The building as a container of information
The starting point for project development and design formulation

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Summary
For planning in existing built contexts, the building survey is the starting point for initial planning proposals, for the diagnosis and documentation of building damages, for the creation of objectives catalogues, for the detailed design of renovation and conversion measures and for ensuring fulfilment of building legislation, particularly by change of use and refitting.

An examination of currently available IT-tools shows insufficient support for planning within existing contexts, most notably a deficit with regard to information capture and administration.

This paper discusses the concept for a modular surveying system (basic concept, separation of geometry from semantic data, and separation into sub-systems) and the prototypical realisation of a system for the complete support of the entire building surveying process for existing buildings. The project aims to contribute to the development of a planning system for existing buildings.

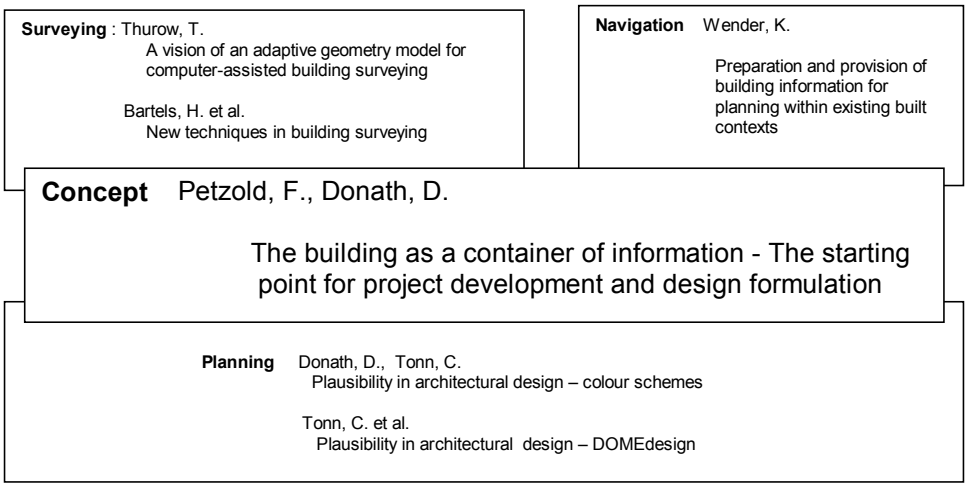


Fig. 1: Overview of the entire project including relevant research papers

The paper gives an overview of the entire project vision for a computer-aided planning-oriented building surveying system at the Chair for Computer Science in Architecture. Figure 1 shows relevant research topics which have been examined in more detail.

In addition to an overview, this paper also examines the role of the initial site visit as a primary building block for the entire computer-aided planning system environment. The initial site visit

plays a key role in establishing relevant project parameters. The spatial structure of the building must be examined and structured, alterations to the building structure noted and analysed, building damage and conditions examined and initial conclusions assessed with regard to planning intentions. The data collected at this stage in the planning process forms the basis for key planning decisions, which building measures could be undertaken, what further information is required, planning proposal feasibility and initial cost planning. The approaches discussed a part of an ongoing research topic at the Bauhaus-Universität Weimar. A software prototype already exists and is currently undergoing comprehensive testing. /Thurow2004, SFB 524 2004/

1 The building survey – the starting point for planning in existing built contexts

Changing socio-political conditions have affected a shift away from new-building towards renovation in the German building industry. The conservation and use of existing buildings stock is not only ecologically sound but also an economic imperative. More than half of all building investments in Germany are in the renovation sector and this proportion will continue to rise. /BMVBW 2001/

Planning within existing built contexts differs from planning for new buildings in that a building is already present with its own history and life-cycle. Existing buildings contain a high degree of potential information relevant to the future planning task, the usability of existing built substance and the coordination of building measures. As the planning process progresses new questions arise with regard to the existing building and which affect further building measures and these in turn necessitate more detailed information. The existing built substance is an influential factor in all stages of the planning process

An essential prerequisite for planning within existing contexts is reliable and informative planning data. In most cases this is not available or has not been kept up to date with the current situation. As a result a building survey is necessary, either as an extension or validation of existing building documentation or to provide new documentation. A building survey which fulfils the needs of a planning task will be described as a planning-oriented building survey.

