



# New Approaches in Computer Aided Project Planning

Towards the use of a Modular Building Information System Based on Digital Survey in the Revitalization Process of Existing Buildings

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## Abstract

The demands for an increasing cooperation of all parties involved in the building process and the implementation of highly specialized software-applications outlines the significance and necessity of new methods and concepts for the development of a computerized integration of all participants.

The aim is to improve cooperation, communication and information between the participating parties. The scaffolding is the establishment of an efficient and faultless data- and information interchange between software applications and specialists of different trades.

A digital building-model in terms of a "virtual building" would form the basic level for the integration of relevant data. This building model would contain all data and information relevant to the projected or existing building.

With reference to todays situation in architectural offices and according to realizable improvements, this article will demonstrate courses for future IT-support on the basis of an ongoing research project. The presented project is part of the special research area 524 "Materials and Constructions for the Revitalization of existing Buildings" which is funded by the Deutsche Forschungsgemeinschaft. It deals with the integration of various parties that are involved in the revitalization process of existing buildings as well as with the provision of adequate information within the planning process resting upon the survey of existing building substance.

## Resumen

*La creciente demanda por una cooperación de todas las partes involucradas en el proceso de creación e implementación de aplicaciones de software, altamente específicas; evidencia el sentido y la necesidad de nuevos métodos y conceptos, requeridos para el desarrollo de una integración de todos los participantes, asistida por el computador.*

*La meta propuesta es la de mejorar la cooperación, comunicación e información entre los participantes. Lo fundamental para tales efectos, será el establecimiento de un intercambio de información, eficiente y libre de errores (sin ruido), tanto entre las aplicaciones de software, como entre los especialistas de diversas áreas.*

*La base de tal integración de datos, la constituirá el modelo virtual de un edificio, el cual contendrá toda la información relevante necesaria acerca de él, sea éste un edificio existente o solo en proyecto.*

*En referencia a la actual situación de las oficinas de arquitectura y acorde con las reales posibilidades de mejoramiento, este artículo señalará caminos para futuros soportes técnicos de interacción (IT-support), sobre la base de un proyecto en pleno desarrollo.*

*El proyecto presentado forma parte del área especial de investigación 524 "Materiales y Construcción para la Revitalización de Edificios Existentes", promovido por la Deutsche Forschungsgemeinschaft (Comunidad Alemana de Investigación) y tiene relación con la integración de diversos participantes involucrados en el proceso de revitalización de edificios existentes, como también con la adecuada confección y provisionamiento de información complementaria al proceso de planificación, sustentado en la incorporación de la sustancia constructiva existente.*

