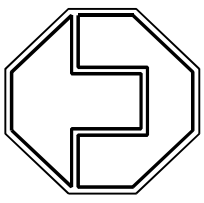
BERICHTE

PROF. DR.-ING. R.J. SCHERER * TECHNISCHE UNIVERSITÄT DRESDEN

INFORMATION

INSTITUT FÜR BAUINFORMATIK



RESEARCH AND LECTURE ACTIVITIES

2004

December 2003

The research of the ”Institute of Construction Informatics” has two different main branches, namely:

Applied Informatics and ***Applied Stochastics***

Areas of research are virtual organisation, knowledge management, engineering ontology, mobile computing, e-learning, risk management and earthquake engineering. The scope of research is not restricted to engineering problems but captures business problems as well.

The view of the brochure is directed to the future, i.e. what is planned to be done concerning new topics in 2004 based on the results achieved in 2003. New research topics taken up are: (1) networked business focused on dynamic, cross-sectional teams exploiting P2P and agent technology, (2) evolutionary aspects of building product and process models, (3) pattern method as supporting method for virtual organization implementations, for context-sensitive information management and interfaces, (4) IT supported risk management. Topics covered by current research projects and already outlined in past information reports are not repeated here for convenience. These are: Product Data Management for Concurrent Engineering and Virtual Enterprises, Legal Framework for a Virtual Enterprise, e-Learning, and Engineering Ontology. The latter is part and has meanwhile been further developed in most of our research projects.

The institute strongly promotes information technology in research and industry. Prof. Scherer is chairman of the European Association of Product and Process Modelling, which has been organizing its 5th conference in September 2004 at Istanbul. The conference again will bring together the leading European academic and industrial researchers and developers in ICT in the AEC area and the current European R&D projects in construction informatics will present their results. See *http://cib.bau.tu-dresden.de/EAPPM* or *http://2004.ECPPM.org)*.

Know how transfer to the industry has indeed a high priority for the institute. The institute is the national information point for the industry in the ProdAEC (www.prodaec.com), a network of European institutions, and is very active in international and national standardization bodies in the domain of IT related product, process, and document modelling. It holds several chair and vice-chairman positions in standardization bodies.

E-Learning activities and the mobile notebook university have successfully been continued. Also the European master course in construction information technology, co-ordinated by the University of Maribor, Slovenia, has made good progress and a first test course for the virtual university organized by CIB, University of Maribor and Carnegie Mellon University Pittsburgh, run in January and February 2003.

New EU R&D projects on concurrent engineering, mobile work on the construction site and virtual organization started in 2003.

In 2003, we were glad to host Prof. Svetla Vassileva of the Sofia University, Prof. Radev of the Russe University and Prof. Danjiel Rebolj of the Maribor University as guest professors at the institute, working with us in earthquake engineering and ICT in construction management.

Since 01/10/2003, the institute has been renamed from Institute of Applied Informatics in Civil Engineering into Institute of Construction Informatics. The German name has been changed from Institut für Baumechanik und Bauinformatik into Institut für Bauinformatik.

The staff at the institute has somehow changed in 2003. Steffen Scheler, Michael Eisfeld and Shumin Qiu decided to leave the research staff in order to concentrate their efforts on finishing their PhD theses in 2004. Gerald Faschingbauer and Ralph Stickl have joined the research staff. In November, Jalal Dabagh, a CE graduate of the University of Aleppo, Syria started his preparation time at the institute to become full PhD student. Further, Kamil Umut Gökce from the Technical University of Istanbul has already reached the status of a PhD student and will enter the institute soon.

Further information may be found at our homepage *http://cib.bau.tu-dresden.de,* which will continuously be updated to provide the latest state of our research activities. From there, the research and lecture activities report can be downloaded, too.

Dresden, December 2003 Raimar J. Scherer

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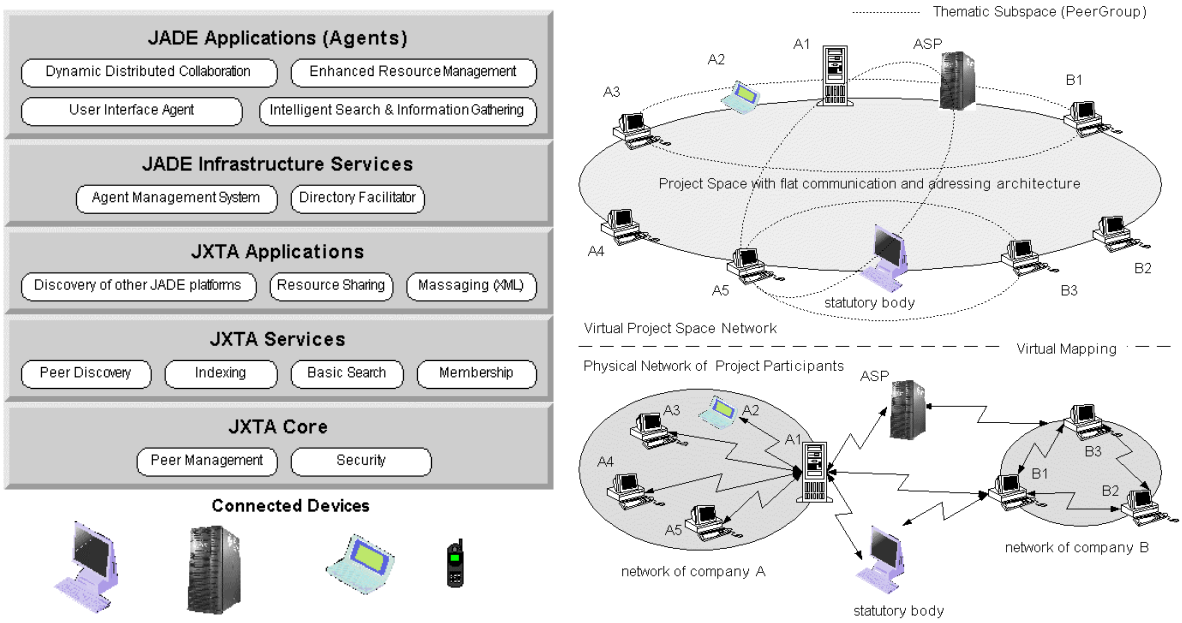
Generic Distributed Environment for Teamwork-Driven Collaboration in Construction

Alexander Gehre, Peter Katranuschkov

Objectives

Today's intra- and extra-network solutions are mainly based on the client-server paradigm used over the World Wide Web. In construction, where multi-company virtual organisations and complex one-of-a-kind products and events are dominant features, we need an efficient and highly flexible collaboration environment.

The objective of this research is to develop a generic distributed ICT infrastructure that can easily be adapted and extended to more specific application domains. It should allow to set up easily and user-friendly team-oriented information spaces, assembled ad hoc from different available information sources, such as dedicated project servers, corporate information systems, content service providers, and domain-specific ASPs, in order to (1) bring together physically divided services and users, (2) provide an efficient medium for ad hoc generation and sharing of content and context knowledge, and (3) enable flexible team-oriented information and knowledge exchange and management.



Left: Layered software architecture integrating Peer-To-Peer networking and agent-based technology
Right: Establishing of Virtual Project Spaces by virtual mapping to physical networks

Approach

The envisaged ICT infrastructure is based on a hybrid layered software architecture, as shown schematically on the left figure above. It combines the JXTA Peer-To-Peer (P2P) framework and the JADE (Java Agent DEvelopment framework) agent platform technology. The P2P Layers are based on the Super-Peer model. They establish a dynamic 'flat' network topology ensuring the overall technical interoperability and the basic information and resource management. The JADE agent technology layers leverage the underlying P2P functionality to provide advanced features, as e.g. intelligent automated processing of various knowledge-intensive and/or context-dependent tasks, automated information gathering, use of past cases, enhanced discovery and notification services. The merging of these two technologies in a unified approach significantly amplifies the potential of software agents, while relying on the smart and fault-prone P2P paradigm for building robust dynamic networks. Hence, distributed knowledge-based software agents can be build upon powerful software concepts like straightforward establishment of thematic sub-spaces (peer groups) within project spaces, and uniform and location independent resource sharing. In this way a secure, reliable and scalable information infrastructure that allows teamwork-driven just-in-time collaboration and flexible sharing of information, computation and human resources can be achieved.