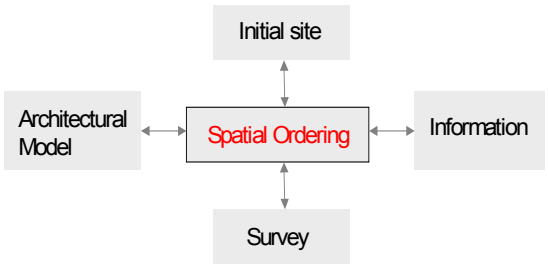


Fig. 2: Sub-systems of the concept

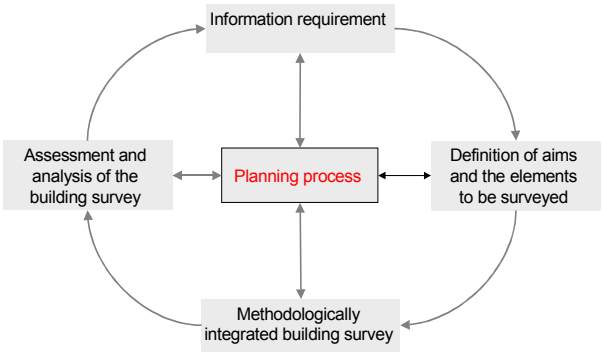


Fig. 3: The relationship between the building survey and the planning process

Despite a range of very different specific situations for building surveys and the resulting different information requirements, an organisational structure for storing the data must be

decided upon which can serve as basis for future expansion: a digital building model. This is generally organised according to the spatial structure of the building. (Fig. 2)

The existing research project contributions detail the optimal processes involved in computer-aided building surveying and modelling for use in building planning. Briefly put they include:

- All data capture tools and methods should be combinable into a complete toolkit (Weferling 2003),
- A data structure should be provided which is standardised for particular building types but whose structure can be dynamically modified to fit the specific requirements of individual surveying requirements and buildings,
- The degree of information detail (density) should be flexible and expandable on demand as not all information is required at every stage of the planning process. A sketch-like overview is sufficient for basic planning intentions, for other (sub-)areas a high degree of detail is imperative (see Thurow 2004 in this publication),
- The captured data must be presented to the user in an adequate form to enable the user to "explore" the building digitally (see Wender 2004 in this publication),
- The captured data should serve as a basis for further design and planning activities (see Tonn 2004 and Donath 2004 in this publication; Donath 2003)

Planning activities in the context of existing buildings involves: the step by step collection of building-relevant information; rule and parameter based solution development; combination of classic and automatic surveying methods and equipment which contribute to the creation (survey) and editing (planning) of a building model i.e. which enable access to the building as a container of information; the consideration of the entire process (building survey); intensification of information density to be captured (from the sketch to detail); the attribution of planning-relevant characteristic values; the provision and modification of ordering systems; and the free combination of different input techniques (surveying methods) in a single system (Fig 3)

1.1 The information container – A basis for structuring information

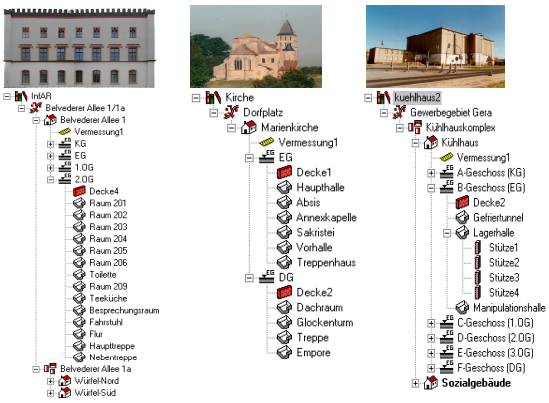
The structured capture and storage of building-related information in an information concept is an essential pre-requisite of an integrative planning system. During building surveying, the data capture is undertaken only to a level necessary for the future use of the information.

