Integrating Planning Systems

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Goals and concepts of integrating different computer aided design and administration systems for many tasks in design and management of buildings were reported from the viewpoint of research and software development. They are presented by example of the ISYBAU-project.

1. Situation
2. ISYBAU - goals
3. ISYBAU - concepts
4. Integration by data exchange
5. Integration by database
6. Datamodel
7. Object = Y- (systems)
8. Use = room + function
9. Coordination of information
10. General informations
11. Logic localisation
12. Integration of numeric and graphical systems

1. SITUATION

The situation of computer aided design for buildings can be described as

1. The design of buildings is a very complex process with
   - many people involved
   - different subjects
   - iterations in phases with different goals

2. Usually the software packages have their own data management
   - on the technical side and
   - - on the logical view.

3. That's the reason why data exchange between applications of different subjects is not very often possible. Usually such possibilities exist only within applications of only one developer.

4. The needs to integrate applications come from economics (lower costs, more results), for example by avoiding breaks of different media demands for better results in planning tasks.

5. Actually the developments in software result in - better user interface - better results - using new technologies for new tasks (for example AI). - integration of applications sometimes result in putting a database system to the graphical system and the exchange of information between these two systems. A complete chain through all tasks in the design process can't be seen.

But:
We only can get more efficiency and effectiveness in computer aided design if we have an unlimited exchange of information between the involved persons and systems on the

- technical level and
- on the logical level.

Whereas the reality is different: people working in well organized projects lack the possibility of unlimited exchange of information between their systems (often even not only between the systems!). They need to tear down the limitations in communication in their offices internal and external to other offices.

The owners and managers of large facilities need to maintenant their buildings besides the tasks of designing new buildings. Integrating design , construction, maintenance and use of buildings in computer aided systems is a great chance.

Not only private designers use computer aided systems, but also the public offices in the FRG. The very many different tasks and the huge size of these public offices forced the ministry of Raumordnung, Städtebau and Bauwesen of the FRG together with the federal states to coordinate their activities in this area. Therefor they started a project called ISYBAU in the year 1986.

2. THE GOALS OF ISYBAU

ISYBAU wants to integrate all tasks, which are possible to be supported by computersystems. This should be in all areas directly in the offices or very nearby. To get there, ISYBAU set up five goals:

2.1. Integration of Information

Information should "travel" through all phases of an object according to the demand: On(c)e input information should be used at any time at any place for any tasks without respect of the original task the information was created with and used and whether the information will be used in the future.

2.2. Integration of application

An integrated design system will consist of many applications. Depending on the applications of only one or a few software companies would discourage the competition in the market. Then the public offices would be isolated from new innovative developments of other companies. Therefore ISYBAU will not accept the dependency of some software products: Every application should be connected with any other application of other companies.

2.3. Integration of systems

As tasks in planning and realisation of buildings will be done not only by the public offices, but also by free architects and engineers it has to be possible, to transmit information quickly, automatically and without any problems between the different systems of the partners.

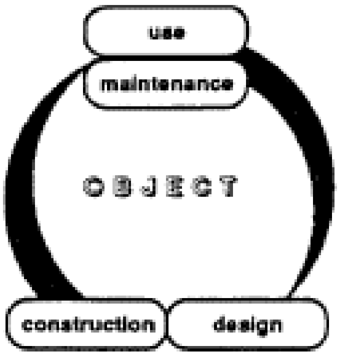
2.4. Integration of hardware

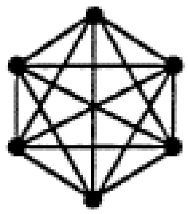
To get any new innovation at any hardware platform all systems for computer aided design used by ISYBAU have to be available on any hardware systems in the market.

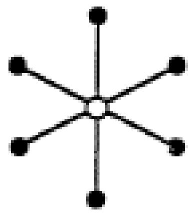
2.5. Using procuts of the public market

ISYBAU does not want to develop software by their own. ISYBAU wants to use common products from the market and to integrate them in t-he way that they can do their special jobs well. ISYBAU encourages and helps in development in different ways. And ISYBAU wants to publish all results to support new innovations in research and development.

3. ISYBAU - CONCEPTS







Integration through all stages in the Object-cycle

A = number of applications f.e.: **T=(6*6)-6=30**
Z =number of connections i.g.: **T=A2-A=A*(A-1**

The direct and specific connection of two applications is reduced to single cases, because the theoretical possible number of connections is too high and this kind of connection is very inflexible.

We have four characteristic tasks in integration:

1. AN-AN i.g. asynchronus
2. AN - Grafik i.g. asynchron us
3. Graphics - Graphics
4. AN+Graphics- AN+Graphics

if possible synchronus if possible synchronus usually only asynchronous, for example through STEF2DBS4

Integration for everything can only be made on the basis of standards. But: "The nice thing about standards is, that there are so many of them to choose from." A.S. Tannenbaum

Integration has four aspects:	1 . organisation	users, jobs
	2. function	logical tasks
	3. information	*informations, data*
	4. technic	systems
in the following levels:	A projects	
	B processes	
	C applications	
	D data management	
	E data exchange	

The organisation results in the security of applications (tasks) and informations to the users, and the use of the "correct" computer systems: who is allowed to do what when and with which application.