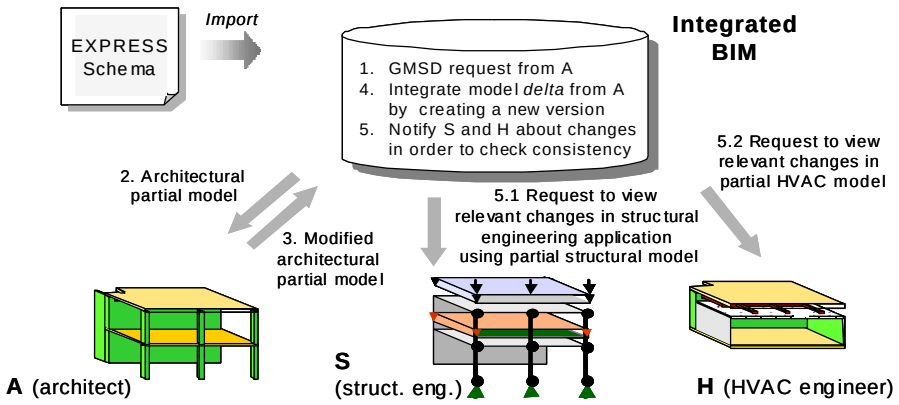
Methods for managing the Evolution of Building Model Data in heterogeneous environments

Matthias Weise, Peter Katranuschkov

Objectives

Two 'illusions' closely related to the use of product data technology (PDT) are that it subsumes no data loss and automatically enforces consistency. These illusions are cherished by solutions developed for closed idealised worlds, where all prototyped components are tightly integrated. For various reasons, such conditions are not fulfilled in practice: (1) existing standard building information models (BIM), such as IFC, are supported with significant variations w.r.t. their interpretation and quality of implementation, (2) domain models do not provide the necessary knowledge to manage consistency, and (3) software applications use their own specific historically developed internal data structures are to less harmonised and hence loss of information results.

The objective of this research is to provide an open server-based environment that enables gradual evolution of the model data via various applications used in the course of design work, and takes into account existing practical considerations. Within this context, the re-integration of modified partial models based on a general model subset definition schema (GMSD) , which uses heuristic matching algorithms. The methods will be evaluated by applying the ratio of additional user interaction/'degree of data loss'.



A typical model evolution step

Approach

We focus on the development of a set of generalised data management methods allowing to keep track of the evolution of the design data. The management environment is comprised of (1) a late-binding schema import module enabling the handling of different EXPRESS-based data models, (2) a data versioning module enabling version management on instance and attribute level combined with user input for audit trail, (3) a module for partial model management using a novel *General Model Subset Definition* schema (GMSD), (4) a module to store and handle bi-directional mapping relations on instance level, and (5) a module for fault-tolerant creation of version graphs, with automatic detection of the differences (deltas) in the data structure of two model versions to support model check-in/check-out by legacy applications. These services will allow to reduce data loss, support run-time mappings between partially harmonised model data, facilitate (semi-automatic) consistency checking, and enable change notification.

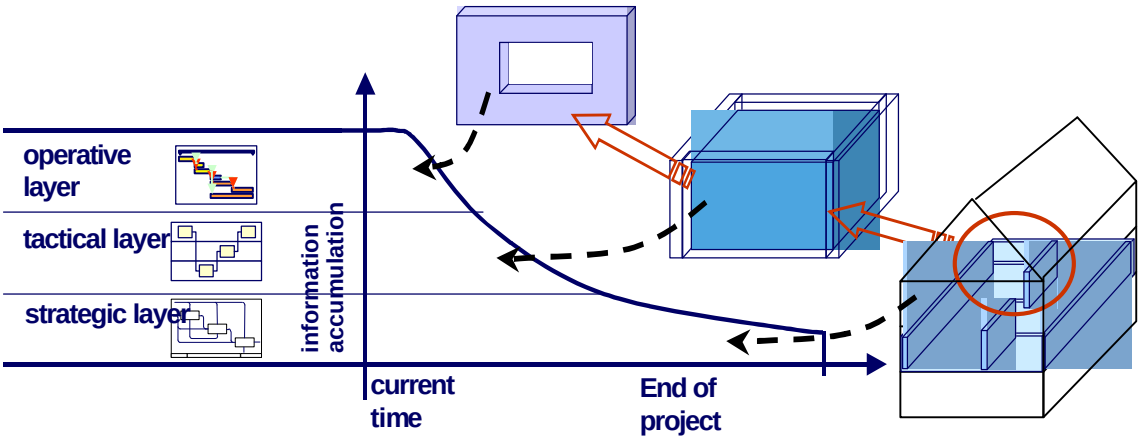
The essence of the approach is in the use of a *version model* storing delta changes of the product data, complemented by methods for extracting model data subsets defined by pre-defined or ad hoc GMSD queries. Their interaction provides the basis for re-integration of modified partial model data. Most critical with regard to data loss and scalability is the estimation of *refinement relationships* by the creation of version graphs. Since object identifiers are often not available or not properly supported here heuristic and incremental iterative methods need to be used. The check-in/check-out process illustrated on the figure above follows a stepwise divide-and-conquer strategy to reduce computational complexity. The proposed approach avoids the current limitations of data integration to a tightly harmonised 'least common denominator'. Thus, it can provide more independently interoperable software applications than currently possible. The proposed approach avoids the current limitations of data integration to a tightly harmonised 'least common denominator'. Thus, it can provide more independently interoperable software applications than currently possible.

Evolutionary Process Models for the Building Industry

Martin Keller, Karsten Menzel

Objectives

In contrast to the predefined, predominantly fixed processes in most industries, the processes in AEC/FM are extremely dynamic. Technical conflicts and modified goals lead to ad-hoc changes of the initial workflow. Sometimes, even minor modifications in the architecture or the bearing structure of a construction can lead to heavy impacts to succeeding processes, and hence, to unexpected costs. Therefore, gaining better information about the prospective tasks would enhance decisions made during the run of the project. To achieve this common principles must be established throughout the building processes, that allow to flexibly combine design objects and work process information in accordance to the underlying organisational model. Consequentially, there is a requirement for an overall model framework representing the different design, construction, operation, and management processes that integrates specific process and product models used for different domains and granularities.



Integrating process models with building product models

Approach

Building product models like the Industry Foundation Classes (IFC) are supporting object-oriented paradigms, and thus, the composition and decomposition of a construction as well as the extraction of different partial models is possible. Combining the building product models with process models leads to an overall project model where modifications of the construction can automatically indicate or even trigger changes in the workflow. Thus, decisions are supported by their effects on the construction processes. With this approach an evolutionary process model can be derived by automatically instantiating the appropriate reference process from a Process Pattern Library in combination with the design objects involved. Such a system would be able to mediate between the building product model and the process information. To achieve that, an intelligent engineering ontology is being developed which contains the same information as the product model, but organised in a new structure, more appropriate to support process information.

To accomplish this, firstly common design and construction processes in the building industries are identified and the appropriate representation model is determined. For this purpose, three layers of granularity for the different stages of the design and construction process are identified:

- strategic layer – global project information (uses spatial information, main structure, utilisation)
- tactical layer – domain flow charts (detailed design processes)
- operative layer – detailed scheduling (construction tasks)

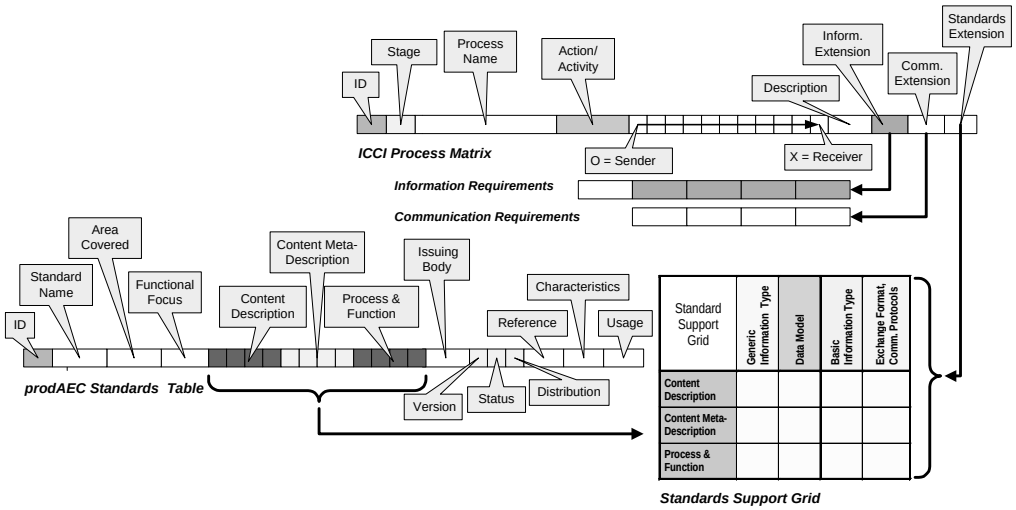
In a second step corresponding design information for the three process layers are determined and performance parameters will be identified. The final ontology realisation will be capable to represent the building product data in an adequate format that can be used as input to the process models. For this purpose an already developed engineering ontology will be used as basis.

A Method to Meet Business and User Requirements with ICT Standards for eBusiness and eWork

Sven-Eric Schapke, Alexander Gehre, Peter Katranuschkov

Objectives

The business impacts of ICT standards supporting information classification, communication and data exchange often lag behind the benefits formerly anticipated with its development. Reasons for these shortcomings are on the one hand related to the current development procedures with long development cycles, limited coverage of business and technological aspects, numerous competing specifications, and lack of appropriate complementary standards. On the other hand, the effective deployment of standards is also aggravated by insufficient clarity of the business and ICT requirements. For a well directed application of information exchange standards these requirements need to be specified (1) holistically, supporting various disciplines and application areas, (2) explicitly, to provide for identifying shortcomings and incompatibilities, and (3) with adequate expressiveness, to allow for evaluation of the overall business impact. The goal of this research effort is to combine methods for harmonising user requirements in a Reference Process Matrix, as suggested in the EU Project ICCI, with methods and data structures enabling proper selection of applicable and appropriate ICT standards. The interlinking of reference processes with applicable standards will provide for better identification of standards supporting critical business processes, standardisation gaps within single processes, and the overall standards collection that needs to be bridged to leverage the full potential of standardisation.