The concept envisages a **comprehensive organisational system** with flexible extension possibilities.

With regard to representing an existing building, three primary structures are relevant when describing an existing building:

- The **Project Structure** – a database for project relevant characteristic values,
- The **Spatial Structure** – an summary of all spatial objects used to classify the building
- The **Building Element Structure** – a hierarchical classification of all building (construction) elements

The basic pattern of an ordering structure can only serve as a suggested building structure. It must be possible to adapt the structure to the specific needs of the task and building at hand, e.g. an office building differs from an industrial building. This necessitates a flexible and extendable organisational system. /Fig. 4/



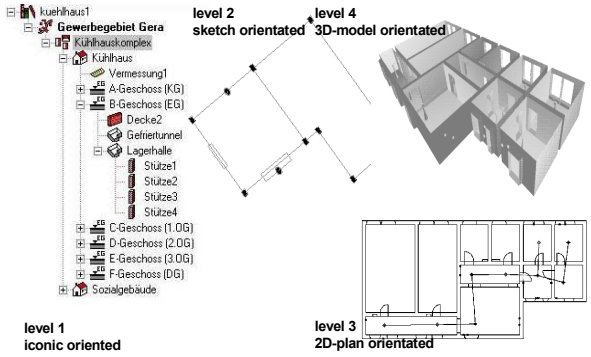


Fig. 4 Basic pattern

Fig. 5. Different levels of detail

In addition to the spatial and building-element oriented capture of the building geometry, other formal (building parameters), informal (text, images, video, sketches etc.) and relational data (inferred structural connections) is also captured. This non-geometric data must be stored within the information container.(Fig. 6)

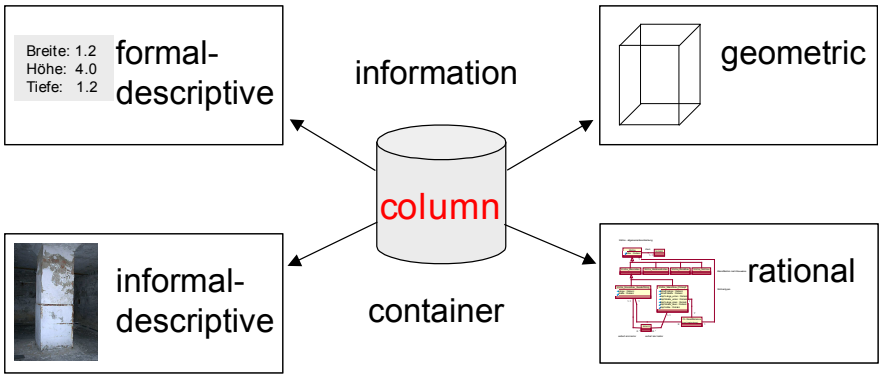


Fig. 6: Information container

An user-class – a spatial or building-element class – is described by formal, informal, geometric and relational properties (attributes). Geometric properties are only linked to elements within a geometric structure. The geometry is “just an attribute” of an element.

A link between parameters of the geometric structure and formal properties (attributes) of the user-classes can likewise be defined and this is a basic concept of the system (Fig. 7), *(see also Thurow 2003 and Thurow 2004)*.

