

The GISMO Project

Complete Integration of Renovation and Refurbishment of Occupied Buildings

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This paper discusses the current proceedings in a joint research project, focused on a complete integration of all tasks involved in a refurbishment under use. All relevant matters have to be modeled in a common internet system, developed by a company for internet based project management. A special focus is lead on

- the integration of the needs of lodgers.*
 - the quantification of ecological impacts.*
 - the optimization of the refurbishment process with an integrated scheduling method.*
 - the development of database elements, consisting of information for invitation of tenders, ecological benchmarking, time, cost, exposures for the renovation tasks.*
- It is a work in progress article.*

Keywords: *refurbishment, internet based project-management, operations research, process modeling in the building industry*

Introduction

In the Federal Republic of Germany, the relationship of the construction of new buildings and the refurbishment is in a change. 10 years ago the amount of construction work laid by 90% for new buildings and about 10% for the renovation of existing buildings. This is changing rapidly and the upcoming tasks and chances for architects lie in-between the refurbishment. Statistics predict that there will be a percentage of 80% for refurbishment work and only 20% for the construction of new buildings in the future.

Overall, the refurbishment has to be more ecological, faster. The quality of the renovation has to become better and the lodgers should be able to stay in their flats to avoid additional costs for moving, hotels, travel expenses.

In order to improve these mostly chaotic and unstructured processes, the named institute started a federal research project, called „GISMO - Ganzheitliche Integration von Sanierung und Modernisierung“, meaning: „Complete integration of renovation and refurbishment (under use)“. The

presented issues are complex, extensive and can not be fully discussed in a single paper. Our aim is to present the project, the current state of work and to promote the theme of refurbishment under use for a wider intellectual debate.

Project Consortium

The joint research project is supplied by Germany's largest company for internet based project management, the conject AG from Munich [conj]. The Edition AUM GmbH, Dachau [AUM] a company specialized in software and tender data for the building industry and the municipal house building company VOLKSWOHNUNG GmbH [VoWo] with owning about 12.000 flats in the city of Karlsruhe.

Two additional institutes are taking part, one of it is the Chair for Sustainable Management of Housing & Real Estate [ÖÖW], the second one is an institute for the Theory of Economics and Operations Research [WIOR]. The research -consortium is lead by the Institute for Industrial Building Production [IFIB].

Project Targets

What we're working for, is a complete framework, handling all aspects of a refurbishment under use. By the systematic integration of all relevant data, we aim on a closed chain from the strategic portfolio management over the refurbishment up to the property management. Overall, there is a focus on a couple of main targets:

- The modeling of processes of a refurbishment process
- The complete transaction and management of all construction works over an internet based project management platform
- The development of an extended building elements, consisting of information for invitation of tenders texts, ecological benchmarking, time, cost and exposures for the renovation tasks
- The integration of lodgers into the refurbishment process
- The quantification and calculation of ecological

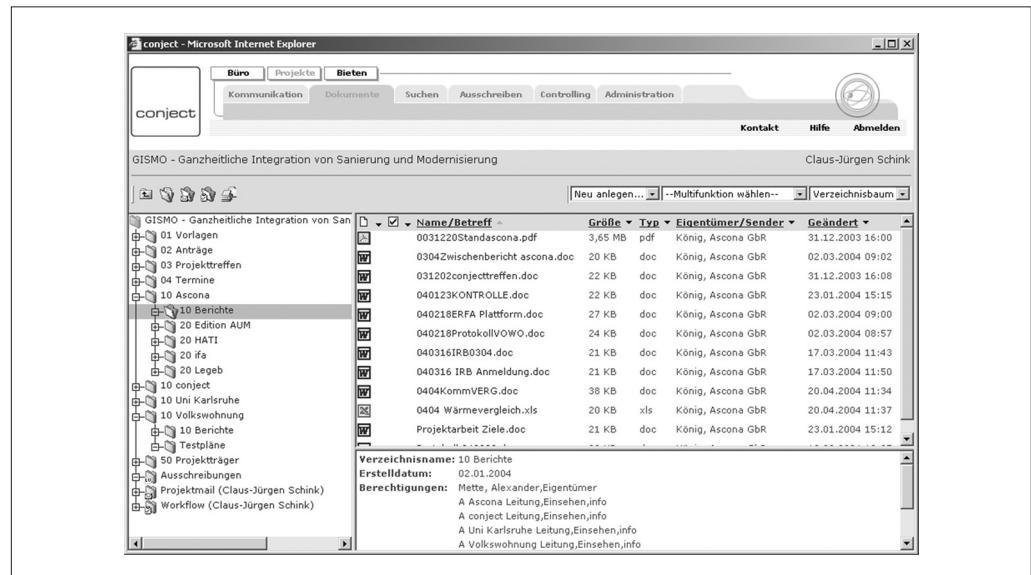


Figure 1
View of the conject document management.

impacts

- The simulation of life cycle costs
- The optimization of the refurbishment process with the use of repetitive scheduling and disturbance scheduling methods.

