about building adaptation are design workshops, design and

calculation models, functional and feasibility studies, and design preference measurements.

Construction management

Construction management involves studying and developing tools to effectively and efficiently delivering a building (adaptation) project. Construction managers use project management principles to organize activities and resources and plan a project timewise. Often used management tools are work breakdown structures, resource breakdown structures, building information modelling, and project planning schemes, enabling them to structure and organize the construction and realization process of a building (adaptation) project.

Asset management

Asset management, or housing management when it considers housing, is predominantly taking place in the management and use phase of building adaptation. Asset managers in building adaptation search for ways to increase the user satisfaction and appreciation of the buildings they use, and maintain and operate the asset in a cost-efficient way. For this purpose, they make use of user satisfaction surveys, user occupancy monitoring, maintenance and operation plans, and energy-use inventories, amongst others to prolong the accommodation lifespan.

Notice that there are many other forms and specializations of management involved in building practice around the globe. The above-mentioned management disciplines, types of managers, and management tools, form a simplification of management involved in building adaptation, and is not representative for management in the built environment as a whole. Nonetheless, it gives a short impression about the many managerial aspects that need to be considered when managing building adaptation.

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