Tempus UM-JEP-14131-1999

Open and Distance Learning in Technical Education

Proceedings of the First Workshop

Editors: Matej Fischinger and Tatjana Isaković

Ljubljana, Slovenia

29. May 2000

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Introduction into TEMPUS JEP 14131

Matej Fischinger

University of Ljubljana, Faculty of Civil and Geodetic Engineering, Ljubljana, Slovenia

The increasing speed at which existing knowledge becomes obsolete, and the rapid changes in the means by which it is delivered and renewed, will require the higher education sector to adopt new methods of open and distance learning (ODL).

In particular, Slovenia is a small country with limited number of experts and limited financial means for development. Therefore the potentials should be used wisely. It is therefore essential to provide very effective exchange of knowledge on the national and international level. Distance education could certainly pay an important role in this process.

A consortium of 4 European universities (University of Ljubljana, University of Maribor, University of Napoli Frederico II and Royal Institute of Technology, Stockholm) has initiated a TEMPUS joint European project "Open and Distance Learning in Technical Education". Final goal the project is the implementation of a prototype international multimedia education system in earthquake engineering using modern information technology. Earthquake engineering (EE) has been chosen as an illustrative topic, since in EE knowledge is not obtained through analytical procedures only, but also on the bases of experiences. Information technology has proved to be ideal for dissemination of this kind of knowledge. In addition to that, conveying the new knowledge (in EE) into practice is of utter importance in the time when new European structural standards "Eurocodes" have been introduced. Therefore a system is needed to support knowledge transfer on multiple levels.

This publication consists of the PowerPoint supported lectures, presented at the first TEMPUS JEP 14131 workshop, being held in Ljubljana and Maribor on May 29, 2000 in the form of the videoconference. Additionally, short introductions have been provided by the authors to point out the main message of their presentations.

Introduction into:
UM JEP 14131
Open and Distance Learning in
Technical Education

by Matej Fischinger (co-ordinator)

PARTICIPATING INSTITUTIONS

- Royal Institute of Technology, Stockholm
- University of Napoli Frederico II
- University of Maribor
- University of Ljubljana

OBJECTIVES

- To enable participating institutions to offer open and distance learning courses
- To implement a prototype of international, multilevel, multimedia education system in structural engineering.

BACKGROUND

- Limited resources of both Slovenian universities
- The increasing speed in creating new knowledge
- Structural Eurocodes are being introduced into practice
- High students' failure rate in Slovenia

WELCOME ADDRESS

Document management in construction – current issues

Bo-Christer Björk

Royal Institute of Technology, Stockholm, Sweden

The negative impact on overall construction costs, through delays and expensive re-building, of out-of date, missing or contradictory information, has been documented in several studies and is well known to practitioners. The effective management of the vast amount of information needed to design, construct and maintain buildings has always been, and still is a formidable challenge. Despite the future promises of product data technology, which have been discussed for 15 years, the effective management of documents, such as drawings, specifications, bills of materials etc., is still today for most companies the key issue.

Construction documents have not undergone major changes since the middle of the 20the century. Plan drawings, sections and elevation, bills of quantities, specifications etc. look much the same as earlier. The technology for producing, managing, duplicating and distributing such documents has, however, undergone a number of fundamental changes. These technology changes have enabled significant changes in the information management process, which among other things have resulted in business opportunities for new types of services and companies. The first important change was the introduction of photocopying in the 60ies, which spawned a great number of dedicated copying firms. The second wave occurred during the 80'ies and involved the proliferation of personal computing and the fax, facilitating the production and the transfer of documents. In the early part of the 90-ies, computer networking, both in local area networks, as well as using point-to-point bilateral lines and modem call up, made possible the use of document management systems for managing project documentation. Such systems were nevertheless relatively little used in our industry, compared to traditional photocopying and courier services, until the Internet changed the scene totally towards the end of the 90'ies.

Today document management is one of the fastest growing applications in our industry. The shift from expensive and often complex software which needed to be installed on the computers of all project participants to software which is located on servers only and used through ordinary web browsers significantly lowers the barriers to use such systems. At the same time a clear shift is occurring from in-house solutions, typically provided by one of the dominating project participants, to outsourcing of document management to third party application service providers. A recent trend is that these services also tend to become integrated into vertical internet portals for the construction industry.

COMPUTER-AIDED DOCUMENT MANAGEMENT

Prof. Bo-Christer Björk

Royal Institute of Technology

Stockholm, Sweden

Presentation at a workshop at the University of Ljubljana

29th of May 2000

Royal Institute of Technology

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The current situation

- Computers are almost as a rule used as tools for *producing* different kinds of documents
- Outside the user's own workstation documents are ***managed*** and ***distributed*** using a variety of methods representing different generations of IT-solutions

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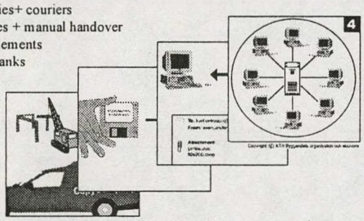
The generations of construction document management

- Analog copies+ couriers
- digital copies + manual handover
- email attachements
- document banks



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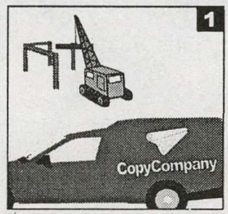
Analog copies + couriers



- 1970s to today
- analog copies
- transfer by couriers
- external service providers

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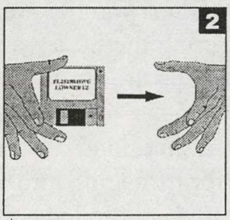
Digital copies + manual handover



- 1980s to today
- digital single copies
- transfer by hand or letter
- Receiver decides on storage

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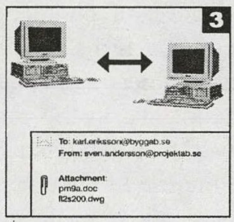
email + attachements



- 1995 onwards
- digital copies
- transfer by networks
- receiver decides on storage

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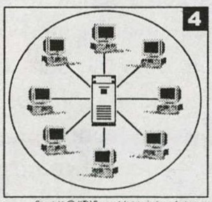
Document banks



Copyright © KTH Byggandels organisation och ekonomi

- from early 1990s
- transfer by networks
- sender decides on storage
- Avoids redundant storage

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How can IT assist in integrated document management ...

- Computer networks
- Databases with reference information
- Graphical user interfaces

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... How can IT assist in integrated document management

- Scanning techniques
- New technique to work with several programs concurrently
- Conceptual modelling and object-orientation

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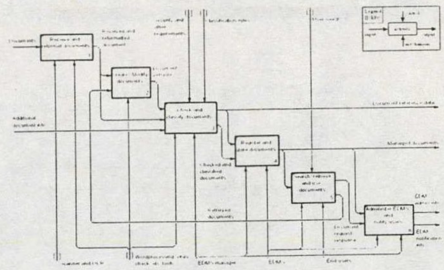
A process model of document management



Goals for integrated document management

- To facilitate the search for the information needed
- To secure that the information is the latest approved version
- To decrease the information retrieval time form minutes, hours and days to seconds

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EDM systems

- EDM = Electronic document management
- Quickly growing commercial supply of EDM systems

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Features of EDM systems ...

- Based on the use of computer networks (LAN and WAN)
- Integrate over many different document types (CAD, word processing etc.)