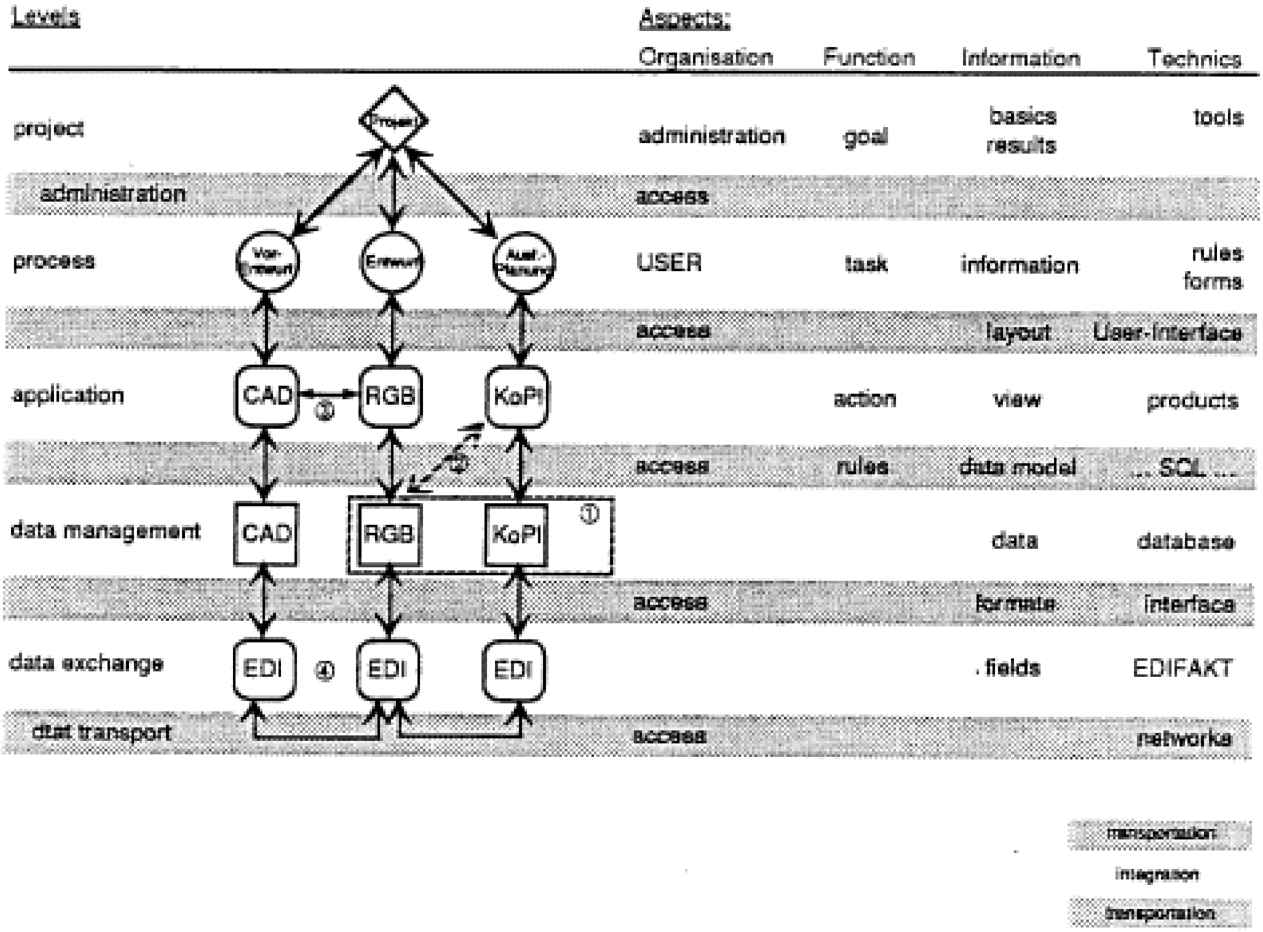
On the functional level is the combination of the applications to the specific task coordinated: what has to be done and how.

On the information level the semantics are defined and the information is kept ready. The structures of information are designed in data models, these models are shown in ER-diagrams. Special difficulties in modelling data are

1 . the subjects and applications are very dynamic
2. models are always only parts of the real world

These problems can be resolved only with dynamic structures or on the level of meta structures. All the time you need the coordination of the semantics and attributes in central office.

On the technical level information is being prepared by
1 . common data bases
2. inter process communication
3. data exchange



1
In general the administration of all information should be together in one distributed relational database. As this can be only in the future when software products have such standard interfaces to databases and when heterogeneous, distributed database systems are available, other strategies have to be used too:

2
On an intermediate stage direct connections to databases of different applications are proposed. In this case the applications use the same logical data model in their own datamanagement.