Schematic presentation of the Process Matrix associations with the Standard Support Grid

Approach

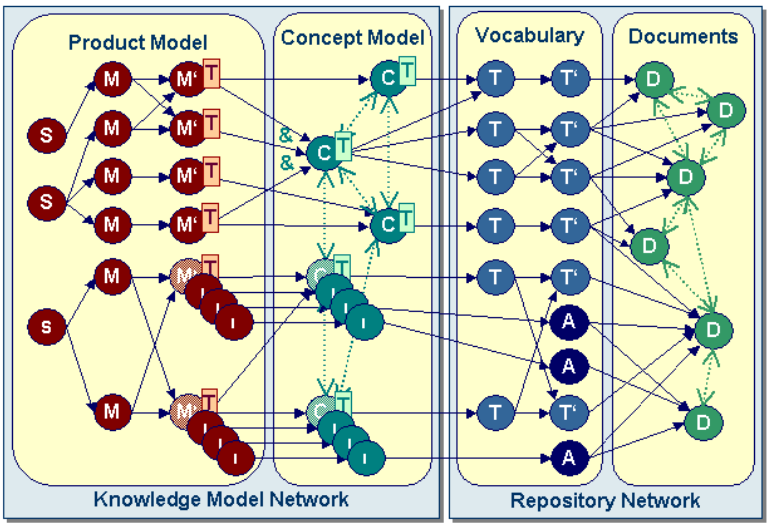
The core of the developed approach is the interlinking of ICT standards for meta data, information exchange, communication and process management to formally specified reference processes, based on an evaluation of their scope, applicability and openness. It builds upon the ICCI Reference Process Matrix enabling to capture reference processes and sub-processes, together with their relationships, involved actors, their roles, and associated communication and information requirements. Based on these user requirements detailed ICT requirements concerning (a) classification of information, (b) data models, (c) metadata standards, and (d) exchange formats and protocols are specified. Standards are analysed on the level of content, content meta-description, and procedural / functional specifications, classified in accordance with their major features w.r.t. one or more components of the process matrix and the related information and communication requirements, and then structured into a Standards Support Grid. The so classified standards are then organised into sets of complementary interoperable specifications to support an overall business process. This approach allows to identify standardisation gaps by analysing the separate standard sets in the matrix. Furthermore, by associating completed sets with respective reference processes these gaps can be further evaluated and the single as well as the overall support of each set can be measured. By pre-selecting relevant processes, migration strategies for deploying standards in a specific business areas can be evaluated and necessary complementary developments identified.

Retrieval of Project Knowledge from Heterogeneous AEC Documents

Sven-Eric Schapke

Objectives

In the building industry project and corporate document repositories provide the most comprehensive collections of business and engineering knowledge. Unfortunately, most knowledge is retained only implicitly in isolated and poorly structured text documents. Thus, identifying content and re-structuring it in regard to the context in which it is needed accomplishes a first step towards knowledge externalisation and combination. Especially product models are expected to provide the necessary background knowledge for contextualising and re-organising the collected information in regard to an individual's mental model. The research project explores methods for analysing text documents and its interdependencies to explicitly represent the content of text corpora in semantic networks. The knowledge encoded in engineering and product models is used to reduce the networks diffuseness and optimise it in regard to a user's context. Furthermore, the established links between documents and product models provide for navigating a text corpus through a related product or concept models.



Five steps to context-specifically structure project information

Approach

A four-layered Bayesian inference network is used to model the corpus reconfiguration task as an evidential reasoning process. Using a vector space model approach, self-contained document fragments are indexed and a preliminary document map is generated based on their semantic similarities. The interdependencies among terms and documents stemming from the analysis and external thesauri are represented in a two-layered repository-network. A respective knowledge-model-network is build from the product data model to be applied to the corpora. In an a-priori configuration, the class-nods are manually labelled with corresponding keywords. On the concept-layer personal configurations and views of the product model are presented. This layer provides for re-labelling classes and filtering certain schemata or levels of abstraction as well as it could be used to aggregate classes into more meaningful concepts. A matching between the terms of the knowledge-model- and repository-network allows for propagating believes about important concepts, terms, and their interdependencies. Based on the so controlled vocabulary, the document map can be re-calculated and further optimised (e.g. clustering). Thus, highlighting aspects in the concept-model-network, the user can intuitively reconfigure the document map. Inference methods adapted from Bayesian network algorithms provide for efficiently updating the believes in the network and learning from user feedback.

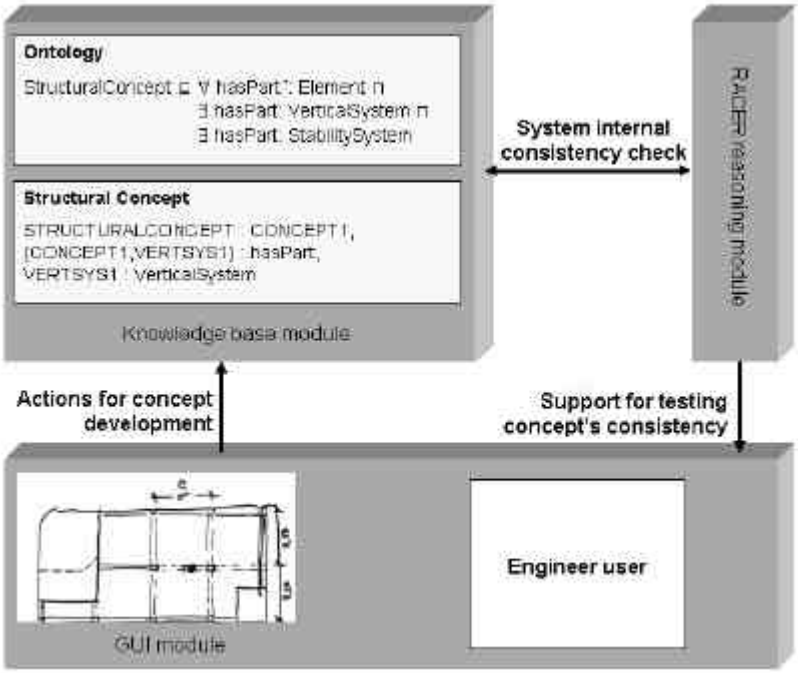
With the inference network it is furthermore possibility to consider various document features in parallel. In the case of populated product models several instances of a single class are represented. In addition to the general terms in the vocabulary more specific metadata or text attributes, verified e.g. with information extraction methods, can be used to determine whether a project document is associated with a particular instance of a corresponding product model.

Logic-Based Assistance in Conceptual Structural Design

Michael Eisfeld

Objectives

Given codes cover only element specific safety and serviceability requirements but leave out the integrity of the structure in terms of load transfer and stability, denoted in the structural concept. Commercial software for computing internal forces and detailed design does not assist the engineer in designing for overall structural integrity because it lacks methods to reason about the structure represented by incomplete information at the conceptual design stage. As a result, designing the structural concept is left to the engineer without assistance. The aim of this research is to reduce iterative cycles by a logic-based method assisting engineers in conceptual design of multi-storey reinforced concrete structures. To achieve this, the system has to represent the conceptual knowledge about conceivable correct structural concepts in a formal *ontology* in the knowledge base, to provide *actions* for the development of a *structural concept* to the user via a GUI, and to *support* testing of the concept's *consistency* by logical reasoning.



Architecture of logic-based assistant

Approach

The assistance is based on a logical structural model encoded with precise semantics, stored in the *knowledge base*, on which the logic-based method can reason about implicit information to support the concept development. The assistant uses the expressive description logic $SHIQ(D)^-$ that we need to represent the conceptual knowledge about qualified load transfer relations among structural elements, their organization into structural systems by compositional relations, and gross-sectional limitations. The logic represents the ontology in a transparent way, since it has a formal semantics, which together with the structural concept obey the model relation. This is especially important for traceable reasoning support being not hidden in the software and incremental ontology evolvement. The logic-based method uses a tableau algorithm modified for finite model construction and local closed-world reasoning to test the structural concept's consistency.

During the design process, the assistant system constantly checks by model construction whether the current structural concept remains consistent with the ontology. The engineer is prompted whenever necessary to revise the developed structural concept to regain consistency or to introduce missing support relations for structural elements to ensure global load transfer.