An essential aspect of the concept is the surveying and capture of building-relevant information with regard to its use in the planning process and the necessary intensification of information-

density. Different levels of detail can and should be able to occur simultaneously within the same model depending upon planning progress (Fig. 5, 8)

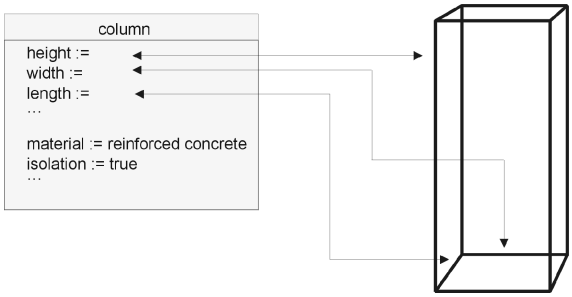


Fig. 7: The relationship between user-class and geometry

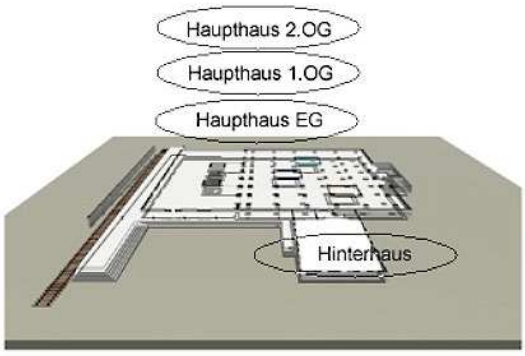


Fig. 8: Different levels of detail

1.2 Basic modules and the experimental software platform

The system concept follows a modular principle. Using server technology it is possible to integrate different modules for surveying and planning within existing built contexts according to requirements.

The individual modules form an extensible, flexible system that can be adapted in real-time and is comprehensive enough to cover all demands from the initial site visit to detailed planning. Each tool is conceived for a specific aspect within an overall integrative planning system.

Selected aspects have been realised as prototypes on an experimental platform and demonstrate the system feasibility. The experimental platform consists of a server and extendable series of different tools in the form of clients. The server is used to store data permanently and centrally and interacts with the various clients. Redundant data storage within the clients reduces the level of continuous data-transfer load on the server.(Fig. 9)

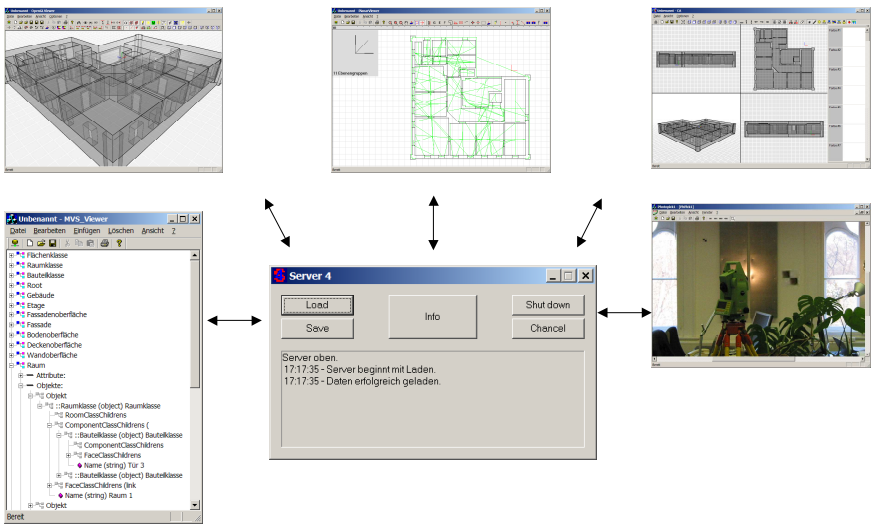


Fig. 9: Server and different applications in the experimental platform

Currently implemented tools / clients include:

- Plan-oriented sketch entry for the initial site visit
- Manipulation and interaction in the 3D-view
- Manipulation of semantic data and structuring
- Different surveying techniques including manual measuring, tacheometry and photogrammetry
- Automatic edge-detection and geometric validation using motorised tacheometers.
- Communication tool with chat and whiteboard functionality

Tools / clients currently in development include:

- The definition of a sketch-based capture module ("pre-structuring")
- The definition of predefined "geometric" spaces/rooms and building elements
- Development of functionality spectrum of the information presentation system
- Assessment functionality for use with estimates costing and data transfer to planning permission documentation functions

2 The module "Initial site visit" – basic planning information

For planning in existing built contexts, the building survey is the starting point for initial planning proposals, for the diagnosis and documentation of building damages, for the creation of objectives catalogues, for the detailed design of renovation and conversion measures and for ensuring fulfilment of building legislation, particularly by change of use and refitting.