3
Data exchange is of special interest, because this is the quickest way for integration of information. But it makes only sense, if this is based on standards. In other ways the efforts for developing and maintenance ist too big. Also in the future this is necessary for the exchange of information between seperate organisations.

4
Interprocess communication is interesting to ISYBAU only when common standards are available and guarantee flexibility (communication between diffent appiications from different producers -> independance from single software houses). At the moment this can be seen ortly in the new system version 7.0 from Apple.

4. INTEGRATION BY DATA EXCHANGE

Data exchange is needed

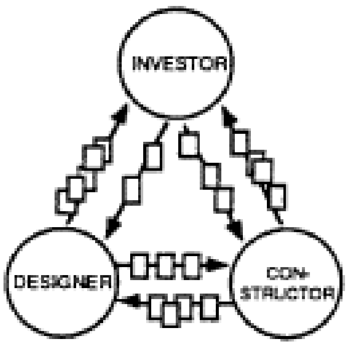
A **between same subjects and tasks**
B **between different subjects and tasks**

a **ISYBAU/Organisation internal**
b **ISYBAU/Organisation external between same logical data models between different logical data models**

1 **between same technical formats**
2 **between different technical formats**

Developing a standard for data exchange

1
In the first step the information with their data elements will be analyzed by the rules for planning and administration in the public offices (HOAI, RB BAU ...). Especially the information being exchanged between the different partners in projects is to be examined:
Who gives what information to whom in which data elements?



There will be analized

reason
document
transmitter
reciever
contents (informationen, data)
formats (form)
media (paper, phone, tape,
stage

2
In the second step "standard messages" are defined from the logical point of view: the contents will be formed in to logical standards.

3
In the third step an EDEFAKT -standard will be designed from the technical point of view. The contents, meanings and formats of messages are defined: ISYBAU wants to get international standards with EDIFAKT for design and administration of buildings.

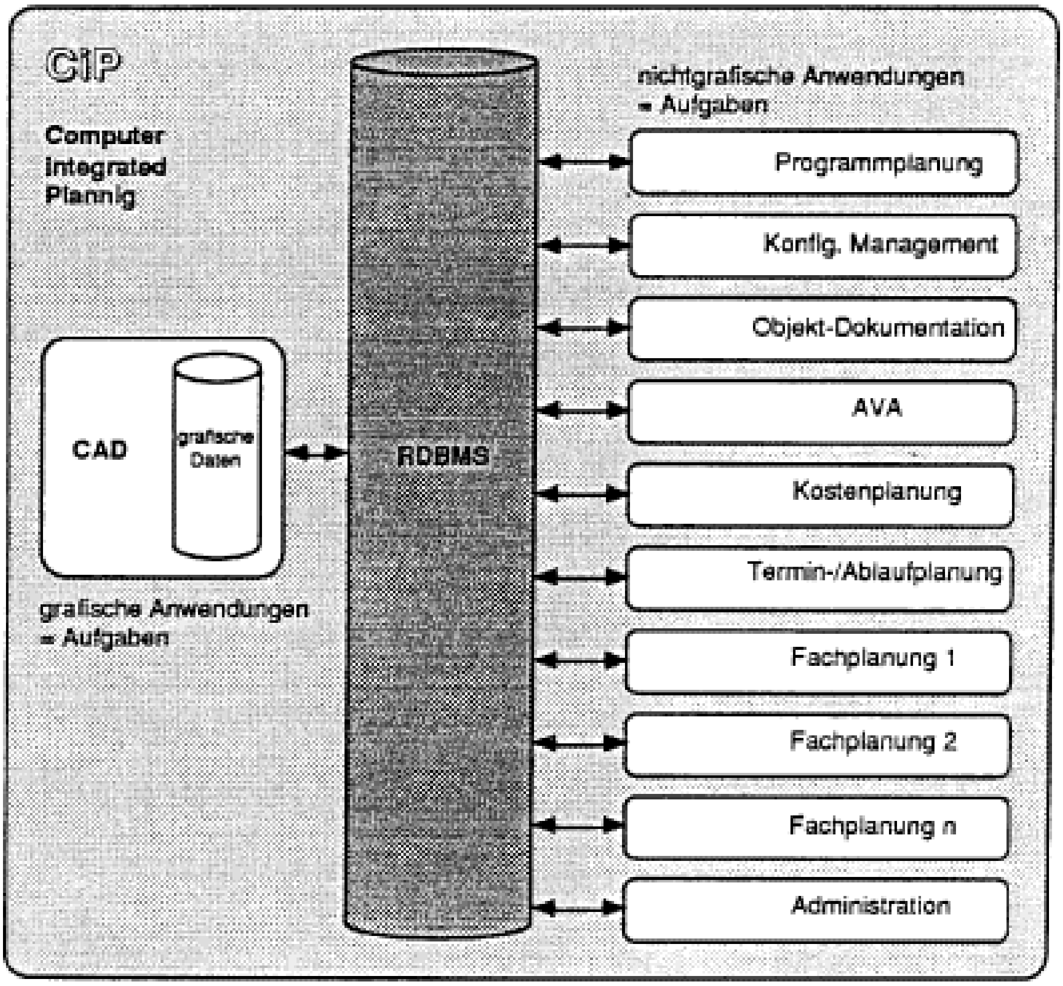
Technical concept for data exchange

To describe entities and attributes EDIFAKT uses qualifiers. These qualifiers can describe attributes themselves as well as parts of an attribute too.