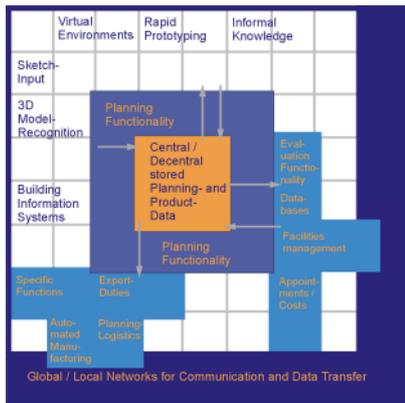


figure 1 The visionary situation

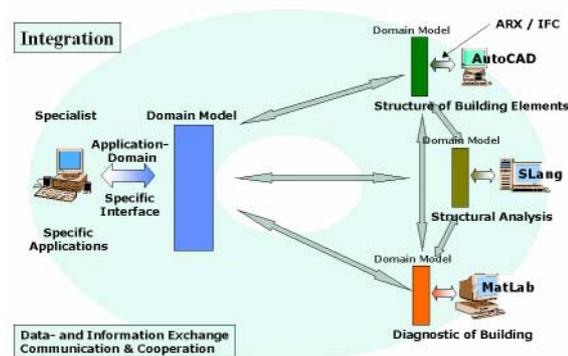


figure2 Conception and administration of models

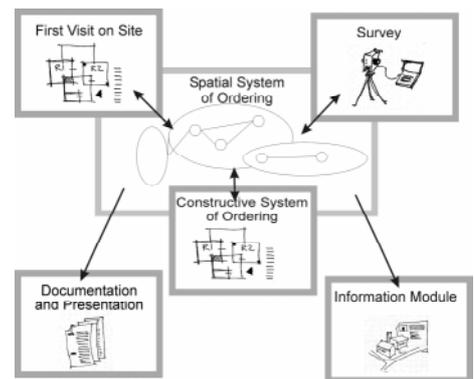


figure 3 principle sketch of the surveying system

## Introduction

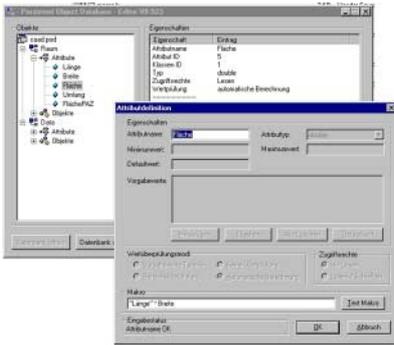


figure 4 Variable attributes

IT-integration of all parties involved in the life cycle of a building charges high demands to research in the area of information-processing correlated to building trade.

Due to highly specified, locally scattered participants with widely ramified knowledge in the planning- and building process, consistent data- and information interchange without losses is an essential part of a persistent computer aided planning process. Thus, it is obvious that cooperation between different planners and the resulting associated integration of highly specialized applications in heterogeneous system environments is unalterable for decisions made within the planning process.

Efficient data exchange requires the establishment of an integrative platform for understanding. This platform rests upon a digital building model. The realization of such a building model proves to be extremely complex within the following areas:

- the definition and specification of relevant data and logical sequences
- data- and information interchange
- coordination of cooperation and communication between specialists.

Resting upon the presentation of these problems the current situation of IT-support for architectural offices will be demonstrated. In the following this article will demonstrate courses and visions for future IT-support on the basis of an ongoing research project.

## Scenario I :The ordinary situation in the planning process

Today's IT-support in the planning process is characterized through sequential succession of planning steps. Planners make use of high-performance specialized programs, represented by isolated applications and commonly used communication technologies like telephones, fax machines and email.

Data exchange between software packages correlated to building science, i.e. survey, CA(A)D, BOQ, works in principle only. The attempt to integrate specialists aspects of all participants targets a unification of model-building as well as a definition of protocols and interfaces.

The exchange of data and documents within the scope of a project takes place in terms of project-meetings, snail mail, courier, fax or email.

## Scenario II: The possible situation in the planning process

With today's software applications work processes in building design could be reformed and improved, reaching an effectiveness which is not possible to be achieved with stand-alone applications and the methods described in the first scenario. In contradiction to object-oriented database management systems (OODBMS), which were praised to the skies, but do not allow to administer a consistent datamodel containing interwoven modules, Scenario 2 presupposes consistent models within each aspect of the planning. Current proposals for solution - like active relationships or the adaptation of the 'event-condition-action-paradigm' wouldn't cause shouts of joy due to the fact that they are often specified for particular cases only (Bergmann, 1994; Kolender, 1997; Olbrich, 1998).

The main criteria and capability characteristics of scenario 2 which current systems are capable to meet will be described in the following.

- Survey as a basis for planning with CAAD in the revitalization and conservation process of existing buildings. (Donath, 1996)
- Availability of complex CAD-systems with extended and specific architectural functionality (CAAD).
- Linkage between CAAD-data and databases (DBMS) providing information for room-books and administration of utilization.
- Linkage between CAAD-data and BOQ and tender-documents for the exchange of quantities and masses.
- Data exchange capabilities to directly deliver CAAD-data to other professionals and executive firms.
- Architectural visualization, presentation and simulation directly derived from the CAAD-package.
- Structured and classified office-organization, including a standardized filing- and archive system.
- Integration of programs to create and exchange digital BOQ- and tender documents as well as price indices.
- Establishment of networked computing equipment with appropriate security mechanisms and standardized access to global networks and net-services (Donath, 2000).