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... Features of EDM systems

- Access control (read only, read and write)
- Management of document distribution
- Conversion of paper-based documents via scanning

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Search methods

- Hierachical folders
- Metadata based document search
- Hypermedia links between documents
- Free text search

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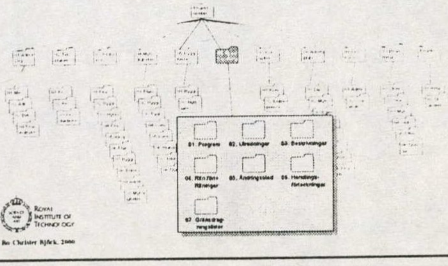
Hierarchical folders



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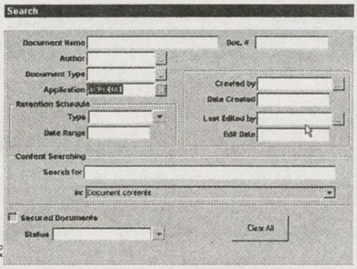
Metadata based document search



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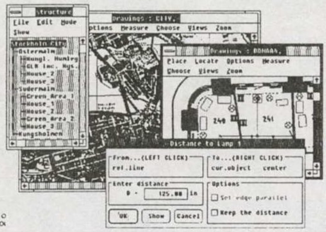
Hypermedia links between documents



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Free text search

- Used in many web search engines
- Only usable for text documents
- Can in some cases also be used on OCR interpreted scanned documents
- (OCR = optical character recognition

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Reference information about documents

- The general information about a document which helps end users to locate the document which corresponds to their information needs and to retrieve and manage it in an efficient way

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Analogy: Bibliografical information

Björk, B.-C. [1992a]

A conceptual model of spaces, space boundaries and enclosing structures

Automation in Construction, vol. 1, 1992, pp. 193-214

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Reference information about digital documents ...

Information needed to:

- archive and find the document
- know which programs can be used to view and change the document
- find other related documents
- know if you are dealing with the latest version of the document

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Two types of reference information

- General reference information
- Context dependent reference information

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General reference information Examples ...

- Information about originating software
- Physical storage of the files
- Author information

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... General reference information Examples

- Access rigths
- Distribution management
- Versioning information

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How is general reference information handled today ?

- Handled quite well in general purpose EDM systems
- Partly included in operating systems, object linking and embedding (OLE) etc.

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Context dependent reference information

- Has to be defined by the IT users within the construction process
- Dependent on the way the construction process is organised

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Context dependent reference information, examples

- How does the document relate to the building and its different parts
- How does the document relate to the activities of the design&construction process
- The representation type of the document (i.e. type and scale of a drawing)

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How is reference information defined in the construction industry today

- Drawing headers
- Embedded text in text documents, lists etc.
- Embedded in the names of folders and files in DOS and windows

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Drawing header

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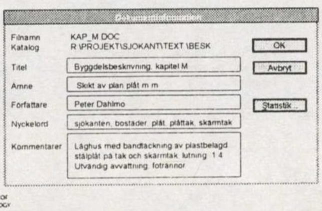
File information



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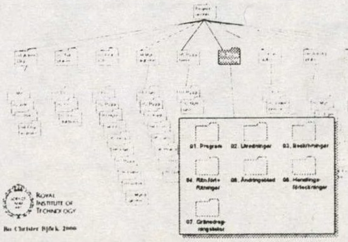
Organisation and naming of files



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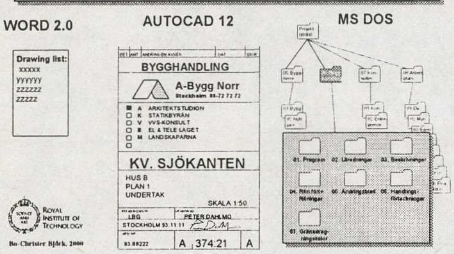
Standardisation today

- Both the information and its syntax (the way it is presented) is standardised
- The reference information is often defined as a part of the document itself

Problems of integrating document reference information

- Partly overlapping subsets of the reference information are handled by different computer applications
- The same information is redundantly present in many places

Example: Drawing reference information



Problem of integrating document reference information

- The information is mostly not computer interpretable ("graphics" to the CAD-system, "text" to the word processor)

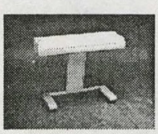
Areas related to EDM

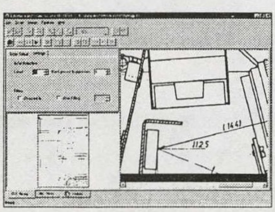
- Scanning/Imaging
- Workflow systems
- Groupware

Scanning of paper documents

- Increasing use for handling already existing large archives of paper drawings and documents
- Savings in storage space
- Fast access to the documents

Scanning of paper documents

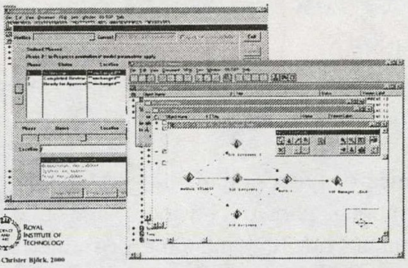




Imaging

- Imaging = Scanning of manual documents and the subsequent computer-aided management of the scanned images

Workflow systems



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Pros and cons of computer aided document management

+ Considerable productivity gains in information management tasks
+ Technology already exists

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Pros and cons of computer aided document management

- A thorough understanding of the information management process is required
- Requires more discipline of the personnel than manual methods
- In some domains legal problems with paper-less mode of working

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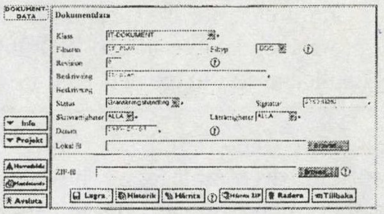
Trend: Commercial document management services



Dokument banken

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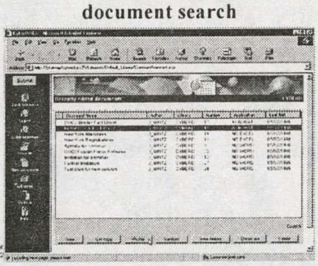
Trend: Web browsers as front ends to document search



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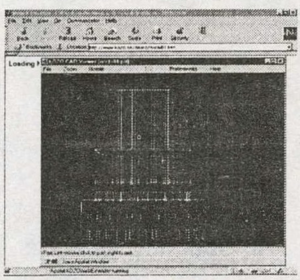
Trend: Viewers for CAD data



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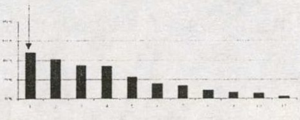
EDM systems top-of-the-list in company priorities

Document management systems



Construction industry companies plans for IT investments the next two years (IT-barometer study November 1997)

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END

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Introduction to process management

Rikard Berg Von Linde

Royal Institute of Technology, Stockholm, Sweden

There are many examples of the increased importance of process modelling. Mapping up processes has become an important and fundamental part of business and quality development projects. In connection with development and implementation of enterprise resource systems, it is necessary to have the processes of the business documented. The process documentation must be in such order that both software developers and the business' participants are able to use and understand it. The international quality standard, ISO 9001:2000, calls for identification of the processes that are needed for the quality system, and it calls for clarification of succession and interaction between these processes. In the previous quality standard ISO 9001:1994, the demand for process management was not as explicit as it is in the new edition.

Processes are often described with relatively uncomplicated symbols, such as boxes and arrows. The disadvantage of these models is that the information content is limited. Researchers and software developers use more powerful methodologies, for example IDEF0, which is a subset of the Structured Analysis and Design Technique (SADT). The experiences from working with IDEF0 show that those who perform the modelling get a sound knowledge of the processes. Problems arise when there is a need to communicate or validate the models in co-operation with practitioners who have not been involved in the composition of the models. The process models lack sufficiently well developed graphical user interfaces (GUI) for this purpose.