The values. of attributes are described in a form, that can be used international without translation - if possible. For example you can describe the colour by giving the physical temperature of the colour instead the word of a language. If you transform the german word “ROT” in EDIFAKT, you use the equivalent physical value of red and then a man in France will understand "ROUGE" and an British will read “RED” at once without translation.

5. INTEGRATION BY RELATIONAL DATABASE SYSTEM

ISYBAU wants logical uniform databases in all offices containing all informations for the different tasks and evaluations with consistency and security. This can be only with physical distributed databases.



With regard to the different applications getting data from these databases the following scenarios are possible:

a) applications get the information directly from the database (for example with SQL), they have no datamanagement themselves.

b) applications have their own local datamanagement
   bl) with the same logical datamodel of the ISYBAU-DBMS
   b2) with their own logical datamodel.

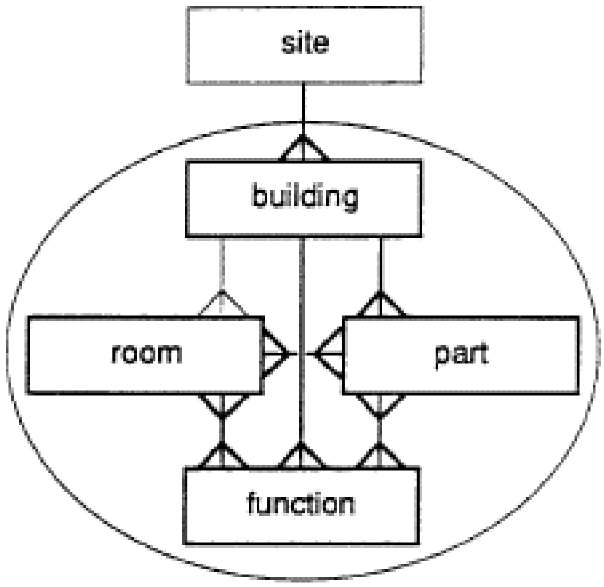
In case a) no data exchange is needed.

In case bl) data can be read, written and exchanged directly in/to "open" databases.

In case b2) an logical (and technical) interface is needed by the application to the central datamodel. This should be an standard interface.

7. DATAMODEL

The basis structure of the datamodel is given in the following picture: (The conditions are not shown)



Each entity in this model can be described with "dynamic attributes" very flexible. They can be classified and structured to the needs of the user.
An information is represented by one ore more entities and the relations between them. 50 it is possible to describe any object with any aspects at any time. More than one state of an object can exist in the database, but only one state exists in reality.
Basis for this model is the structure of a building with subsystems, which have relations between them. Every part of a subystems can be described in its physical, functional and local situation.

In this main structure exist substructures for different descriptions: parts
(consisting of) qualities general
descriptions

supported by static forms
variable checklists.

Within so called object versions all states of an object in its life-cycle can be distinguished.

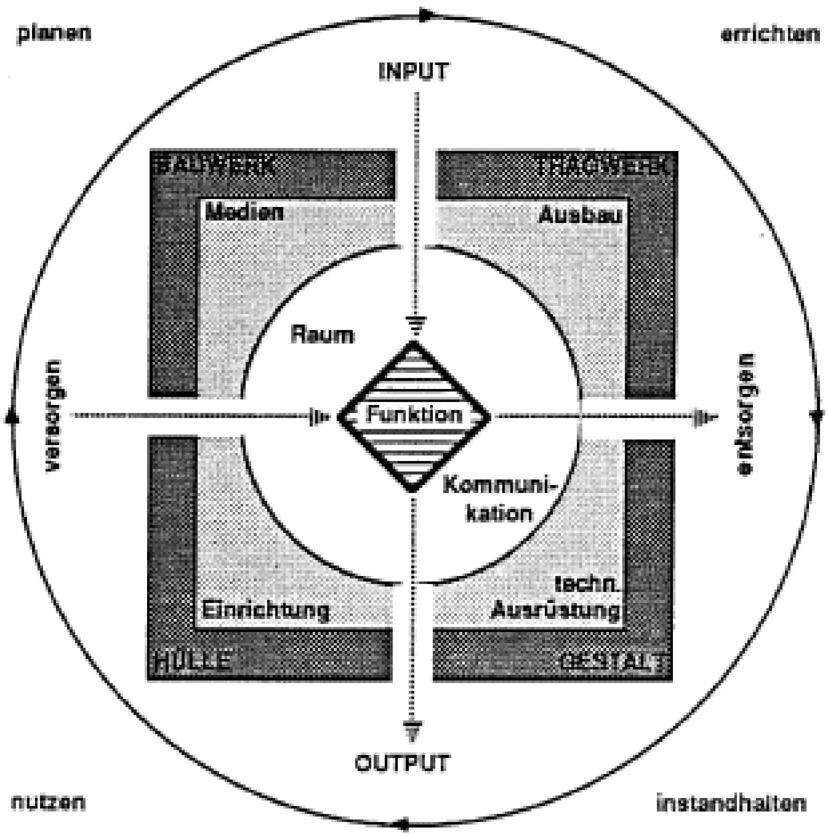
The informations of an object reference -> "Catalogues" and -> "Structures" for general detailing and classification purposes.