A Pattern Language to Support SMEs Implanting VO-Networks in A/E/C&FM

Karsten Menzel

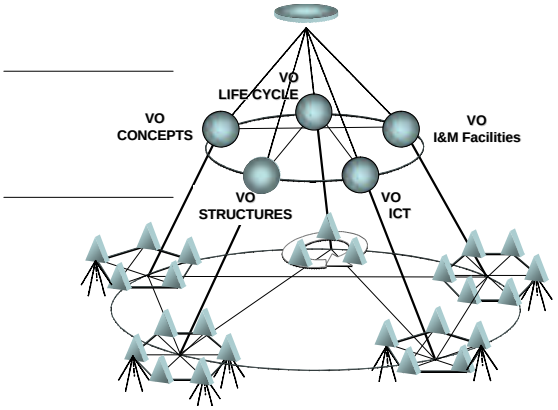
Objectives

The pattern-based paradigm is well established in both, the field of architecture as well as the field of informatics. It is used to support the design of built artefacts and software systems. However, this approach can also be extended to develop an implantation strategy for VO-network structures in the building industry and the area of facilities management. Based on the results of various research projects, such as IuK-SystemBau, VOSTER, PORTIKO, E-Sharing, ISTforCE, and iCSS the development of a pattern language to support a flexible workflow and resource management as well as to support context-sensitive information management and representation in VO-networks is the goal of the following research approach.

Approach

Pattern languages have a network structure. This structure is described in different levels of detail. Thus one pattern can be described in more detail by using a sub-network of additional patterns and its relations. It is suggest to use the VO-implantation patterns in a sequential, top-down approach. The user shall start by applying general patterns to generate the overall VO-framework and continue by applying life-cycle specific, more detailed patterns in order to manage and control the Virtual Organization.

In the following, the five major classes of patterns are explained:



- *VO-Concept patterns* define the overall VO-framework and map societal, political, environmental aspects towards the specific VO-goals. The application of VO-concept patterns is one major pre-requisite for the definition of VO-structures.
- *VO-Structure patterns* are used to establish the primary VO-structure. The VO-structure must be developed in compliance with restrictions of the secondary internal organizational structure of the participating organizations. However, internal organizational hierarchies will not be assigned to the commonly used VO-structure.
- *VO-Life Cycle patterns* support the generation, operation, adaptation and dissolution of VO-structures.
- *VO-Information- and Communication patterns* allow to easily operate and manage VO-structures in an efficient, complete way by developing a well balanced, open, distributed ICT-concepts.
- *VO-I&M Facilities patterns* support the implantation of appropriate, modular and flexible VO-infrastructure systems. Such systems must be incrementally extendible, re-configurable. Furthermore, such components shall consume minimal resources when operated. Finally it should be possible to re-built them stepwise and re-use parts of them in other configurations. Immobile and mobile Facilities shall support specific VO-concepts and VO-structures.

Within our research group, we are currently working in three specific domains:

- **VO-Structure patterns**, describing tasks, equipment and roles are currently under development as contribution to the EU-project *E-Sharing* (Ulf Wagner). The ability to merge VO-structure patterns leads to VO-Life Cycle patterns.
- First examples of **VO-Life Cycle patterns**, *describing the initialisation and operation phase* were developed by Martin Keller within the *ISTforCE* and *iCSS*-project. They were additionally evaluated in a cross-sectorial context within the EU-Cluster project *VOSTER*. The necessary integration with product models is described in more detail by Martin Keller and will be performed within the *ArKos*-project.
- **VO-Information- and Communication patterns** to support the application of mobile, ambient-intelligent systems on construction sites are currently developed by Karin Eisenblätter as part of the project *IuK-SystemBau*.

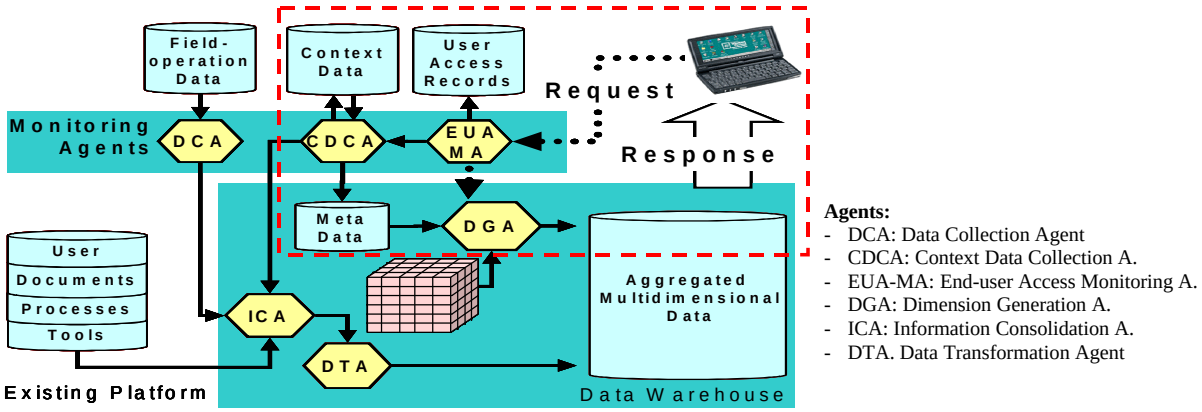
Effective Mobile Work through Context-Adaptive Mobile User Interfaces

Karin Eisenblätter, Karsten Menzel

Objectives

Current designed user interfaces are mostly not able to adapt to specific individual working scenarios. A working scenario is the context in which a user interface is used. The lack of the context-adaptive qualities increases the barrier for workers to fully exploit the potentials of mobile devices/systems. To successfully achieve the goal of effectively supporting mobile e-workers and contributing to an increased project performance we will enhance mobile IT-systems with highly adaptable mobile user interfaces and underlying intelligent services, providing workers with mobile, easy access to information.

The overall research objective is to propose a strategy that will *seamlessly integrate* mobile computing into the working environment – *the construction site*. To ensure early end-user involvement rapid-prototypes of mobile components, including multi-dimensional data management and adaptive user interfaces, will be developed. Current research objectives are focusing on: (1) the development of a context framework for collaboration scenarios in AEC through a pattern-based approach, and (2) The set-up of a multi-dimensional data management system based on agent technology.



N-dimensional data management system, data sources and agents
(the dashed frame indicates current research efforts)

Approach

We use the term *context* to refer to an AEC-specific working and collaboration scenario in which an actor is using a mobile device to obtain, enter or modify information that s/he requires to accomplish his/her activity at a location and time under specific environmental circumstances. Using *context parameters* to describe these scenarios, we will map each scenario to a so-called *context pattern.* A pattern describes the rules for the configuration and adaptation of a mobile IT-system, or more specifically for the adaptive user interface and its underlying information management structure. The *context framework* lays out the hierarchical order, relations and dependencies among the various *context patterns*. Our results will be validated with already investigated and analysed AEC-specific working and collaboration scenarios.

Software components will be designed and implemented reflecting the requirements and rules described in the *context patterns* supporting dedicated system features (e.g. representation, navigation, information retrieval). Suitable methods for generation and configuration need to be identified and developed.

The IT-system will comprise a multi-dimensional data management system combined with agent technology to manage properly collected data and generate appropriate dimensions for on-site information delivery. Agents are used for collecting, consolidating, aggregating, and representing data within the mobile information management system. For example, the *context data collection agent (CDCA)* and the *end user access monitoring agent (EUA-MA)* contribute to the collection of context data and user behaviour. They enable the identification of appropriate *context patterns* and trigger the configuration of the system. System configuration will be supported by the *dimension generation agent (DMA)* that will adapt the dimension-specification of the data cube according to current, up-to-date collaboration scenarios and user preferences.

Integrated Resource Sharing and Management

Ulf Wagner, Karsten Menzel

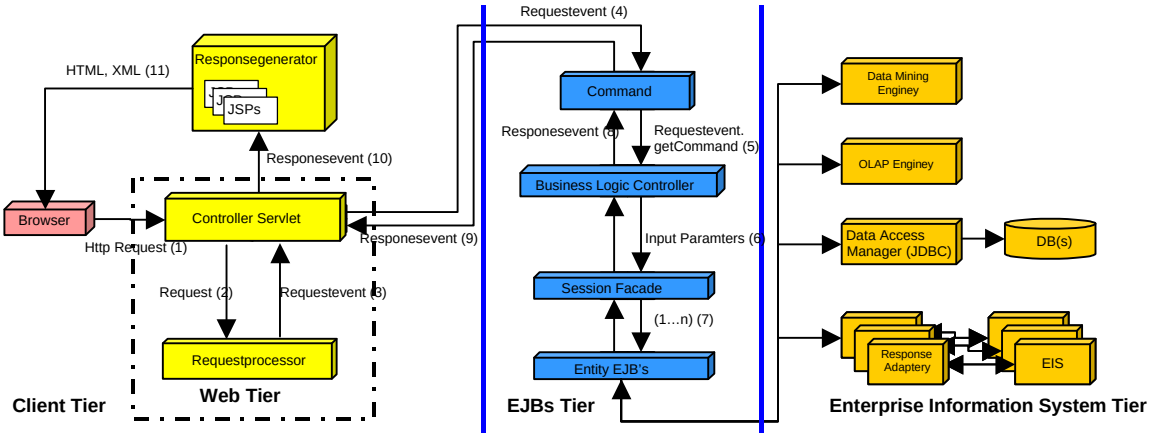
Objectives

The utilization of equipment or human resources depends on contract situation, which fluctuates strongly in the AEC industry and hence idle resources are an important cost factor. This is more pronounced for small enterprises, which often does not have the financial background to buy expensive equipment and does not run the high risk to use it only for one project. Therefore a *sharing system* for idle resources, brings both sides, lesser and lessee a competition benefit.