A detailed inspection and survey of the existing building substance serves as the basis for economically viable planning in context. Precise information is a far more reliable foundation than planning according to appearances. The majority of serious conflicts arising during the planning process are due to omissions in the survey. This can lead to dissonant preparation, loss of information during the building process, time delays and supplementary costs resulting from planning revisions during the building phase.

Before a building survey is undertaken, an organisational structure for storing technical and legislative data must be decided upon which can serve as a basis for economic viability calculations and project controlling as well as for the formulation of alternative design proposals. /Kohler 1999a, Kohler 1999b,Kalusche 2002 and Nentwig 1999/

The initial site visit plays a key role. The building's spatial organisation is determined and captured, modifications and extensions to the building structure (which deviate from existing documentation) are recorded, existing building damages and the condition of the rooms and the building elements must be recorded, and these must then be analysed and interpreted as recommendations for the future planning.

2.1 The digital plan case – project specific parameters

At the beginning of the project, non-geometric building parameters are often most important. Boundary conditions and basic characteristic values are determined for the project i.e. information from pre-existing building documentation and research.

The module “initial site visit” offers practical orientation in the structured recording of such project specific parameters. The project structure includes the address of the client, documents (meeting protocols, emails, contracts etc.) and pre-existing planning documents (plans, reports, photos etc.)

The structure as given in the project “OSCI-Xbau – standardisation in electronic exchange of administrative building information” forms the basis for the project specific data. (Fig. 10 /11) (XBAU 2004)

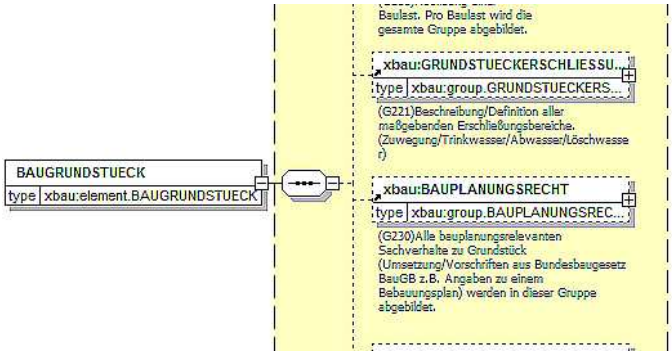


Fig. 10: Xbau Structure - Plot

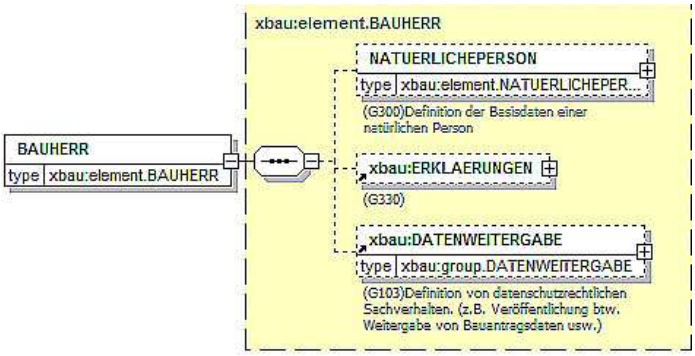


Fig. 11: Xbau Structure - Client

When planning with existing buildings all available existing information is researched and captured. This can include older plan documents, files etc. from the planning department archives as well information in literature, chronics, inventories and archives (especially for historically important buildings). An assessment of these leads to the definition of further information requirements and special measures such as the abstraction for the building survey or the uncovering of hidden historically important building elements.