All data are supported by administration to guarantee consistency and security.

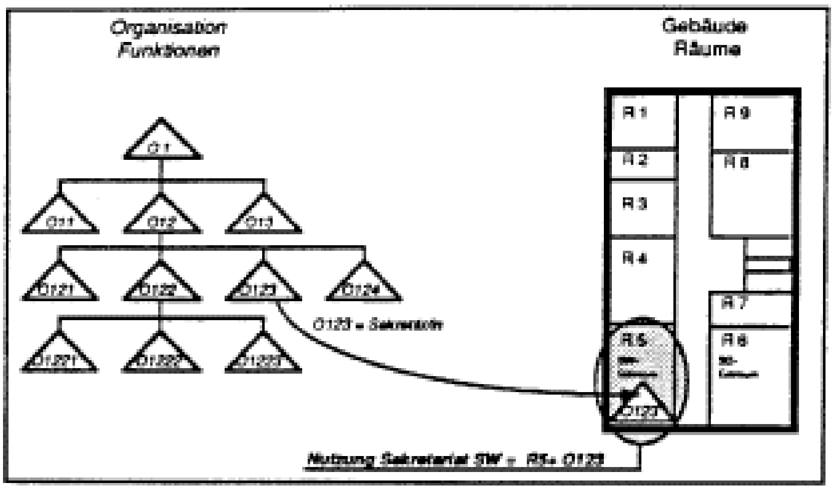
7. OBJECT = ∑ (SYSTEMS)

An object is a complex system,

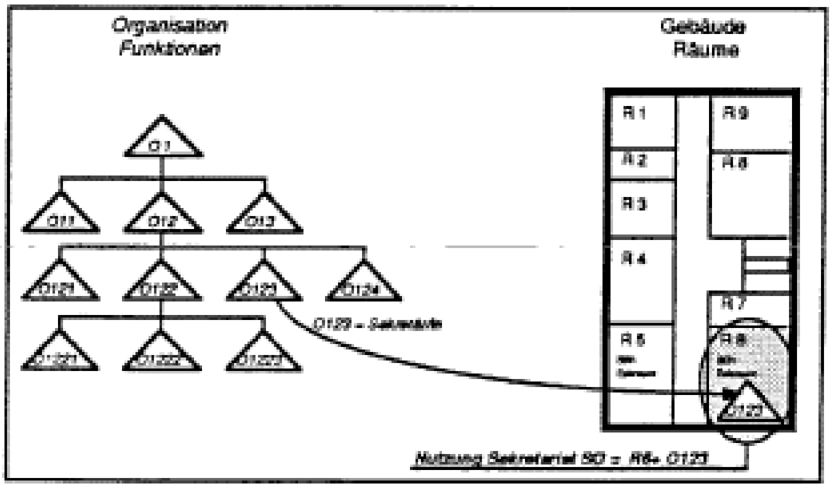
consisting of many subsystems:	- parts
	- rooms
	- functions, tasks
living with different processes	- supplying
	- producing
	- *entsorgen*
changing the building itself during its life through the stages of the object-cycle:	- design
	- construction
	- use + maintenance



8. USE = ROOM + FUNCTION



a)



b)

An example for a systemoriented approach is the use of a room:

Usually in the past a room was identified according to its proposed use, for example living room, children, sleeping room, kitchen, toilette, bathroom and so on. If the use of the room changed, the identification changed too, even if the room itself does not change at all! The use of a room was used to identify the physical room. In the design process this caused inconsistencies as long as no reorganisation of all documents and descriptions was made. This means a lot of additional work.

If you divide the identification of the physical room from the use of the room - you can see the room as container for a task / function - this problem is resolved: Changing the use of the room does not affect the identification of the room. Therefore it is good to make the following definition:

USE = ROOM < + > FUNCTION

The use is changed by breaking the old reference and making a new reference between the room (container) and the function, which resides in the room.

With this structure it is for example possible to analyze costs of construction or maintenance not only according to the structure of buildings, but also to the uses (functions) existing in the building.