Resources that shall be shared and managed in the envisaged sharing system can be of any type, e.g. human resources, office space, equipment, or warehouse space. These resources will be managed by an bidder system, which offers both sides best possible prices based on a *data warehouse* for the offered resources. Therefore, an *integrated resource & task type model* is necessary. This model will support intelligent decision making within *Virtual Organisations* in two ways. Firstly, by holistically and effectively describing complex tasks that need to be accomplished and secondly by immediately proposing an appropriate selected combination of necessary resources.

Approach

The suggested resources are selected from a virtual shared resource pool that includes the company-users own available resources and the idle resources from other VO-members. The selection of the resources is based on several factors such as productivity, leasing costs, functional costs, possession costs, time constraints etc.



Structure and functionality of the Sharing system

Three types of resources are for lease within the sharing system: *equipment*, *tasks* and *roles* (describing *qualification profiles*). These resources will be described by a specific *XML-meta schemata*. With it, a generic, pattern-based description of all possible *resource types* will be created. These meta schemata are stored in an object-relational database, which is managed by *enterprise java beans* (EJB). Schemata for *tasks* and *roles* are corresponding with each other. Within the sharing environment the meta schemata will be maintained and continuously updated by the provider of the sharing system. They are designed in a way that the administrator can add, delete and modify these schemata during runtime and use the shared system via *Java Server Pages*(JSP).

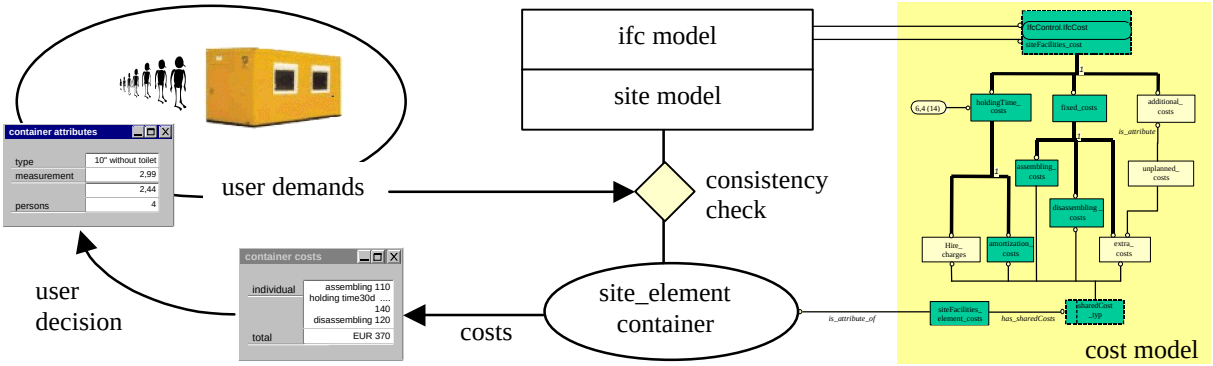
Complex assignments of different resource types can be created by combining the complementing patterns represented by meta schemata to a complex but holistic *assignment*. In order to merge the specific schemata it might be necessary to map certain schemata into a common data structure. For example the requirements of a *task* will be fulfilled by using the potentials of the *equipment* used. The operation of a specific *equipment* needs a dedicated qualification (*role*). Therefore, both sides (lesser and lessee) have to commit to a common ontology. The task might be described as: '*excavate pit*' and the equipment is specified as: '*excavator shovel*'. Consequently, the equipment has to be mapped into 'can *excavate the pit'*. This will be provided by a mapping specification based on a common ontology.

Model-consistent, Cost-controlled Approach for Construction Site Installations Planning

Steffen Scheler, Peter Katranuschkov

Objectives

A fast cost estimations for site facilities, without deep and detailed cost-volume-profit analyses should be achieved by applying normative and heuristic rules from engineering, together with typical construction knowledge of site installations. For fast and consistent interaction, an evolutionary site model is developed to accommodate changes due to partial modifications of the initial (design) product model for site installations. This would enable more accurate comparison of different alternatives to provide for adequate scheduling of the site facilities costs depending on the design cost estimation and the actual construction progress and needs. Typically, at construction start site installations and the related product model are simple (e.g. a few containers). During construction it will grow to a large and complex product model, when more and more will be added and moved as well. Thereby the cost summary of the resulting more complex site model will also change, but not the cost model itself.



Cost structure of the site element "container" depending on the current placement in the site model

Approach

The kernel part of the site model defines the placement and the global position of the whole site installations. It is comprised of partial models for the different basic types of site facilities. A dedicated geometric model and the cost model complement the site facilities model to specify additional characteristics for the needed dynamic site simulation. In our approach the cost factor is extracted from the instantiated knowledge base depending on the model structure filled with the objects corresponding to the chosen solution. A separate cost model derived from the IFC model specification enables the tackling of costs independently of the other partial models in the framework. In the cost domain, three basic types are distinguished: (1) holding time costs, (2) fixed costs, and (3) additional costs, which are integrated in the site facilities model in view of future model extensions. Currently the latter are simply related to the extra costs which are a subtype of the fixed costs.

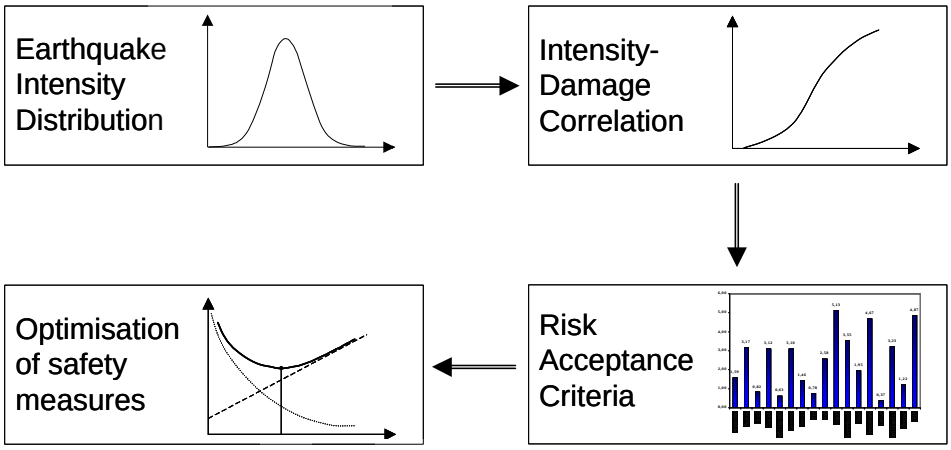
The instantiation of these elements in a pre-defined class hierarchy is realised by using a dynamic classification method based on description logic. Whenever a partial model is modified (e.g. social facilities, more complex container), the instances of the whole model – respectively linked to the pre-defined elements -, are analysed and, if necessary, re-classified to reflect the changed structure. In contrast to the typical object-oriented approach, the instantiation process is not a simple assignment of values to object attributes followed by association of these objects to respective classes. Instead, object classification is performed dynamically, governed by value ranges determined on the basis of cost estimation elements in the knowledge base.

Risk Management for Earthquake Hazards Based on Risk Acceptance Criteria

Gerald Faschingbauer

Objectives

Risk management for earthquake hazards is an optimisation problem. The target is to find the best possible safety measures against earthquakes. The decisions to be taken in this task are of high importance, due to the tight financial situations in the national budgets of the most concerned countries. If there is a need to consider seismic impacts, determining risk reduction measures leads to difficulties. It is a complex task to specify the repercussions of a specific earthquake on a structure. In order to make the structural effects of an earthquake and the damages out of it computable, a great number of impacts ought to be considered. Moreover, it is difficult to specify the effectiveness of mitigation measures (rescue measures). The purpose of the research is to bridge this gaps and develop an economic decision supporting system using a simplified approach of cost-benefit-analysis, which enables to estimate the optimum design parameters for seismic design. Furthermore it is envisaged to give economic decision criteria for the implementation of mitigation measures. Recent developments in the field of risk acceptance criteria for structures are considered to derive cost-optimal earthquake design and risk management in seismic regions.