There are several ways of creating a more usable GUI for process models. Layer techniques, a conscious and knowledgeable use of colours, and awareness of heuristics for usable computer applications are a few examples of methods, which can be used to improve usability of process models. Layer techniques (similar to the ones used in CAD) direct the attention to demarcated parts of the model. They also make it possible to gradually reveal details and build up a model in the presence of a watcher who will have a fair chance of understanding the model. A fully developed model is hard, or even impossible to penetrate, but a step-by-step composed model is manageable. Colours can be used to categorise different types of inputs and outputs, to indicate which organisational unit activities belong to, or to express dependence. Knowledge that has been developed within the research area of human-computer interaction (HCI) could be used to provide guidelines for model design, since process models mainly are managed in computer environments and especially with web applications.

Two different cases with fundamentally different demands on the GUI are possible to identify. In the first case the user explores and tries to comprehend a process model all by himself with no one besides the computer to interact with. This situation calls for a carefully designed GUI, especially if the process model is based on a methodology unknown to the user. The second case is the situation where a process model is presented by a lecturer to a group of people. Tools for presentation must support the demands of this situation; possibilities to reveal details in an adjustable pace, means of hiding irrelevant details, smooth export from the modelling environment to the presentation environment, flexible navigation (not just sequential), and so forth.

Introduction to process management

29.5.2000

Rikard Berg von Linde
Royal Institute of Technology
Stockholm, Sweden

What is a process?

A definition:

A description of a set of related activities that, when correctly performed, will satisfy an explicit goal.

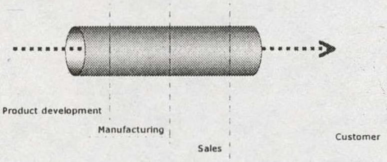
What is a process?

In ordinary words:

A process is what happens in an enterprise, step by step, until the customers get their products.

What is a process?

A process is a tunnel through the enterprise:



What is a process?

The difference between a process and a project:

The process is continuous and repetitive, the project is time-limited.

The railway is the process and the trains and the journeys are the projects.

What is process management?

Process management is:

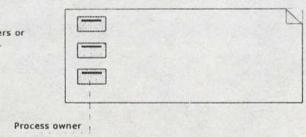
1. Focusing on the processes of the business
2. Control of processes
3. Improvement of processes

Process modelling

How to model - a simple modelling methodology

Step 1

Define process owners or process participants.



Process modelling

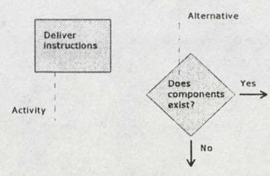
How to model - a simple modelling methodology

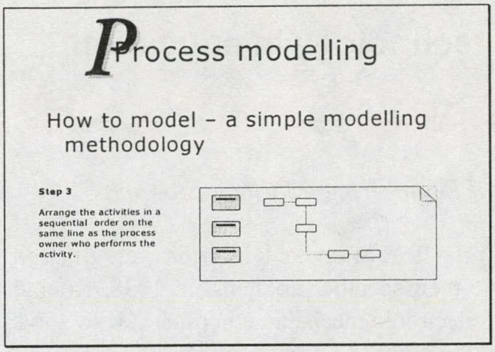
Step 2

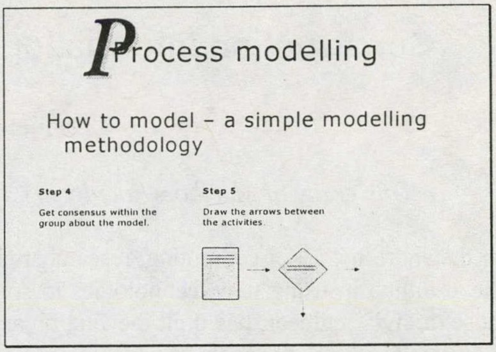
Formulate activities.

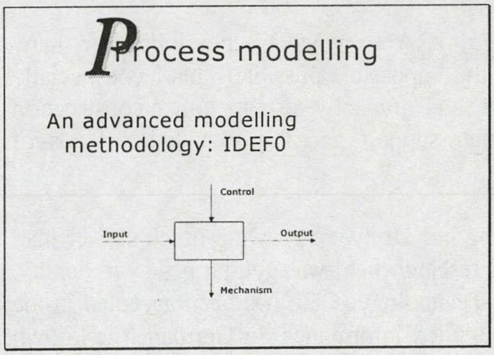
Use verb and nouns, i.e. "write minutes".

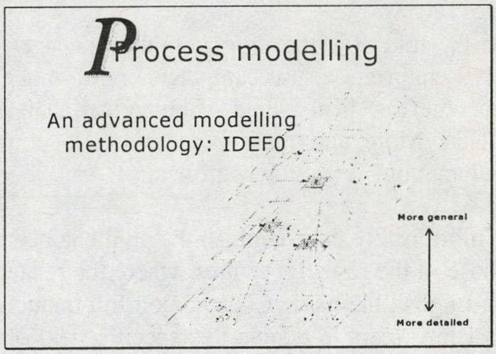
Use rectangles for activities and rhombus for alternatives.

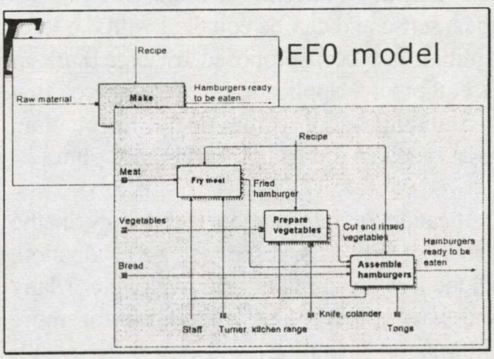


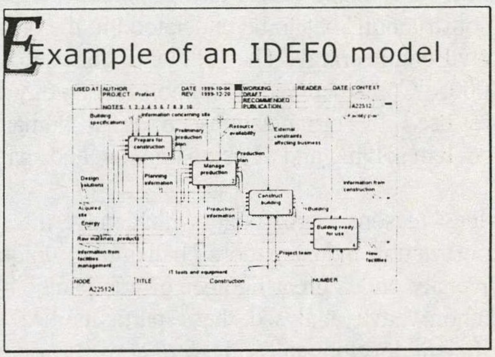

Process modelling
How to model – a simple modelling methodology
Step 3
Arrange the activities in a sequential order on the same line as the process owner who performs the activity.

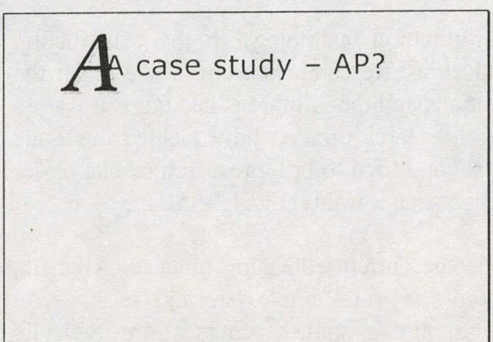

Process modelling
How to model – a simple modelling methodology
Step 4
Get consensus within the group about the model.
Step 5
Draw the arrows between the activities.