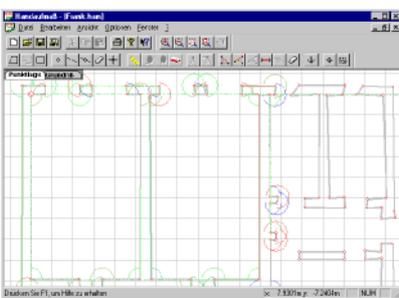


Figure 5 Manual measurement

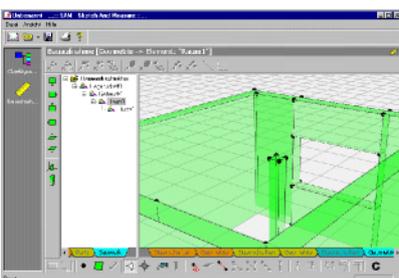


figure 6 SAM2000

## Scenario III: The visionary situation for the integration of IT in the planning process

Apparently, the current situation is not satisfying to the architects demands. Thus, it has to be clarified how architects could formulate their expectations and their hopes with reference to a further development of these tools.

Research in architecture and informatics related to building science strives for an explicit mapping of product- and process modeling for a long time. Previous attempts led to partial improvements, but they did not solve the problem entirely. The coverage of this complexity could be warranted on a higher level of integration only.

The basis of our vision of an integrated planning model as mentioned above will be built by a digital building model. In terms of a “virtual building” this model represents an existing building to be revitalized or a building that has to be newly designed. It constitutes itself through abstraction of attributes and properties of a commemorated/real building.

Consequently it represents a system of ordering of the totality of belonging data. The main task and functionality of a building model alike is the administration of all information necessary and the exchange of data between the specialists involved. This information and data interchange takes place on the basis of universally valid, formalized data structures.

According to that planning actions are temporal and spatially distributed cooperative processes, whose coordinating platform is the modeled representation of the planned object (figure 1).

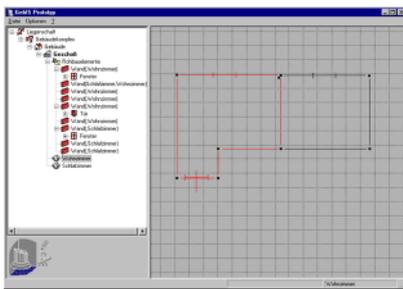


figure 7 GEBSexp - sketch

## De facto developments within special architectural areas

### An integrating platform for revitalization projects

The usage of computer aided information processing within the revitalization process is an indispensable part for the solution of special presentations of a problem. Accruing information has to be filed in a structured manner to allow cooperative processing of revitalization projects. Structuring, gathering and organization of information interchange forms a central and connecting role in planning.

The amount of different building types (industry, housing, ...) and their unique character as well as the multitude of different views within the life cycle of a building lead to extremely complex building models. These complex models could be controlled only by the use of a dynamically adjustable “view-oriented” subdivision of the whole amount of data into various domain-models.

The domain models reflect a relevant dynamically modifiable clipping at a time, i.e. survey, the architectural model, the load bearing model, of the disposable data of the building (SFB524, 1999).

The availability of building information to be based on the relation-oriented model approach will be realized throughout the various phases of the buildings life cycle. In this sense the digital building model serves as a virtual building (figure 2) (Villenbacher, 2000; Petzold, 2000).

### Digital survey- and information system relevant to building planning

Coverage and survey of existing buildings very often forms the originator for planning intentions. The information to be covered, i.e. geometry, subject catalogues and informal data depend on the intended purpose. The information of the existing will be the basis for the following planning process. They will be completed with information gathered from following phases of the life cycle of the building.

The aim of our research is a deduction of a concept and the implementation of experimental systems for quick and save coverage and gathering of our built environment.