Current working progress, implementation steps

The modeling of processes of a refurbishment process

Current work is focused on the modeling of construction-processes, the house building-company duties and the complete refurbishment matters with the usage of a database driven business modeling tool [Nautilus]. We're examining all relevant matters in the housing company and the whole building activity. This data, gained with expert interview and evaluation of several finished housing projects, is transferred into a workflow management system. The workflow is modeled in the conject database, providing the foundation for the net-based collaborating system.

Participants, roles and tasks for the project are given and different views for the specialized project-room refurbishment created. Each participant has its own, specific view delivered by the database system, depending on the role he's playing in the building process.

Development of extended building elements

For the planning of the refurbishment process, there is a need for a predictive simulation tool. Not only for refurbishment costs, but mainly for the estimation of life cycle costs and ecological impact. What we need is the combination of an existing catalogue for tender documents with replenished ecological data and information about life cycle costs.

The Edition AUM [AUM], publisher of a digital catalogue for tender documents and element costs, is developing additions for extended simulation possibilities. The existing building elements are balanced for ecological impact, environmental impacts, en-

ergy and water requirements. Each element is separated into used materials (concrete, steel, pvc, etc.) and balanced for disposal costs, CO² consumption, SO². With this extended database, a software tool is developed which takes advantages of geometrical and construction data for various calculations.

The integrated software-tool Legep [LEP] will be able to calculate a huge number of simulations, just by estimating the building elements and geometric information used by the German industrial norm 276 [DIN276] and a few additional information like climate data, exposure and orientation. It can predict the life cycle costs, the energy consumption, the ecological impact and of course the construction costs with an integrated database for the tendering documents.

With this result we are able to simulate all aspects of a planned refurbishment. Decision maker have the possibility to value the planned renovation and to matter-of-factly evaluate different variants.

An Integrated project management system

To improve the chaotic and unstructured planning and constructing processes, a complete land map of all tasks was drawn. Therefore the constraints within the limits of the law had been kept. This is, for example, a necessary waiting period of three months, to give the lodgers the possibility to file a protest. All other tasks were redesigned and carried forward to a common project template.

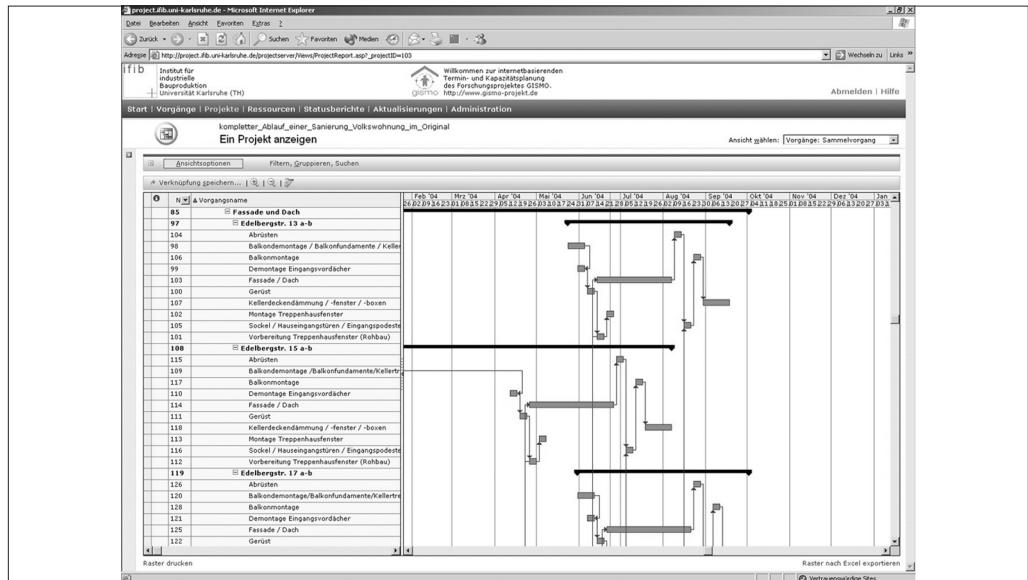
This project template consist of two main phases, the planning phase, taking about 2/3 of the whole project time and the building phase taking only 1/3. For a conventional refurbishment of a building, we have a land map with roundabout 400 single tasks to fulfill the project.

The next step was the transformation of the hand-made project-template into a net-based project management system. What we have chosen was the Microsoft Project Server 2003. A system consisting of a relational database (SQL-Server) and a web server with active scripting. It is a centralized multi-project depository with the ability to handle a huge amount of projects with common resources

Figure 2
The combined tender and cost-planning tool legep.