Process modelling
An advanced modelling methodology: IDEF0
Control
Input
Output
Mechanism


Process modelling
An advanced modelling methodology: IDEF0
More general
More detailed


EF0 model
Recipe
Raw material
Make
Hamburgers ready to be eaten
Recipe
Meat
Fry meat
Fried hamburger
Vegetables
Prepare vegetables
Cut and rinsed vegetables
Bread
Assemble hamburgers
Hamburgers ready to be eaten
Knife, colander
Staff
Turner
kitchen range
Tongs


Example of an IDEF0 model
USED AT
AUTHOR
PROJECT
DATE
REV
WORKING
DRAFT
RECOMMENDED
PUBLICATION
READER
DATE
CONTEXT
NOTES 1 2 3 4 5 6 7 8 9 10
A225124
Prepare for construction
Manage production
Construct building
Building ready for use
NODE
TITLE
Construction
NUMBER


A case study – AP?

Construction information technology in education

Danijel Rebolj

University of Maribor, Faculty of Civil Engineering, Maribor, Slovenia

In the short history of computing, researchers in the field of civil engineering were often in the frontline in using new technologies to solve their specific problems. In 1938, Konrad Zuse, a civil engineer, has built the first binary electronic-mechanic computer Z1, to solve the static problems of constructions that were getting more and more complex.

In the mid 50's the programming language FORTRAN opened the possibility for many civil engineers to use computers and to make the impossible possible. This has especially become true in the field of numerical analysis, and gradually also for other construction fields. More and more processes got computer support and the so-called "islands of automation" were slowly growing.

Unfortunately the islands in the civil engineering industry were growing much slower than those in the research centres, where the related research field was getting it's own identity. In English the name Construction Information Technology (CIT) has been accepted in the last few years to denote this specific field of applied informatics. In German it is known under the name Bauinformatik and in Slovenian as gradbena informatika. Hereby "construction" has to be understood in the broadest sense and can be equalled with the term "civil engineering". The following concise definition has been proposed by Žiga Turk in 2000: "Construction information technology is equipment, applications, and services that are used by organizations to assist human communication, commitment negotiation, problem solving and decision making, and spans over several civil engineering disciplines."

Many reasons were found which make the application of information technology in the construction industry more challenging: uniqueness of products, dispersion of production, diversity and a great number of companies included in the building life cycle, etc. Many authors have analysed these particularities and have tried to lay guidelines for more efficient development and use of construction information technology.

It has been often noted that the intake of information technology in the construction industry has been slow, slower than in other industries. Researchers seem to live under the impression that they have all these fantastic solutions and that all that is lacking is a way to make the construction industry use them. Several research projects have tackled this issue from the perspective of educating the practitioners and tried to bring research results closer to the practice (e.g. SCENIC) or asking the practice what it wants (ELSEWISE).

We believe that a part of the reason also lies in the current education practice. After all, students are powerful agents of change when they are employed, and a powerful technology transfer mechanism. During undergraduate studies, courses are typically available that introduce computer science, elementary programming, office and CADD software. The students are supposed to master skills so that they could use computers in the assignments given in the professional, engineering courses. During these courses they also learn about particular software that tackle that particular area, for example finite elements solvers, planning and scheduling software, proportioning and reinforcement design programs etc.

And here lies the problem; (1) none of the above actually fits the definition of construction IT, (2) this way of learning about discrete, unconnected software tools only widens the "sea" between the "islands of automation" and (3) does not educate in an area where the potential of IT in construction is the largest - in integrating the fragmented profession and thus providing a holistic perspective.

At present the share of IT subjects in undergraduate civil engineering curricula varies considerably from university to university. Typically there are general introductory courses and specialised courses on IT applications like design of building models, technical drawings, finite element and heat loss programs for the determination of physical behaviour, systems for construction management, or systems for enterprise resource planning. The courses are, however, mostly unconnected from the aspect of information technology. Graduates, coming to the construction industry, only know how to use the existing information systems, but have no idea of the many hidden potentials of the IT of today. To improve this situation, some civil engineering faculties enriched their curricula by some advanced IT (and CIT) courses. Typically database systems, visual programming and component technology, Internet technologies, product and process modelling, general information system development, etc.

To reform undergraduate curriculum is, however, not an easy task. The question of how much IT a civil engineer needs has very many very different answers. Therefore Construction IT postgraduate course seems to better suit the needs. Since adequate human resources and experiences in Construction IT are scarce it has been proposed to join forces and develop an international multi-institutional postgraduate course. The idea was first presented and discussed at the CIB W78 conference "Construction IT 2000" in Reykjavik on 29th of June 2000. 18 participants, mainly professors from European, but also from other universities, have expressed their interest to join. This interest led to a joint development project, which has already been followed by a Socrates Erasmus curriculum development application with the goal to offer a European Master programme in Construction IT.

Construction Information Technology in Education

Prof. Danijel Rebolj
University of Maribor,
Faculty of Civil Engineering

Overview

- What is CIT?
- The history of CIT
- The history of CIT in education
- Comparison of some curricula
- A dilemma: more or less?
- FG.UM model

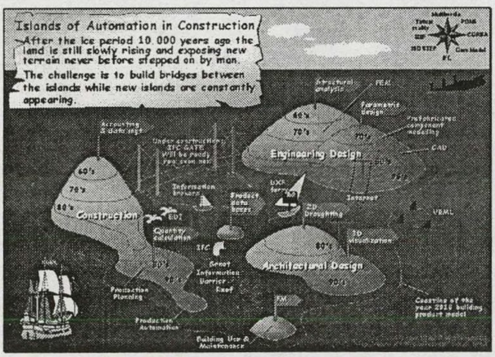
What is CIT?

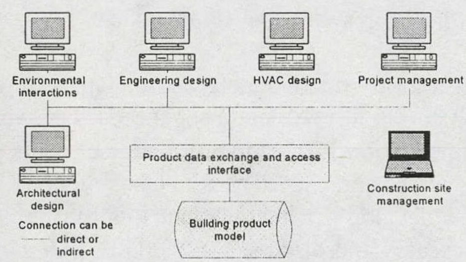
Construction information technology (CIT) is IT equipment, applications, and services that are used by organisations to assist human communication, commitment negotiation, problem solving and decision making, and spans over several disciplines in construction (= civil engineering).

Source: Žiga Turk, 2000

The history of CIT

- Early days (Konrad Zuse & Z1, 1938)
- First steps (FORTRAN, 1955)
- First island applications (STRESS)
- Computers come to companies – the era of computer centers and 1001 applications
- PC's → networks → need for integration
- New organisational concepts, collaboration and shareing





Source: B.C. Björk, 1999

History of CIT in education

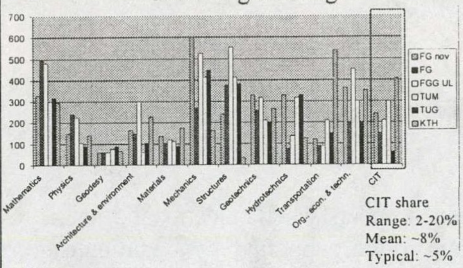
- 100101101110, ALU, registers,...
- FORTRAN & algorithms
- FORTRAN v. BASIC v. Pascal v. C...
- Programming techniques
- Use of computers in "other" subjects (but mainly SA, CAD & PM)
- OOP, Databases, visual & web tools, computer graphics,...

Curricula comparison

Institutions observed

- KTH
- TU München
- TU Graz
- University of Ljubljana
- University of Maribor

Civil Engineering



CIT share
Range: 2-20%
Mean: ~8%
Typical: ~5%

Curricula comparison

Typical subjects

- Introduction to Computer science
- Computer programming, OOP
- Algorithms
- CAD tools and methods, CA*
- Structural analysis, FEM
- Database technology, SDB & GIS
- Construction IT

CIT in education now

- diversity of freshmen background
- diversity of views between universities
- diversity of views on institutions (every professor has her or his own point of view)
- very few CIT departments

⇓

- diversity of CIT subjects in curricula

Dilemma: more or less?