9. COORDINATION OF INFORMATION

To organize and coordinate information you can use the following levels:

1. Object data	consist of the object specific informations
2. Catalogs	represent general informations
3. Structures	define logical structures through classifications in relational database systems
4. System data	organize informations and applications

A special problem in the project of ISYBAU is, that the meanings (semantics) of words of the different partners are very different. At this time we just try to make a synopsis of the important words used in the processes of design and maintenance. We try to find homonyms and synonyms and define then the "standard meanings" for this project. As this will be not possible in all cases we want to create tables of synonyms and homonyms. Perhaps this is useful in general, because an architect from southern Germany sometimes has problems speaking with northern people.

The definitions of describing attributes will be defined in general in the so called "MerkmalKatalog" (catalogue of attributes). This catalogue has to be maintained all the time by a central office. It will grew up in the years.
Also the structures will be defined and maintained by a central office, based on genera.1 standards like DIN 276 (costs of buildings).
Whereas catalogues change all the time, structures usually remain unchanged for long periods.

10. GENERAL DATA

10.1. Catalogues

Definition: Catalogues contain data, which can be used in general and be referenced by information of objects.
For example: A part, used in different objects, *WW* be described only once in a catalogue and then be referenced by the different object informations.

Examples:

1 . Article	parts, tasks, resources of different kinds
2. components	reciepes for components
3. Attributes	"dynamic attributes"
4. Kennwerte	of different kinds als Planungsgrundlagen
5. Standards	predelined solutions or values

...........................on demand

10.2. Structures

Definition: Structures keep ready attribute values for the classification and identification of information. They can be used to describe relations between different subjects and object in a building.

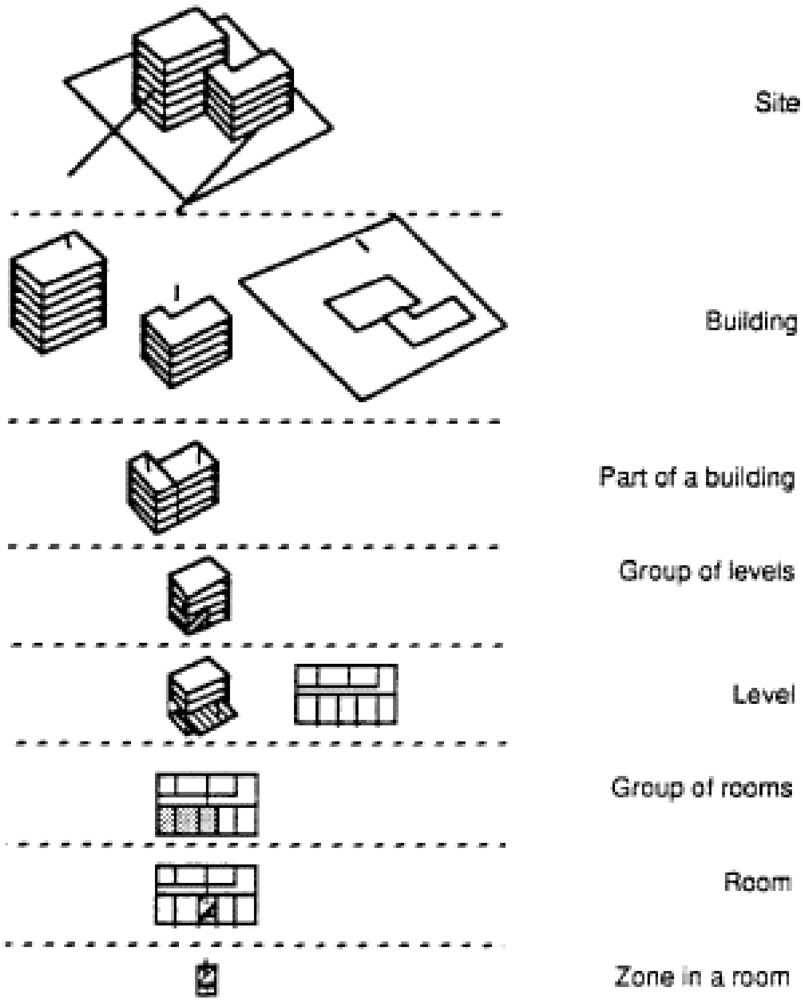
Examples:

1 . Object-Systems	Definition	subystems of objects
2. Kinds of object	Classification	
3. Structure of buildings	Classification	structure of construction
4. Stucture of rooms	Classification	rooms
5. Structure of functions	Classification	functions
6. Kinds of space	Classification	spaces (DIN 277)
7. Kinds of volumes	Classification	volumes (DIN 277, 283)
8. Jobs	Classification	jobs (VOB, STLB)
9. Articles	Classification	parts, jobs
10. Stages	Classification	stages of an object / in a project
11. Tasks	Classification	tasks, processes,
12. Partners	Classification	
13. Offices	Identification	
14. Costs	Classification	DIN 277,18960
15. Space-costs	Classification	cost for use and maintenance
16. Accounts	Reference	
17. Documents	Classification	
18. Attributes	Classification	
	on demand	