2.2 The digital plan case – digital room log and building element description

Decisions made at the early stage of planning can have a major effect on the future course of planning measures. A broad range of information must therefore be collected and assessed as the basis for informed decisions.

The pre-existing building documentation often does not represent the building as found. They have been changed, adapted, modified and used for a variety of purposes during their lifetime. Modifications are rarely or typically only partially recorded. It is therefore essential to visit and assess the degree of change on-site.

In each planning task and for each building the answers to the following questions are required:

- What must be renewed or replaced, supported or strengthened? (structural safety)
- What can remain as it is? What is required in addition? (fulfilment of planning and functional requirements, project costs etc.)
- How is the building structured? (same building organisational structure for all participants in the planning process)

With regard to economic viability, the following information must be ascertained or prepared:

- A functional study at a rough scale
- Estimated massing and cost calculation
- Estimated available floor area for the purposes of use/rent

All the important aspects for making informed planning decisions (spatial structure, essential elements, relative positions and connections, size of rooms, uses, damages etc.) must be recorded and assessed as simply as possible without needing to go into more detail than necessary. For the moment structural and constructional aspects are less important. The aim is to obtain a quick and flexibly-structured overview of the main spatial units (rooms) and building-elements. The building survey therefore usually begins with an overview of the building's spatial structure and a recording of the principle properties in the form of sketches and a room log.

The module "initial site visit" is used to create the building model and define the spatial structure of the building. Its core functionality lies in the realisation of essential elements in a sketch-like or iconic form whether these elements are rooms, room-descriptive elements (wall, ceiling, floor surfaces etc.) or building elements (doors, windows etc.). The recording of formal information and informal data (such as damages information, inferred structural congruence, areas and massing) is also possible in this early phase. The recorded sketch-like representation forms the initial abstraction level of the building model which can then be intensified with more detail as planning progresses.

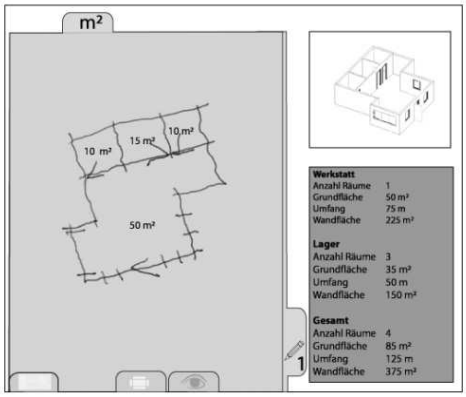


Fig. 12: "Lea" Screenshot – space view

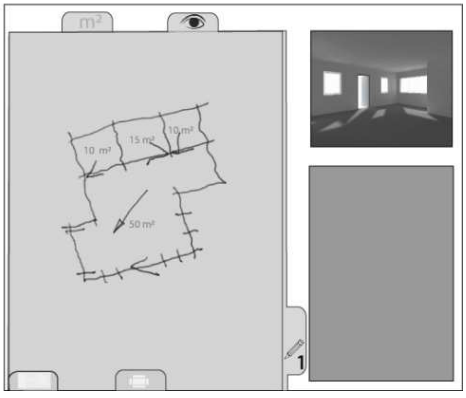


Fig. 13: "Lea" Screenshot - viewpoint

As part of a research project, algorithms were derived in which the sketch and process of sketching during a site visit leads to the creation of a building model. Through the use of

contour detection and interpretation a building-element oriented 3D building model was derived from a sketch drawn on the screen.(Fig. 12 and 13) /Beetz 2003/

The freehand description of buildings in plan not only accords to the working method of architects. In many cases it also contains more information (expression, value) than a formal 2D orthogonal model abstraction can provide.