Arguments for "Less"

- Because of intuitive OS (mainly graphical user interfaces) there is no need to know much about backgrounds of computer and information science
- Computers should mainly be used and applications learned in civil engineering subjects – as they are in practice

Dilemma: more or less?

Arguments for "More"

- Information revolution is a fact, transformation into information society is in progress
- New IT gives new opportunities
- To efficiently use IT it is essential to understand the principles and concepts
- CIT can't be improved in practice without understanding new possibilities of IT

FG.UM model

Concepts

- String of subjects covering CIT themes from fundamentals to holistic models - in undergraduate courses
- Postgraduate course on CIT
- Use of computers in other subjects is related to CIT string and stimulated
- Assuring infrastructure (HW, SW, NW)
- Stimulating projects like "Student PC"

FG.UM model

CIT subjects (undergraduate)

1. Computer and information science fundamentals (history, HW, OS, languages)
2. Information technology (programming techniques, RAD, DBS, GIS, Internet)
3. Information systems (IS life-cycle, design techniques, integration methods,...)
4. Computer integrated construction (PPM, collaborative design & construction)

Thank you !

Danijel Rebolj, UM.FG Construction IT Centre

Learning for distance working

Žiga Turk

University of Ljubljana, Faculty of Civil and Geodetic Engineering, Ljubljana, Slovenia

Distance learning is a formal learning activity which occurs when students and instructor are separated by geographic distance or by time, often supported by communications technology (Glossary of Terms for Higher Education and Distance Learning, Indiana College Network Web Site, http://www.icn.org/resources/glossary.html). Distance learning is not an invention of the information age. First correspondence courses were set up in mid-late 19th century in England and gave the participants formal degrees of education. First university level distance learning program was created at the University of Chicago. It is quite common in Italy and India, where special TV channels are broadcasted from the satellite. Reputation of distance level courses varies and is generally worse that that of the traditional courses.

Traditional distance education "technologies" include print, books, audio, video and computer based training materials such as drill and practice programs, courseware, presentations, kiosk systems, guided tours, electronic books, hypertext systems, simulations and interactive programs. Internet based distance education offer all of the above and in addition the possibility of interaction student - courseware, student - student, student - faculty. Current state of IT enabled interaction is a poor replacement for live interaction. Therefore, distance learning should look for motives elsewhere.

Distance education has been possible for some time, however, it is only recently gaining interest with the members of the academic community. The author believes there are three main reasons for this change: (1) the professors like to be in control of the publication process. They are in control of chalk and blackboard, of the typewriter and typesetting process of a book, but very few filmed videos or any other kind of multimedia courseware, because it requires highly specialised knowledge or dependency on those, that have it. Recently it became possible to desktop-publish course materials and technology to develop interactive courseware is maturing as well. (2) in some fields of technology there is a lot of research and development in the industry as well and academic research is lagging behind. Educational topics are such that are not threatened by the industrial research. (3) distance learning can prepare the students for distance working. Civil engineer's job is such that can be done over a distance - engineers produce information that can be encoded in bits and bytes. In the remainder of the summary, the author would like to suggest a few other motives.

Education is traditionally considered a transfer of knowledge. This narrow view has been criticized by Schoen and others who pointed to pre-rational knowledge and tacit knowledge, to education as building up responsibilities, education for working a social context etc. They found that knowledge is in the working, that problem solving is relatively easy compared to problem setting. Problems need to be constructed from messy, uncertain situations. Theoretical models and derivations of formulae lectured at theoretical lessons and recipes given at exercise lessons do not provide this kind of knowledge. Work happens in a social context. It is not input-processing-output but giving and accepting commitments. See Turk, 1998 for more on this topic and views.

Education goals in engineering education should therefore be (1) to move the focus from problem solving to problem setting, (2) from scientific rigor to professional relevance, (3) from parts to whole, (4) from processing to commitment negotiation. Education should be (a) integrated within the discipline - classes should exist that pull together all the pieces of knowledge. (b) Education should be interdisciplinary and involve other professions from the AEC, it should admit that (c) the knowledge is in the doing, it is with the practitioners, and it should involve these practitioners in the educational process. Education should (d) respond to the globalisation by working internationally and by using communication technology, (e) provide the students the tacit knowledge of distance working technology (that is similar to distance learning technology), and finally (f) set up a pattern for continued distance education that will provide continuing education to professionals.

Communication technology and distance learning methods are an enabling factor to achieve this. With using distance learning technologies one should not replace any current class with a distance learning one; instead it should enable the transitions mentioned in the previous paragraph.

Education for Distance Working

Žiga Turk
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FGG-IKPIR

Overview

- what is distance education
- history of distance education
  - distance learning is not new
- why distance education is important now?
  - because of distance working
- goals of education for distance working

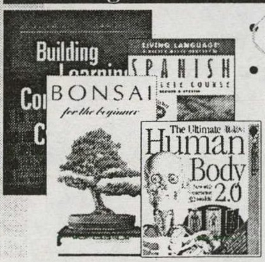
What is distance learning?

- Distance education takes place when a teacher and student(s) are separated by physical distance and technology, that is, voice, video, data, and print, is used to bridge the instructional gap." (Barry Willis, 1994)

History of distance education

- First correspondence course in mid-late 19th century in England.
- First university distance learning program through an extension program at U of Chicago under the direction of William Rainer Harper in 1892
- common in Italy, India and all over the world
- questionable reputation at University level

Traditional distance education technologies



- print, books
- audio, video, computer based training materials
- combination packages

Internet based distance education

- same as above + interaction
  - student - courseware
  - student - student
  - student - faculty
- IT enabled interaction is a poor replacement for live interaction

Recent growing interest in distance education

- because desktop publishing of multimedia courseware is becoming available
- because it is needed for teaching distance working

Tempora mutantur ...

- globalization, internationalization
- digitalization
- cost of structure vs. life cycle cost
- ways of study similar as ...

Impact on engineering

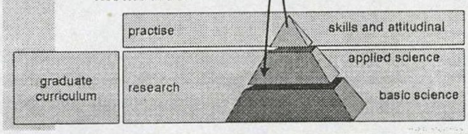
- engineers produce information
- rednecks make buildings
- information can be transferred digitally
- opportunity and reality of distance working
  - happening now: outsourcing
- students are agents of change, no time to collect experience for years, as with professional knowledge

Education

- education as transfer of knowledge
  - what is it? where is it? how it shows itself?
  - rational knowledge
  - pre-rational knowledge, tacit knowledge ...
- education as building up responsibilities
- education for working a social context

Traditional education - knowledge:

- design is problem solving
- problem solving: application of rigorous methods and principles based on sciences
- rational, transparent, methodical

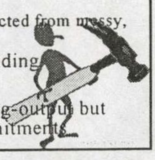


Critique, alternatives ...