Earthquake Risk Management Methodology

Approach

Input for the Risk Management Process are data bases of environmental data like hazard values in urban scale, local site conditions, building development including classification of building types, vulnerability functions for each building type and test results. This input provides the pre-condition for estimating citywide damage distributions and generating earthquake loss scenarios. Based on this information safety measures can be optimised using a simple methodology. The methodology consists of four steps: (1) Probabilistic representation of earthquake intensity: the random peak ground acceleration for a specific region or country is probabilistically evaluated as a function of its influencing parameters, i.e. source geometry, magnitude model (including uncertainty of the upper bound magnitude), occurrence rate, error term. (2) Probabilistic assessment of the correlation between earthquake intensity and structural damage (vulnerability): results from recent earthquakes are included to present the damage probability matrix for several building classes; the associated model uncertainties are taken into account. (3) Formulation of risk acceptance criteria based on the Life Quality Index LQI Approach: by using this approach an optimum acceptable cost per averted fatality (ICAF) can be derived for a specific country. (4) Optimisation of safety measures based on the aforementioned risk acceptance criteria: safety measures against earthquakes such as preventive design (safety factors) or mitigation measures (disaster planning, emergency management, emergency personnel training, rescue and response, community education, information and mass-media, simulated earthquake exercises, medical preparedness) can be optimised by comparing the relative measure costs to the aforementioned ICAF and by considering their risk reducing effectiveness (based on experience and risk analysis background).

An Approach for the Selection of Strong-motion Records by means of Data Mining Methods

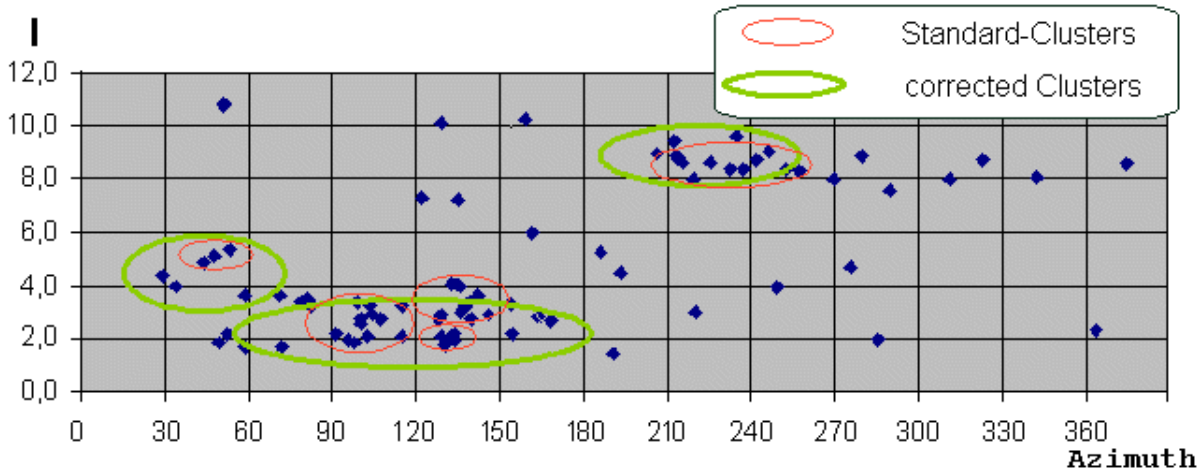
Jörg Bretschneider

Objectives

In the framework of realistic dynamic analysis, real acceleration time histories are preferred in order to examine the structural behaviour under the corresponding load impact. Such time histories are either simulated or manually selected from a plenty of real, recorded data according to design requirements and seismic information. Selection criteria are based on experienced, but nevertheless subjective knowledge and few indicative parameters, which do not sufficiently take into account the non-stationary and three-dimensional character of seismic ground acceleration in a satisfactory way.

A considerable improvement of the selection process would be the use of a parameterized non-stationary load model based on geo-topographic and seismic information instead of using a few general seismic parameters. The bottleneck is the classification process, which is too slow and too cost-intensive when carried out by hand. Therefore, the usability of Data Mining methods for automatic classification will be examined and a software-prototype with graphic user interface will be developed, for the demonstration of the classification and determination of suitable records to choose for a particular case. In order to rely on a secure statistical basis and to meet the practical requirements of the user, the database must be extendable and automatically re-classifiable.

Cluster analysis for intensity with and without proximity correction of recording sites



Approach

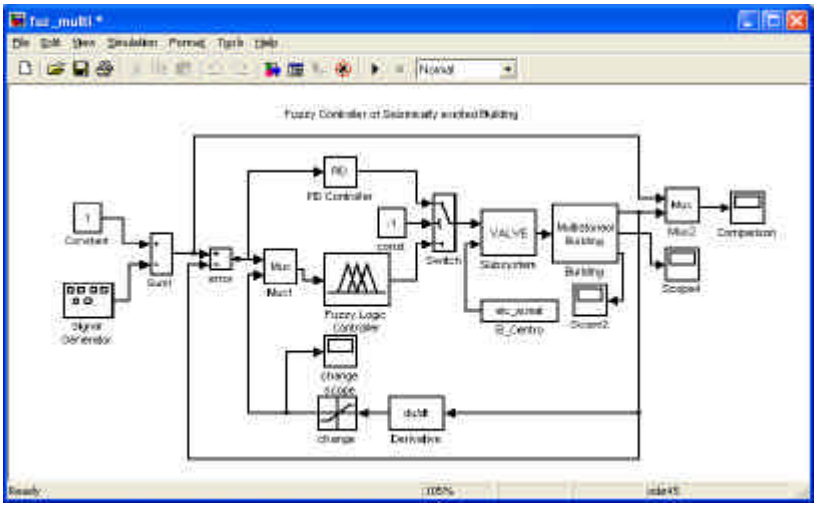
Recent research results on non-stationary, seismic parametric load models like the wave-based evolutionary model (see 2002 and 2003 reports) will be used for the development of novel classificatory methods, which are stick on physically interpretable parameters, as are energy of incident waves, soil layer damping, hypo-central distance, and this way directly on the physical process of ground acceleration. Classes of accelerograms are to be determined automatically by means of cluster analysis and alternating optimization – methods from the area of Data Mining – based on parameters of the load model and site information. For this purpose, a flexible data format is necessary, which supports dynamic classification in case of an extension of the database or changes in classification rules and requirements by the user. Arbitrary density and proximity of measurement sites for particular events are taken into account, as well as missing site information, by suitable weighting procedures.

Simulation of fuzzy logic based structural control system of buildings under earthquake loading

Shumin Qiu

Objectives

Structural control is an attractive design methods to enhance the safety and reliability of structures subjected to earthquake without changing the architectural design. The objective of this research is to contribute at a novel level to the improvement of safety and dynamic performance of civil buildings by introducing fuzzy logic control technology. Our work is focused on developing a fuzzy logic based seismically excited structural system for suppressing dynamic vibration of buildings which is demonstrated and verified by computer simulation. The conventional seismic structural control systems are usually designed on optimal control theory. The characteristics of ground motion and the uncertainties on structural performance are not considered normally. We have proposed and developed a seismic structural control system, which include the uncertainty and characteristics of ground motion in the control system. The simulation is implemented in MATLAB/Simulink development environments on a personal computer. This ongoing research endeavours include the validation of the more complex active control system; both in simulation and on an actual platform. This simulation enables a more effective development of behaviours using automated optimization techniques such as genetic algorithms and neural networks. The control modelling schema is shown as following in MATLAB environment with Simulink.



Simulation environment of fuzzy logic based seismically excited structural control under MATLAB/Simulink

Approach

The simulation of proposed fuzzy logic based control system can be completed in following steps:

- Modelling of fuzzy logic control system: The model is designed with expressive powers of representation embedded in linguistic variables and improved methods of interference based on fuzzy logic for seismically exited building. The uncertainty in structural performance and capability and the characteristics of ground motion are expressed in linguistic values.
- Compilation of fuzzy rule bases into fast access lookup tables. These tables can be used by a simplified run-time engine to determine the FLC's crisp output for a given input.
- Implementation with MATLAB/Simulink package: This development tool provides an integrated environment for computation, visualization and programming to design fuzzy controller and allows us to define the inputs, outputs, data set, and initial rule sets simply. The performance of designed fuzzy control system is tested by the simulation for multi-storied seismically exited buildings.

Research Contracts

Title:	**e-Sharing – Resource Sharing Constellations**
Financial Support:	EU, IST – 2001 – 33325, **e-Sharing**
Person Years:	28 (total), 3.1 (CIB, TU Dresden), Duration 2 years
Approach:	The objective of the e-Sharing is to design, develop and evaluate a service provided by a third party for the efficient management and sharing of idle resources, namely human labour or equipment. Companies are lessors and lessees as well. Resources shared through e-sharing can be of any type described by a resources type model designed in the e-Sharing framework. e-Sharing target is to provide an intelligent decision support system to companies letting them describe the tasks they need to accomplish and proposing them to use a combination of resources for the accomplishment of the described tasks. The selection of the resources is based on several factors such as productivity, leasing costs, functional costs, possession costs, time constraints etc. e-Sharing aims in assisting the company-users to decide whether to lease resources or use their own and in providing for an alternative channel for the enterprises to exploit expensive and rare resources when they remain idle.
Partners:	Intracom S.A., Greek, Sema Group, sae, Spain, Pouliadis, Greek, Helsinki University of Technology, Finland, AKTOR S.A., Greek, Müller-Altvatter, Germany, Dachdeckermeister Dittrich, Germany.