Name	Nr	Menge	labor	inh	KG	KG Art	Zeit	Ergebnis	Gesamtwert	Nr
248.281,77									314.938,61	
13002111	350,000	m³	3111	0,00	20,61			7.212,50		
13002111	46,000	m³	32	0,00	275,59			12.723,90		
38.163,06								744,49		
13002141	141,000	m³	336	0,00	5,28			744,49		
13002121	141,000	m³	336	0,00	5,48			7.620,89		
13011205	141,000	m³	311	0,00	114,81			16.180,21		
12042233	141,000	m³	338	0,00	126,89			17.659,49		
13000923	4,000	Stk	33	0,00	443,50			1.774,00		
13002123	61,000	m³	33	0,00	279,52			14.000,72		
13049314	12,000	m³	334	0,00	729,40			8.490,80		
13049311	12,000	m³	334	0,00	644,60			7.975,20		
13049321	1,000	Stk	334	0,00	2.095,50			2.095,50		
13012511	36,000	m³	338	0,00	345,80			12.471,04		
13008112	15,000	m³	34	0,00	431,58			6.523,70		
13002122	112,000	m³	34	0,00	89,95			10.074,40		
13002122	54,000	m³	34	0,00	107,44			5.821,76		
13002124	86,300	m³	34	0,00	181,17			15.536,27		
13049321	1,000	Stk	349	0,00	4.402,00			4.402,00		
13002121	25,000	m³	35	0,00	142,71			3.567,75		
13002122	3,000	Stk	35	0,00	4.257,51			12.712,53		
13002111	29,500	m³	352	0,00	85,32			2.514,94		
13002111	43,000	m³	352	0,00	62,70			2.445,30		
13002111	56,000	m³	352	0,00	29,94			1.662,63		
13021112	4,000	Stk	362	0,00	99,91			3.997,64		
32.629,40								32.629,40		
13041112	110,000	m³	361	0,00	49,02			5.392,20		
13002124	110,000	m³	363	0,00	187,99			20.679,80		
13045422	71,000	m³	364	0,00	77,30			5.484,30		
36.622,24								36.622,24		
14006111	1,000	Stk	41	0,00	539,01			539,01		
14006111	2,000	Stk	41	0,00	270,40			540,80		
14006121	1,000	Stk	41	0,00	239,40			239,40		
14006211	1,000	Stk	41	0,00	739,70			739,70		
14006211	2,000	Stk	41	0,00	818,30			1.636,60		
14006821	1,000	Stk	41	0,00	1.002,10			1.002,10		
14006211	2,000	Stk	41	0,00	749,70			1.539,40		
14006711	1,000	Stk	41	0,00	913,60			913,60		

Figure 3
The prototype for net-based scheduling for refurbishment scheduling.



like workers, calendars, materials, costs, etc.

With the new structured template we can now handle all participants and their tasks within a single data model. The real-time manipulation and feedback of the common schedule via Internet Explorer is possible. What we wanted to have is an easy way to integrate small companies and craftsmen. We can invite contractors to join the project management system by clicking on a link in an email-invitation. The assigned tasks will then be entered in the clients MS-Outlook calendar and also entered in the task-list of clients personal information manager. It's not necessary to log on to the net-based system or to use of a complex scheduling program.

If a craftsmen finishes his job on the construction site, he will tick the task off in his email program. Afterwards the centralized database will react and recalculate the schedule. Automatic emails are sent to the following craft, so that their work can now begin.

A new scheduling method

As the refurbishment process is an unstructured, mostly chaotic process, we have to react on the lodgers needs. The burden and the psychological stress, involved by a refurbishment under use is extraordinary. Lodgers are living for three or more months on a building site with dust, heavy noise and sometimes without electricity or water.

We're developing a method to make dynamically suggestions how the building has to be refurbished and make a proposition for a scheduling plan.

Since the used database is open and the data can be manipulated, we're able to make additions and changes. Although non open-source, the web server can be fully scripted in .NET Technology giving us the ability to integrate our own scheduling algorithm.

We're adding the new resource „lodger“ in the scheduling base data, giving the possibility to know if a person is available and involved with his flat, furniture and nuisance. The other needed resources are the rooms. Than we can optimize not only for

costs, but also for personal concernment and additional issues.

We have to integrate the list of building tasks, the amount of craftsmen, the costs, the building topology, possible working crews, the lodgers and constraints like construction site and common pipes for electricity and water for several flats.

What we see is that the use of the common CPM-method, or the usage of Petri-networks can't satisfy our needs. Although the refurbishment is a deterministic issue, we have to deal with a multidimensional view and with a kind of repetitive construction. We have some repetitive tasks like tiling work in identical bathrooms in several floors. On the other hand, each flat has its own problems and time tasks to solve. Also the matter of learning and getting faster while the repetition has to be considered. The second bathroom will take less time to refurbish, caused by learning effects. Although it is absolutely identical. The closest approach to our needs can be found in the disturbance scheduling method and the repetitive scheduling method. At the moment we're working on a redesign and addition derived from these existing methods. This will give us the possibility to use a new scheduling method for the specific needs of a refurbishment under use.

Outlook and further steps

If succeeding in the current implementation tasks, we will evaluate the system in a real-life construction site with about 150 flats in several buildings, located in Karlsruhe. The perceptions will flow into the prototype and reveal missing components.

The currently developed scheduling method will be implemented in a software prototype. This prototype will automatically generate schedules out of the extended GISMO-Framework.

What we will gain is a complete information and framework to improve the quality of the building. Not only the refurbishment process, but especially the possibility to raise the lifetime of the building, lower the ecological impacts and reduce the life

cycle costs. It will help to enable housing companies to diminish their costs, will avoid the move out of lodgers and significantly reduce the construction time.

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