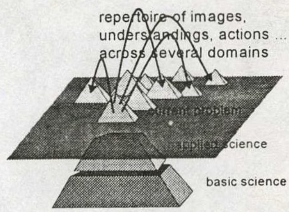
- Heidegger, Gadamer, Austin, Searle
- Winograd, Penrose, Dreyfus&Dreyfus
- Thomas Kuhn
- Donald A. Schön (MIT)
  - how professionals think in action

Findings:

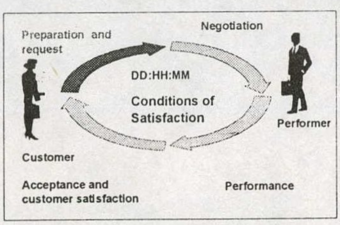
- knowledge is in the working
- problem solving is relatively easy
- problem setting
  - much harder than problem solving
  - not taught!
  - problems need to be constructed from messy, uncertain situations
- models and recipes are blinding
- work in a social context
- work is not input-processing-output but giving and accepting commitments



Problem solving in practice



Giving and accepting commitments in practice



Education goals:

PROFESSIONAL KNOWLEDGE

- from problem solving to problem setting
- from scientific rigor to professional relevance
- from parts to whole
- from processing to commitment negotiation

OTHER ISSUES

- to integrate within discipline
- to get interdisciplinary (involve AEC)
- to involve industry
- to work internationaly
- IT: enabling factor

Conclusions

- Distance learning is not so important:
  - to replace any current classes with a distance learning one
- Importance of distance learning:
  - to get tacit knowledge of distance working tools
  - to set up a pattern for continued distance education habits
  - to provide continuing education to professionals
- Opportunity:
  - modernize curriculum related to professional knowledge

The end

Collaborative structural design

Tomo Cerovšek

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The presentation is focusing on the importance of collaborative work in engineering education. Collaboration has a crucial role in structural design especially during conceptual design as well as at any other stage where engineer needs to interact with others. Structural engineering is one of the typical professions that require cross-functional collaboration due to the fact that individual work in isolation usually results in double work, delays, inconsistency, extra costs, etc. To brace the debate several positive experiences related to the best practice in AEC collaboration were presented. These experiences were gained by the author while actively participating in PBL (Project Based Learning) Course at Stanford University (also known as AEC Global Teamwork). After brief introductory notes and familiarization to the topic, major issues were exposed. Through critical discussion on current practice in most of the traditional engineering schools in Europe and elsewhere, a straightforward problem statements were given: (1) Existing common practice in engineering education excludes collaboration from learning environment, (2) Collaboration means multidisciplinary teamwork and that is hard to teach, (3) Conceptual design as one of the most creative parts of structural design is not covered in current curriculum.

Rationale behind these three statements lays in the fact that current learning set up does not cover several very important aspects. These aspects are related to the fact that the industry is the final client of the education process and they are the one who expect from students to be prepared for the real-life situations. The education system in the As-Is state does not encourage the development in the direction of effective teamwork and interpersonal skills as well as it does not pay attention to the development of problem solving skills. These personal qualities are proven to be crucial for successful integration into productive as well as creative working environment. Due to historical reasons individualism and lexicographic knowledge are prevailing characteristics of successful student. Many specialists in the field of education have emphasized the controversy of traditional education process in that the more successful a person is as a student, the more likely they will encounter problems of applying their knowledge. The major shift towards better process is to define problems appropriately so that they will include the development of structural concepts and interaction. PBL was presented as a pedagogical method for contextualization, real-life problems that occur during the project. While working on the project collaboration with architects and others takes place. Even if they're geographically dispersed, the use of Internet technology can solve the barrier. PBL Course at Stanford showed that such kind of work is even possible worldwide. Besides positive experiences to motivate others to adopt PBL, remarks on several obstacles were made.

Collaborative Structural Design

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Content

- Introduction
- Problem statement
- Collaboration and Structural design process
- Best practise example: PBL Course
- Conclusions

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Introduction

- Merriam-Webster's definition: to work jointly with others or together especially in an intellectual endeavour
- Structural engineers' involvement in the building project demands collaboration with other parties.

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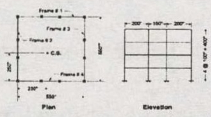
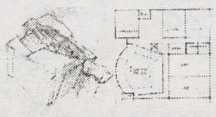
Collaboration in education

- School practise
  - Problem starts with defined structural sys.
  - Individual work



- Real projects
  - Problem starts with architectural concept
  - Team work



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Problem statement

- Current status in education exclude collaboration from learning environment
- Collaboration means multidisciplinary teamwork and that is hard to teach
- Conceptual design as one of the most creative parts of structural design is not covered in current curriculum

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Collaboration&Struct. design

- Collaboration takes part in all phases:
  - Pre-Project planning
  - Project planning
  - **Conceptual design**
  - **Preliminary design**
  - Detailed design
  - Construction
- Collaboration with almost all parties

- Non collaborative environment leads to:
  - Low quality, inconsistent building project
  - Conflicts between discipline professionals
  - Waste of time and material,...
- Extra costs, Delays

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PBL experience

- About PBL:
  - PBL stands for Problem, Project, Process, People Based Learning,
  - Organised since 1993 by dr. Renate Fruchter, Stanford University to educate next generation of AEC professionals
  - Work in multi-disciplinary, geographically distributed teamwork

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Project activities

- Alternative = composed of comlete set of AEC solutions
- Each team must provide 4 overall alternatives for two footprints with focus on the process itself

- Team activities
  - Concept development phase concpetual 3(d models, quick calc.)
  - Prliminary design phase (use of tools to support discipline tasks, collaborration, shared model, archive,...)

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Multi-disciplinary teamwork

- Facts:
  - Decisions have effect on other disciplines
  - Each participant must provide multidisciplinary interpretations
  - Response is needed before you can proceed with work
- Effects:
  - Shared project space must be provided
  - Understanding others' discipline perception speeds up the process
  - Dependency on human resources involves social categories

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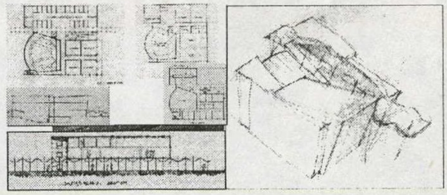
Architectural input (example)



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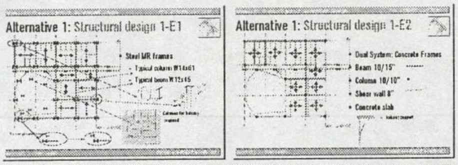
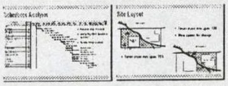
Structural solutions





- Structural concepts include material and structural system variations schematically showing distribution of vertical and lateral forces

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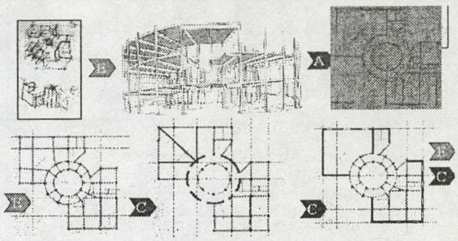
Example of AEC interaction



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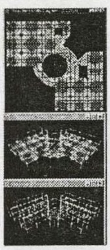
Structural evaluations

Structural systems: Pros and Cons

Structural System	Advantages	Disadvantages
Steel Frames	Redundant Large energy capacity	Non-structural components Flexibility, Pounding, > welding
Braced Frames	& Reduced Frame members Easy & fast, < field welding	& Worst energy dissipation capabilities, Close the space,
RC Frames	& more places for Energy dissipation	Confinement requirements Complicated joints (reinforcement)
Structural Walls	Large stiffness High strength	Low ductility (not designed prop.) Close the space & view
Dual Systems	If properly combined (W $ F) Advantages of both systems	Complicated behaviour (different mechanisms)



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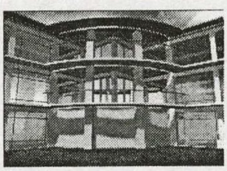
Example of final solutions



- Multiple alternatives through conceptual design provide efficient way for practise of collaboration and team work.
- Preliminary design uncovers uncertainties that were hidden in conceptual design phase and needs evaluation

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Geographically distributed

- Consequences:
  - Different time zones
  - Limited accessibility to project documents
  - Technically harder to communicate
  - Requires additional computer skills for successful operation
- Solutions:
  - Time co-ordination
  - On-Line collaboration environment
  - Videoconferencing and application sharing
  - Learning setting must include additional IT education