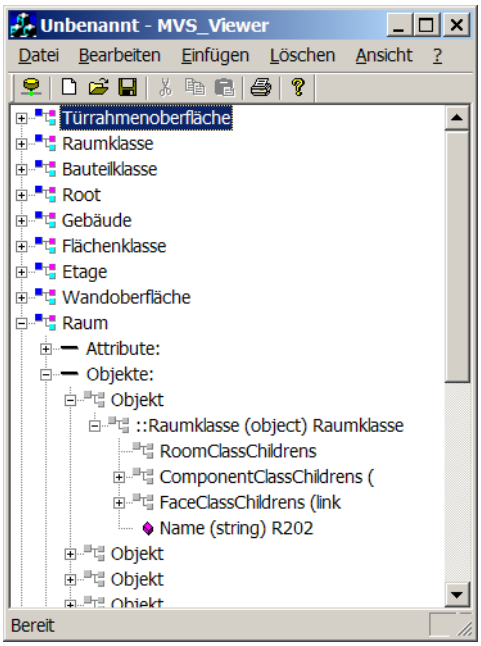


Fig. 14: experimental platform -Icon view

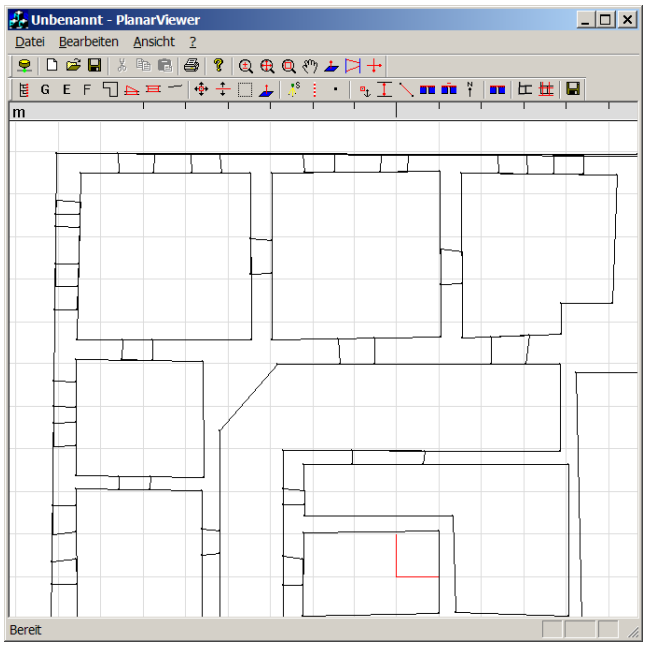


Fig. 15: experimental platform -sketch-oriented view

The recording of room structure and the sketch-like representation of the rooms and building elements as well as the representation of formal (parameters) and informal data (photos, verbal descriptions etc.) in a digital room log provides sufficient information for the creation of functional feasibility studies, associated cost estimates, damage appraisals, basic planning application data and the assessment of future measures.

Important information such as:

- Function and location of a room with regard to cardinal direction
- Arrangement, size, function and fittings of the room
- (inferred) location and arrangement of walls, doors and windows …
- Floor areas, useful floor area, room cubature

can all be derived from this data.

The result is a preliminary, sketch-like and room-oriented organisational representation of the building not to scale. (Fig. 14 and 15) The captured data is presented to the user in an information presentation module which will provide tools for retrieving selected data with regard to the current aspect of the planning task (see also Wender 2004 in this publication)

3 Conclusion

An economically viable project realisation necessitates the capture of a particular amount of relevant information. The principal means of obtaining this information is through an initial building survey – an initial site visit – (i.e. room and building-element oriented recording of a building and access routes) and through research into historical documentation and basic geodetic, geotechnical and other basic information regarding the immediate relevant surroundings. All this should be recorded with a view to the envisaged future use of the building and the associated planning requirements.

Future research will focus on assessing the data captured. Of particular relevance are modules for supporting financial viability, for supporting the design process and an adequate information presentation module.

The concept described in this paper and the experimental platform discussed confirm the relevance of the approach to develop a use-oriented model and information container for planning within existing built contexts.

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