Title:	**Innovation, Co-ordination, Transfer and Deployment through Networked Co-operation in the Construction Industry**
Financial Support:	EU, IST-2001-33022 **ICCI**
Person Years:	10 (total), 1.3 (CIB, TU Dresden), Duration: 2.3 years
Approach:	The ICCI initiative builds a cluster upon a set of 7 European IST projects with the overall goal to enhance the co-ordination of research and development in European projects targeting the construction sector, to promote the results of selected large research efforts and to provide concerted support for the future implementation and deployment of ICT in industrial context. Based on the results of the member projects in the cluster and on the expertise of the partner organisations, ICCI will: 1) synthesise industrial requirements and processes, 2) publish ICT state-of-the-art in the fields of technical innovations and commercial offerings, 3) synthesise information for the integration of human, organisational and technical elements to provide best practice guides, 4) assess the latest developments in the area of legal and contractual support for the use of ICT in construction, and 5) identify potential new needs, strategies, implementation plans and research directions required by the industry. CIB is leader of WP1 that deals with collecting, synthesising, consolidating and validate user requirements from the ICCI member projects and other related major research efforts.
Partners:	CSTB, France; University of Salford, UK; Loughborough University, UK; AEC3 Ltd., UK; Delft University of Technology, Netherlands; TNO, Netherlands; VTT, Finland; IKPIR, University of Ljubljana, Slovenia.

Title:	**European Network for Product and Project Data Exchange, e-Work and e-Business in Architecture, Engineering and Construction**
Financial Support:	EU, IST-2001-32035 **ProdAEC**
Person Years:	7.3 (total), 0.6 (CIB, TU Dresden), Duration: 2 years
Approach:	The ProdAEC initiative aims at the creation of a thematic network in the European AEC sector to promote the use and implementation of standards for product data exchange and sharing, e-Work and e-Business. The project brings together construction companies, suppliers, designers, software vendors, R&D centres and universities. Within the set up thematic network, a number of activities will be carried out as follows: 1) dissemination of standards and best practices, such as ISO 10303-STEP, ISO 13584-PLIB and IAI-IFC (ISO/PAS 16739), 2) collecting of industry requirements to contribute to standards evolution, 3) defining a strategy for integration and harmonisation between the existing heterogeneous AEC-related IT standards, 4) establishing standardised (EDIFACT and XML-based) data and message architectures for the adoption of e-Commerce and e-Work in the construction industry, and 5) establishing liaisons with existing working groups in AEC and other related industry sectors, such as the shipbuilding, process plant and furniture industries.
Partners:	AIDICO, Spain; Antara Technologies S.L., Spain; UNINOVA, Portugal; VTT, Finland; CSTB, France; Université Claude Bernard Lyon I, France; Haas & Partner Ingenieurgesellschaft mbH, Germany; AEC3 Ltd., UK; Taylor Woodrow Construction Ltd., UK; Stichting STABU, Netherlands; BIC Toscana SCPA, Italy; IKPIR, University of Ljubljana, Slovenia; Cervenka Consulting, Czech Republic.

Title:	**Virtual Organisations Cluster**
Financial Support:	EU, IST-2001-32031 **VOSTER**
Person Years:	10 (total), 0.75 (CIB, TU Dresden), Duration: 2.5 years
Approach:	The VOSTER project focuses on collecting and analysing the results of several leading European research projects on Virtual Organizations (VO). These results are synthesized by the VOSTER consortium. General scientific and technological objectives of VOSTER are: (1) consolidation of VO related concepts and their relationships, VO types, characteristics and indicators; (2) identification and recommendation of VO modelling approaches; (3) identification of relevant technologies and standards and assessment of their potential use for VOs; (4) definition of functions for VO infrastructures and suggestion of implementation strategies; (5) promotion of VO approaches in the European industries. The main research focus of CiB is on Virtual Organization Infrastructures (WP 4); Virtual Organization Concepts (WP1) and Virtual Organization Modelling (WP2). CiB is contributing its knowledge from the ISTforCE project, especially models and expertise in the area of personalized workflow management and software delivery on demand.
Partners:	VTT (Finland), FHG-IAO (Fraunhofer Society Germany), CeTIM (Center for Technology & Innovation Management, Germany), UNINOVA (Portugal), Research Institute for Operations Management – RWTH (Germany), Loughborough University (UK), YIT Corporation Ltd. (Germany), TU Dresden (Germany), Salford University (UK), Computas AS (Sweden/Norway), Consortium for Advanced Manufacturing International (UK), University of Amsterdam (Netherlands), Concurrent Engineering Consulting (Italy), Silesian University of Technology (Poland)

Title: **Architecture for Collaborative Scenarios**

Financial Support: BMBF (German ministry of education and research), **ArKoS**

Person Years: 30 (total), 3.4 (CIB, TU Dresden), Duration: 3 years

Approach: The main objective of the ArKoS project is to improve the management of collaboration and cooperation between different enterprises from a conceptual to the system level. Therefore the project will start with a State-of-the-Art analysis and requirements definition. Derived from this a comprehensive architecture, which consists of modelling techniques on macro and micro level, integrating meta-models and a modelling tool, will be established. In a second phase domain-specific reference models and software systems will be developed and validated. Within the project the building industry will serve as the reference-domain for design and validation of the aspired methodology.

Partners: Inst. für Wirtschaftsinformatik (IWi), Prof. Scheer, Saarbrücken; Inst. für Wirtschaftsinformatik & BWL, Universität Mainz; FG Bauinformatik, Fachhochschule Gießen-Friedberg; Nemetschek AG München; f:data Sömmerda; WeltWeitBau Berlin; INTERACTIVE Software Solutions Saarbrücken

Title: **Mobile Information and Communication System to Support Construction Activities**

Financial Support: BMBF (German ministry of education and research), **IuK-SystemBau**

Person Years: 9.9 (total), 2 (CIB, TU Dresden), Duration: 3 years

Approach: Development and prototypical implementation of a mobile information and communication system for controlling construction activities in SMEs using PDA or "handhelds", accessing data through a web-based portal, and re-engineering of existing business process models. Research is focused on context-based interfaces and context-focused information applying data warehouse methods. Information will be represented in XML and structured according to the BC-XML model. The data model will be implemented using a distributed, object-relational DBMS. For the implementation we are using commercially available software packages and hardware components ensuring that SMEs will be enabled to use cost-efficient, up-to-date, easy to learn information and communication technologies.

Partners: TU Dresden, Institut für Baubetriebswesen; Claus Dittrich Dachdeckermeister GmbH & Co. KG, Dresden; Müller-Altvatter Bauunternehmung GmbH & Co. KG, Niederlassung Dresden.

Title: **Cooperative model for monitoring and control of diverging design states – Identification of design data conflicts**

Financial Support: DFG (German research foundation), Sche223/27-2

Person Years: 2, Duration: 2 years

Approach: Concurrent parallel design inevitably leady to diverging data states. Therefore methods are needed to recognize these differences and to transform the various domain data models into a consistent state. This 2-year project continues the work of a prior DFG project that dealt with the development of a declarative mapping specification language for building construction and realisation of a respective mapping engine to enable modelling object transformations between heterogeneous representations. The work in this stage of the overall research on this subject is dedicated to the tackling of differences occurring by the concurrent modification of partial models by different designers. This includes a) identification of changes, b) classification of detected differences and notification of relevant actors, c) prioritising the differences to help subsequent co-ordination and reconciliation processes, d) version management. The implementation is carried out within the environment of a Product Model Server developed at CIB, thereby enhancing the existing functionality of the latter.

Lecture Activities 2004

Title: Computer-Aided Design and Drafting

Intended Audience: 1st semester, students of civil engineering
Lectures and Tutorials: Scherer/Böttcher
Subjects: This course provides background knowledge of the methodology and techniques of computer-aided design. Basic CAD 2D and 3D functionality is presented as well as advanced methods for the efficient application of CAD technology in civil engineering design, such as data structuring techniques (layers, blocks, symbol libraries), data exchange paradigms and formats (DXF, STEP, IFC), user interface and output facilities. The general features of CAD systems are presented on the example of ALLPLAN/ALLPLOT. Attention is given also to specialised systems for building design with examples from the field of reinforcement detailing.

Title: Computer-Aided Solutions of Engineering Problems

Intended Audience: 2nd semester, students of civil engineering
Lectures and Tutorials: Scherer/Gerk
Subjects: The systematic analysis, synthesis and implementation of software solutions for engineering problems are presented. Focus is on numerical engineering problems. The use and benefit of a formal graphical representation language using the structogram method is demonstrated. Special emphasis is given to distinguishing between the topological, geometrical and the visualization model. The practical tutorials aim at writing and testing structured programs in the programming language C++.

Title: Data structures and data bases

Intended Audience: 3rd semester, students of civil engineering
Lectures and Tutorials: Scherer/Gerk
Subjects: Introduction to abstract data types, sets, relations, objects and classes. Classification in linear data types, partitions, graphs and associations. Definition of equivalence relationship and introduction to relational data structures and corresponding basis operations. Presentation of the corresponding support of C++ for objects, classes, methods, inheritance and operators. The Tutorials practise these methods and algorithms in the programming language C++.