Depending on an in depth analysis we developed criteria for a computer aided building information- / survey system. These criteria include:

- persistent support
- model building on-site as well as plausibility tests
- gathering of information with different characters and criteria
- generation of a system of ordering
- flexible geometric representations (Donath, 1997)

From a variety of demands the following items were chosen to be used in concepts and experimental software applications:

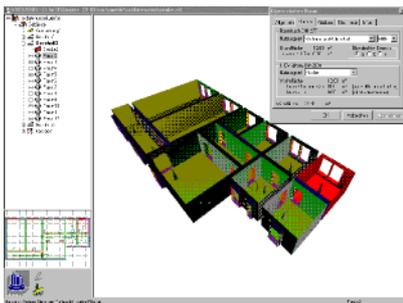


Figure 8 Definition dialog - variable attributes (Vitruvius®)

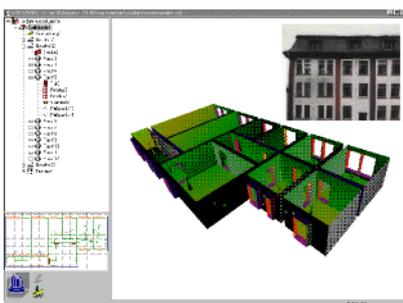


figure 9 Room - 3D representation (Vitruvius®)

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Willenbacher, H., Hübler, R. (2000). "Relationen zwischen Domänenmodellen - Ansatz zur Schaffung einer integrierten computergestützten Bauplanungsumgebung", accepted paper at *IKM2000 Weimar*.

1. Analysis of survey relevant to building planning
  - classification of buildings and structural elements
  - techniques and procedures for gathering information
  - techniques, tools and methods for survey
  - levels of abstraction relevant for planning (geometry and subject catalogues)

2. analysis of procedures and tools in information technology
  - oo-modeling and oo-databases
  - administration of models
  - graphical user interfaces

3. conception and development of overall tools through
  - modular / object-oriented realization of basic tools
  - interface definition to processing programs and persistent data storage
  - test and evaluation of gained results

The concept includes a set of tools for computer aided coverage of buildings in architecture (*figure 3*).

The single tools form a persistent, evolutionary and flexible system providing support from the first visit on site to adequate preparation of data at the very end. The system will support the surveying specialist within the scope of structured coverage of buildings, postprocessing of data as well as analysis of data. Each of the single tools covers exactly one aspect of the surveying process.

Within the scope of the research project critical aspects of the concept were realized on the basis of prototypes. These prototypes include:

**Variable attributes:** Descriptive properties were determined as alphanumeric attributes. An all-inclusive determination for every single situation still seems not to be possible. The prototype proves the possibility to define user-depending attributes during runtime (*figure 4*).

**Manual measurement:** This prototype realizes 2D-oriented measurement of buildings. Various methods of measurement were supported, i.e. distance- and angle measurement and definition of restrictions like parallelism (*figure 5*).

**SAM2000 :** As the predefinition of all building components with their geometric peculiarities seems not to be possible a prototype was developed who allows dynamic generation of building components (*figure 6*).

The results gained from this research project form the basis for the experimental system "GEBISexp". This system supports structured room- and building component oriented measurement of existing buildings.

The geometric survey happens in different levels of abstraction (*figure 7; figure 9*). In addition to geometric description room- and building components could be mapped through evaluating (descriptive) alphanumeric properties and multimedia information (*figure 8*). A commercial development of this experimental system is realized as an application called Vitruvius® (Vitruvius, 2000).

Further information about the research project is available at the following address:

<http://www.uni-weimar.de/architektur/InfAR/forschung/GebIS/index.html>

## Outlook

The long-term objective contains an easy to use IT-system that adjusts planning data with the actual built situation. A superimposition of reality and the mapped image could be realized through the combination of survey and AR-techniques. By this means faults could be detected and corrected in time. The precondition would be a flexible geometric model (Thurrow, 2000). Future developments in computer engineering with respect to miniaturization allow new ways to be gone. Thereby current developments and research results will be integrated and modified according to the demands of digital survey. In addition to technical presentations and solutions of the problem the project focuses on the preparation of the operating procedure during survey.