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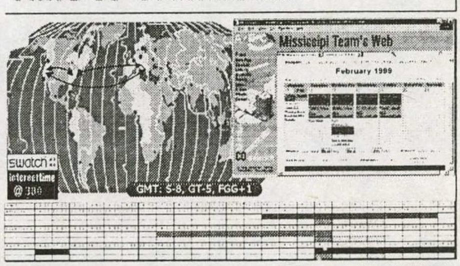
Time co-ordination



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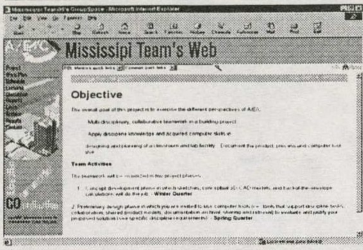
WWW shared groupspace



ftp, http
share
archive
project tracking
coordination
linking
delivery

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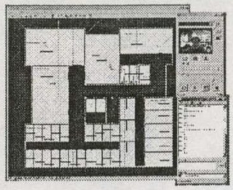
Videoconferencing



- Face to face meetings and application sharing provide sufficient infrastructure for exchange of information
- Capturing interaction can provide valuable information to analyse design process and especially conflicts

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Conclusion

- School should educate teamwork, give more attention to symbolic models and provide efficient attitude to conceptual design
- Computer tools for support of conceptual design phase should be developed
- Infrastructure and tools for On-line collaboration can solve some of the issues

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Distance learning in earthquake engineering – practical example

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The current procedures in earthquake resistant design have been developed during an evolutionary process based on the observed behaviour during strong earthquakes. Therefore, it is important to visit earthquake sites to build the "feeling" for the behaviour of structures subjected to strong seismic loading. However, only few people have had opportunity to visit damaged areas after earthquakes. Until recently, the only alternative has been to visit lectures supported by slide projections.

During his twenty years of teaching experience, the first author has realised several impediments of such approach. The lectures are fixed in time and space. It is difficult for audience to maintain concentration and make notes in the deemed light environment. The background and interest in the audience typically differ from person to person and it is difficult to formulate the appropriate level of additional explanations. Up to recently, the only alternative has been to either prepare copies of slides with commentaries, or print reconnaissance reports. Both are typically very expensive. In addition to this, printed material should always follow a predefined concept (by the type of structure or by the type of material for example). It is frequently difficult to look over such material and cross-references are typically tedious. Modern information technology provides, however, an excellent opportunity to disseminate such empirical knowledge.

The solution, which is not any more fixed in place, is a video-conference using simple PowerPoint presentation. If pre-recorded such lecture is also not fixed in time. While such presentations do not overcome most other above-mentioned problems, they can include some additional features, like (Web supported) response animations to enhance the interest of the students.

However, the Web certainly encourages entirely new ways of publication and enables inexpensive publishing of content, which could not been printed on paper. As an example, the earthquake engineering slide information system EASY is presented. EASY is a hypermedia tool based on digital slides to learn from post-earthquake investigations. The core of the tool consists of 500 digital images showing earthquake damage after recent major earthquakes. While many data bases with earthquake related images exist on the Web, extensive commentaries are probably the most distinguished feature of the EASY. They include short captions, detailed global descriptions and general descriptions of different causes of failure. Links to related slides and information are also provided. The system offers state-of-the art navigation, browse and search options using a combination of database technology and friendly Web hypertext interface. The system is available on the Web (http://ikpir.fgg.uni-lj.si/EASY) and on the CD-ROM.

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Open and Distance Learning in Technical Education
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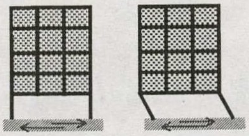
DISTANCE LEARNING IN EARTHQUAKE ENGINEERING
- practical example

by Matej Fischinger & Tatjana Isaković

INTRODUCTION

(Earthquake) engineering is strongly based on



- experience
- intuition & feeling for structures

IDEA

IT can be used to disseminate and enhance empirical knowledge

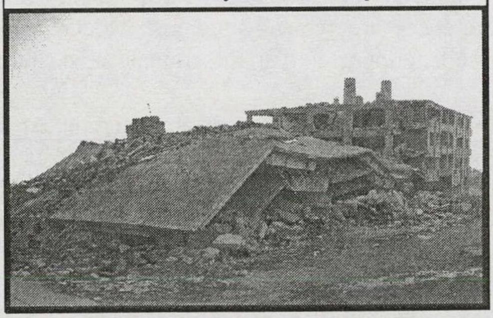
SOME OPTIONS

- PowerPoint presentation
- Response animation
- Information system on the Web and CD

EXAMPLE (1)
PowerPoint presentation

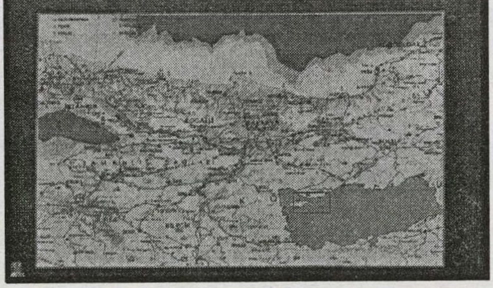
Lessons learned from Turkey 1999 earthquake

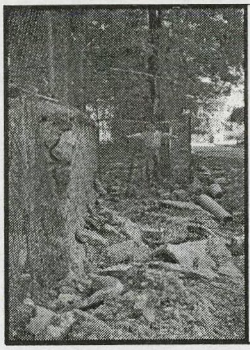
One of many total collapses



Social consequences

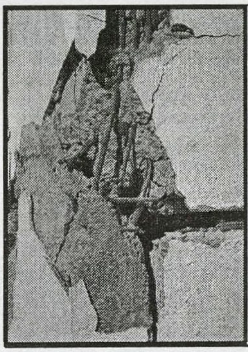
Damaged area





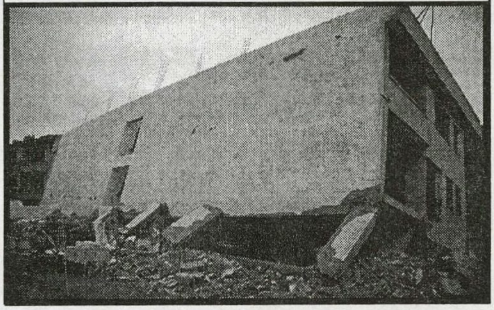
Slip along the fault

Soil problem (liquefaction)

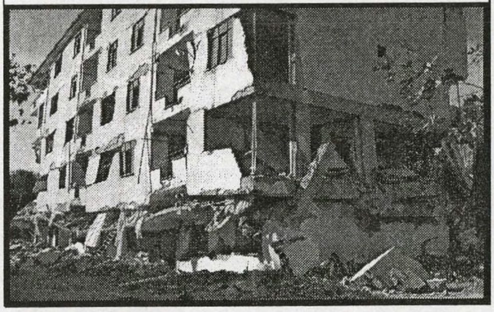


Poor detail (insufficient anchorage)

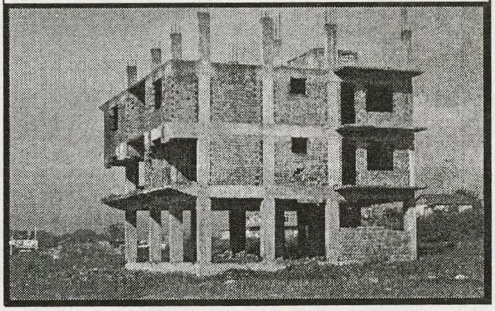
Collapse in the weak direction



Collapse of the infilled frame



Typical structural system (weak story)