11. LOGIC LOCALISATION

As an example for structures the concept for logical localisation is presented:

Usually in different buildings different structures to identify the rooms are used. Theoretically a building can be divided in many hierarchical levels. In practice I saw, that nearly every building can be structured with 6 levels, so that all the needs of different users can be supported. As it is more efficient to use fixed structures than dynamic structures 1 prefer and propose the following structure:



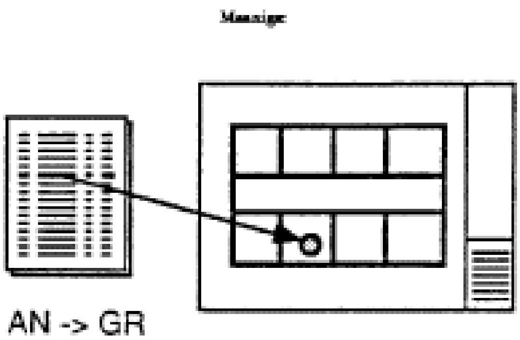
All of the 6 hierarchical levels exist in the computer codes, but outside the system only the necessary levels are represented. This can be defined for every object individually.

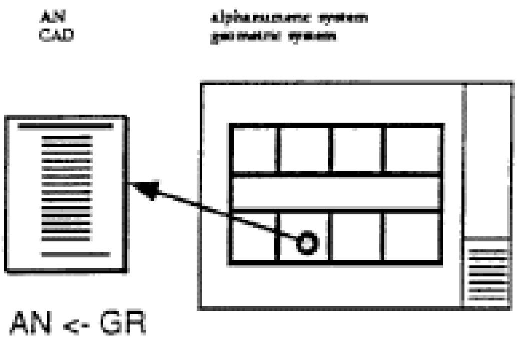
Besides this logical structure there can exist other structures too, for example geometric structures.

12. INTEGRATION AN-CAD

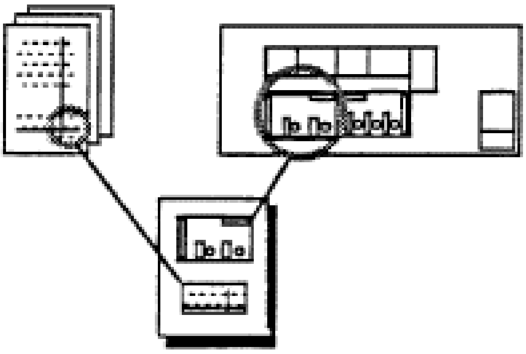
In the integration and communication of alphanumeric and geometric systems you can setup the following basic tasks:

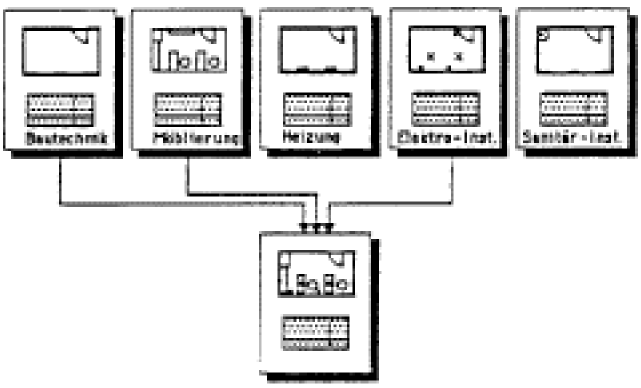
1	No redundance of information	AN	<->	CAD
2	Consistancy information	AN	<->	CAD
3	Qualification of graphical Objects Symbols	AN	>	CAD
4	Localisation of graphical Objects Symbols	CAD	->	AN
5	Geometric data	CAD	>	A N
6	Quantity calculation	CAD	>	AN
7	Selection by qualities -> graphical presentation	AN	- >	CAD
8	Selection graphically -> presentation of qualities	CAD	- >	AN