Title: Numerical Mathematics

Intended Audience: **4**th semester, students of civil engineering
Lectures and Tutorials: Hauptenbuchner
Subject: This lecture informs on, and consolidates methods of numerical mathematics being used in CAD and CAE-software. After a general introduction to the methods of numerical mathematics, algorithms of solution for linear systems of equations, esp. the Cholesky method, and algorithms of solution for large band-structured matrices are introduced; this is followed by a survey of algorithms of solutions for eigenvalue problems. Graphical representation of results from numerical methods, which are available in discrete form, is realized by interpolation methods, esp. SLINE-methods.

Title: Relational data structures and systems data management

Intended Audience: 5th semester, students of civil engineering
Lectures and Tutorials: Scherer/Gerk
Subjects: First, an introduction to data management and data bases is given and hierarchical and relational data structures are shortly opposed. The requirements of engineering applications like very long term transactions are summarized and opposed to other applications. The basics of relational data structuring like entities, relations and association types, cardinality, key attributes, transformation of relations, redundancy, recursive relations, generalization, specialization are presented. The bottom-up procedure of a data base design using the normalization approach is shown. Basics of SQL are introduced. Tutorials are carried out applying ORACLE software.

Title: Computer-Aided Engineering: Applications for Structural Engineering

Intended Audience: 6th semester, students of civil engineering
Lectures and Tutorials: Scherer/Wagner
Subjects: Introduction in object modelling, EXPRESS and EXPRESS-G representation techniques and STEP physical file format. A simplified IFC compliant model for the structural system modelling and analysis is outlined. Basic principles and techniques for the effective use of numerical analysis programs in the solution of various structural design tasks are introduced. An insight into the methods for correct modelling of engineering problems as well as for the appropriate structuring of the necessary information and the proper interpretation of analysis results is given. Special emphasis is put on the formulation of FEM analysis tasks in terms of the entity relationship modelling approach. Examples include the modelling and solution of typical FEM problems, such as stress-strain analysis of slabs and shear walls subject to various kinds of loads applying the structural analysis package SOFiSTiK.

Title: Object-Oriented Modelling - Fundamentals and Application in Structural Engineering

Intended Audience: 8th semester, students of civil engineering, track structural engineering
Lectures and Tutorials: Scherer/Katranuschkov
Subject: This course aims at giving civil engineering students an understanding of the basic principles and the practical application of the object-oriented modelling methodology as a powerful vehicle for the design and realisation of complex computer-aided engineering tasks. Special emphasis is put on the discussion of advanced product data technology methods based on the international standard STEP and industrial standard IFC of the IAI. The students will be actively involved in modelling tasks selected from everyday engineering practice with focus on the adequate formal specification of structural design problems and the respective product data representation and product data exchange specification.

Title: eBusiness & Data Warehouses in A/E/C and FM

Intended Audience: 8th semester, students of civil engineering, track structural engineering
Lectures and Tutorials: Menzel

Subject: Within this course students will get a broad understanding of e-business in AEC and Facilities Management. Firstly, the different types of “eBusiness” are explained in general. Secondly the students gain detailed knowledge about methods of Business Process Modelling (BPM). Furthermore, the students acquire fundamental knowledge about basic IT-methods and technologies supporting eCommerce. The major focus is on multi-dimensional data management. Finally, the students will get an overview about technical aspects of data security and billing systems. Within seminars the students learn how to implement a project using ROLAP technology.

Title: Artificial Intelligence Methods and Their Application in Structural Engineering

Intended audience: 9th semester, students of civil engineering, track structural engineering
Lectures and Tutorials: Scherer/Katranuschkov
Subject: This course of lectures aims at introducing the methods of *Artificial Intelligence* to engineers related to specific problems of their daily practice as mainly design, processing of standards and team work. In principal the students shall gain an understanding that computer support is not restricted to numerical computation, as e.g. programs for structural analysis, but also can involve manipulation of symbols and thus produce some sort of "intelligent" behaviour. The lecture is intended to introduce AI as a technology for useful programs that might influence the way engineers do their design in the future.

Title: Mobile Computing

Intended Audience: 9th semester, students of civil engineering, track structural engineering
Lectures and Tutorials: Menzel

Subject: The purpose of the subject is to understand the potentials and the importance of mobile computing in construction, to learn about underlying technologies of mobile computing and the ways of using it in construction projects, especially in the building phase. An essential part of the subject is to gain experiences with introducing and applying mobile computing in the field. The intended learning outcomes are: in depth understanding of the basic technologies and potentials of mobile computing. Furthermore the participants will analyse and specify usage scenarios for mobile computing technologies in the AEC or FM-sector.

Title: Computer-Supported Information Management in the Construction Industry

Intended Audience: 9th semester, students of civil engineering, track structural engineering
Lectures and Tutorials: Scherer/Katranuschkov
Subject: The effective management of design, construction and facility management information throughout the whole life cycle of a building is a task with strategic importance for the competitiveness of the building industry.This course discusses basic information management techniques used in current engineering practice (structuring of CAD information, data exchange paradigms, workflow management), as well as emerging new software methods and techniques. On the basis of typical co-operative engineering scenarios, advanced information management methods like Internet-based communication, product, process and document modelling and information sharing are discussed. Emphasis is given to the organisation of concurrent engineering work.

Title: Applied Informatics in Environmental Engineering

Intended Audience: 9th semester, students of civil engineering, track environmental eng.
Lectures and Tutorials: Scherer/Menzel
Subject: The course focuses on the introduction of technologies and respective analysis and design methods enabling homogeneous, integrated, multi-dimensional information management to support sustainable design and management of built infrastructure systems. Special emphasis is given to data warehouse technology and on-line application processing methods to meet short-term and long-term data and knowledge management.

Title: Informatics in civil engineering
Intended Audience: 6th semester, students of science of the economy
Lectures and Tutorials: Hauptenbuchner
Subjects: This lecture aims at giving an introduction to the specific problems of software in civil engineering, the special requirement to the hardware, the way of work with the software and the future trends. Especially the area of the functionality of CAD- and CAE software will be discussed. The students get a survey of the software used in civil engineering offices and can acquire knowledge that allows them to judge such software products concerning quality and performance. A further aim is to enable the students to assess the expenditures on installation of new software, training of staff to operate it and carrying out of projects by appropriate software products.

Title: Informatics in architecture
Intended Audiences: 1st semester, students of architecture
Lectures and Tutorials: Hauptenbuchner
Subjects: The course shall allow the students to acquire knowledge of and proficiency in computerized data processing that will enable them to prepare multi-media documents of up-to-date quality. This requires experienced skills in using operating systems, text and graphic processing software, calculation programs and data bases as well as interfaces between them. Because of their wide-spread use Microsoft Office products are particularly presented. A performance test after the course shall prove the knowledge of and proficiency in the usage of Microsoft Office products incl. of interfaces provided to prepare a document of a subject chosen at liberty but according to well defined criteria.

Publications in 2003

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[2] EISFELD M., SCHERER R.J.: Wissensbasierte Entwurfsunterstützung für die Konzipierung von Tragwerken in der frühen Entwurfsphase, Bericht, Institut für Bauinformatik, Technische Universität Dresden, 2003.

[3] SCHELER S., SCHERER R. J.: Site Installation Modelling to Support Construction Cost Simulation, From 3D to nD Modelling – International workshop, University of Salford, Manchester, UK, January 2003.

[4] WEISE M., KATRANUSCHKOV P., SCHERER R.J.: Generalised Model Subset Definition Schema, Proceedings of the CIB-W78 Conference 2003 – Information Technology for Construction, Auckland, 2003.

[5] WEISE M., KATRANUSCHKOV P., LIEBICH T., SCHERER R.J., Structural Analysis Extension of the IFC Modelling Framework, *e-journal ITcon*, www.itcon.org, Volume 8, pages 181 -200, 2003.

[6] MENZEL K., SCHERER R. J.: Information Management for Project Based Teaching Supported by Mobile Devices, Proceedings of BEAR 2003 conference, Salford, UK, April 2003.

[7] MENZEL K., SCHACH R., SCHERER R. J., EISENBLÄTTER K., NAUMANN-JÄHRIG R.: Re-engineering Potentials in Construction by means of Mobile ICT (in German), Proceedings of IKM 2003, International Colloquium on Applications of Informatics and Mathematics in Architecture and Civil Engineering, Universität Weimar, June 2003.

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Membership in editorial boards of journals

Advanced Engineering Informatics	Elsevier Publishers	The Netherlands
Information Technology in Architecture, Engineering and Construction	Millpress Publisher	Great Britain
Information Technology in Construction (electronic journal)	TH Stockholm	Sweden
Construction Innovation	Arnold Journals Publisher	Great Britain

Membership in standardization groups

DIN GA-CALS	German CALS committee (integrated information and process flow)	Vice chairman
DIN Dok-Bau	Standardization committee for technical product documentation in civil engineering	Vice chairman
DIN NAM 96.4.1-3	Product data exchange in civil engineering	Vice chairman
ISO 10303/BC	Standard Exchange of Product Data, work group Building Construction	Member
IAI	International Alliance of Interoperability (product modelling in civil engineering)	Member
IAI/ST-4	ST-4 Structural Model	Vice chairman