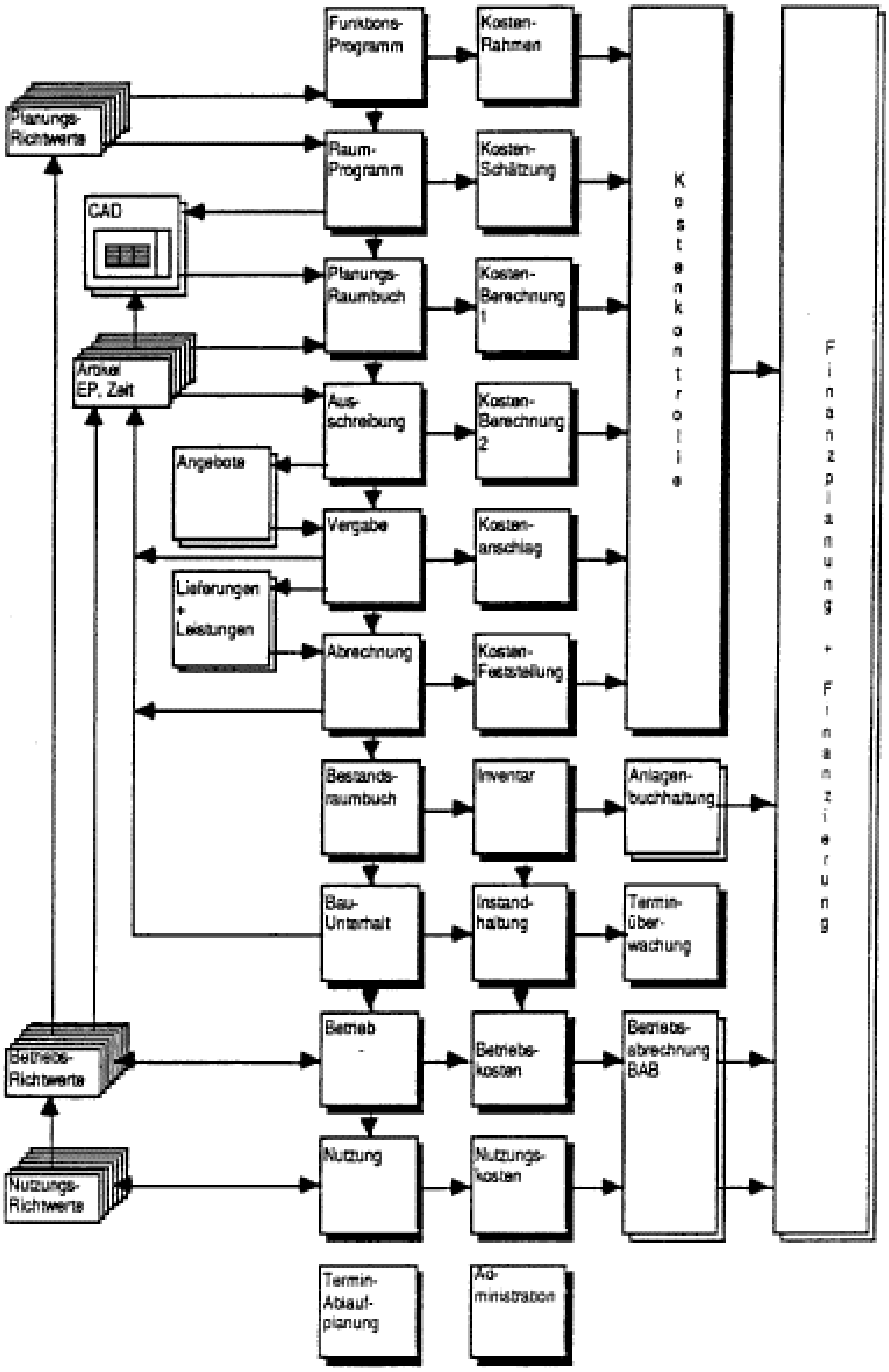
It should be possible to get graphical and quality information together in one document according to the logical tasks.





13. INTEGRATION OF APPLICATIONS

The following diagram represents the modules of a system, where the different applications are integrated by a relational database. This systems was designed and developed in the last years and is the basis for my research.



14. CONCLUSIONS FOR EDUCATION AND RESEARCH

1. Thinking in system

Buildings need to be seen as complex systems. Their subsystems have to be defined, their interfaces and dependencies have to be well known. Thinking, designing and presentation with systems is important as well in the analysis as in the synthesis of the design processes, especially using computer aided and integrated systems.

2. Educating a holistic view

Thinking in systems needs to see details together as a whole: The single subsystem must not be optimized without regard to the whole object as the major system. Every subsystem has to be worked on in spite of the its relations to the environment, the other tasks and sciences: The whole system is more than only the sum of its parts!

3. Coordination of our languages

A very important element of integration is communication. Different meanings of the same words is one of the most difficult problems of partnerships in projects and offices. It is necessary to get a common semantic standard in practicing an efficient integration.

4. Integration of Project - and Object - Management

"Project Management" is accepted in science and practice to manage projects as processes.
To manage the use and maintenance of buildings well is one of the most important tasks in the future. This is already known in the USA as Facilities Management. But as this word is too difficult to pronounce (not only for me), I propose to develop "Object Management" as science and profession of the use and maintenance of buildings. OBJECT as object in contrast to PROJECT in the meaning of the process as object of the activities.

Object Management, integrating all processes done on an object, will be of special interest in the future for integrating planning systems and for our society, changing from constructing new buildings to reusing existing buildings with less resources.

THE END

To integrate design, construction, use and maintenance in the management of projects and objects is an important supposition to get a better environment and better design processes.

Proper education and research for suitable tools are necessary, so that every architect and engineer can fulfill his tasks as a specialist as well as a generalist.

I would be glad if these concepts would initiate other projects not only optimizing existing tools, but also integrating our tools, information and tasks for

integrating planning systems