EXAMPLE (2)
Time-history animation

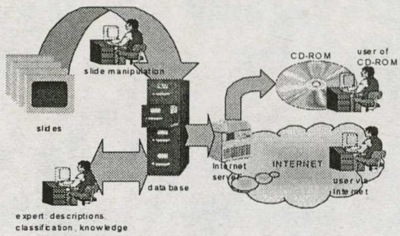
Collapse mechanism of an infilled frame

EXAMPLE (3)

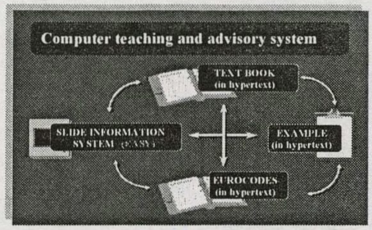
Earthquake
Engineering
Information
System EASY

http://www.ikpir.fgg.uni-lj.si/easy

System components



FUTURE WORK



CONCLUSIONS

- IT offers teaching opportunities far beyond classical education process
- We are looking forward to work on this exciting project.

From the earthquake to structural behaviour

Gaetano Manfredi

University of Napoli Frederico II, Naples, Italy

In the frame of the TEMPUS UM-JEP 14131-99 "Open and Distance learning in Technical Education" case studies in the field of the earthquake engineering have been planned. This field has been chosen as representative field because it involves various types of knowledge, which are very demanding and challenging to teach, to learn and to present. To illustrate these types of knowledge, a lesson typical for earthquake engineering is presented.

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D.A.P.S.

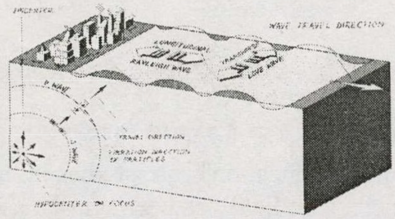
Tempus Jeep 14-131
Lubjiana - May 29 2000

Learning Structural Response from Earthquake Characteristics

Prof. Gaetano MANFREDI

D.A.P.S.

Seismic phenomena depends on complex mechanism: from fault rupture to building response



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Main question in seismic engineering

How the ground motion characteristics influence the structural damage ?

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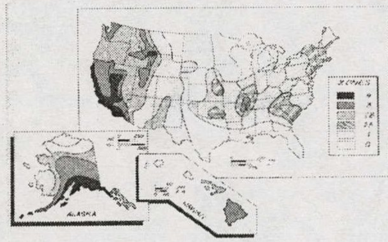
Seismic hazard depends on seismological aspects



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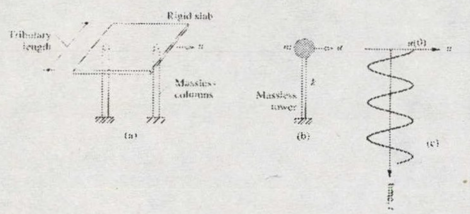
Structural response under seismic actions can be simulated using simple models: SDOF system.....



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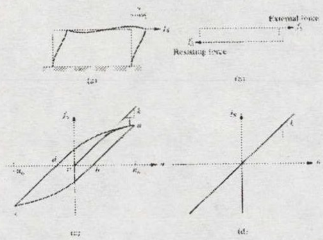
..... but force-displacement relations can be complex: from linear to non linear degrading behaviour



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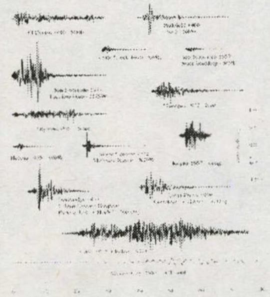

Ground motions recorded in the world are very different

Which characteristics can measure the damage potential ?

D.A.P.S.

Ground motion parameters and damage measures

Peak parameters

PGA	**peak ground acceleration**
PGV	**peak ground velocity**
PGD	**peak ground displacement**

PGA/PGV ; PGD/PGV ratio

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PGA is a basic measure of earthquake potential, but is not totally reliable;

PGV seems to be a more representative measure of earthquake potential, as it related with energy demand;

PGV/PGA is indicated as measure of destructiveness

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Ground motion parameters and damage measures

Integral parameters

$$RMSX = \left[\frac{1}{t_E}\int_0^{t_E} a_g^2(t)^2\,dt\right]^{1/2}$$ **Root mean square acceleration**

$$I_A = \frac{\pi}{2g}\cdot t_E \cdot RMSA^2 = \frac{\pi}{2g}\int_0^{t_E} a_g(t)^2\,dt$$ **Arias intensity**

$$I_D = \frac{2g}{\pi}\frac{I_A}{PGA \cdot PGV}$$ **Cosenza – Manfredi damage index**

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Integral parameters are more effective for measuring the energy content of earthquake

Arias Intensity can be related to energy

I_D can be related to number of plastic cycles and, therefore, to energy

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Ground motion parameters and damage measures

Integral parameters

t_E **Total Duration**

t_D **Effective Duration**

t_B **Bracketed Duration**

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Definition of duration from a structural point of view

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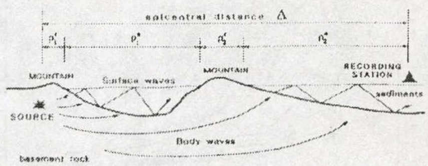
$$t_E = t_{fault} + t_{propagation} + t_{local\ effect}$$



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Experiences from different earthquakes have confirmed that the duration of ground motion largely influences the level of structural damage.

Records with large acceleration and spectral values produce slight damage if the duration is short, whereas records with low acceleration and long duration can be very destructive

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Linear response behaviour

T elastic period

ξ damping

Linear response spectra

Ae(T)=Ce·PGA $T<T_1$

Ve(T)=Cv·PGV $T_1<T<T_2$

De(T)=Cd·PGD $T>T_2$

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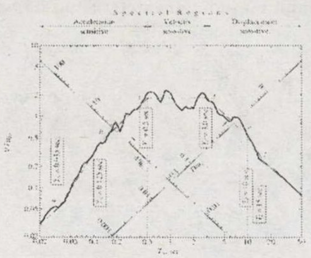
Trilogarithmic representation of elastic spectrum



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Linear response behaviour

Ae,m maximum pseudo acceleration

Ve,m maximum pseudo velocity

De,m maximum displacement

$$I_s = \int_{0.1}^{2.5} V_e(T)dT$$ **Housner Intensity**

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The maximum pseudo-acceleration, Ae,m, is a measure of the maximum strength demand of the earthquake

The maximum pseudo-velocity, Ve,m, is a measure of the kinetic energy of the earthquake

The Housner spectrum intensity, Is can be interpreted as an integral measure of the energy demand

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Non Linear Response Behaviour

$\mu=\delta u/\delta y$	**Ductility**
$Ap(T)=Ae(T)/R(\mu)$	**Inelastic spectrum**
$R(\mu)$	**Reduction Factor**

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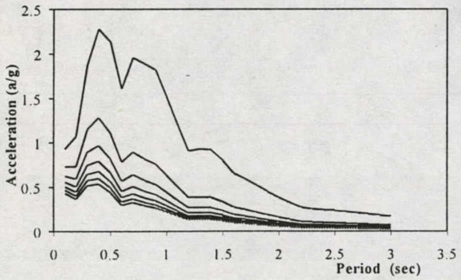
KOBE 1995
Response Spectra



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Non Linear Response Behaviour

E_h	**hysteretic energy**
E_i	**input energy**
n	**number of plastic cycles**

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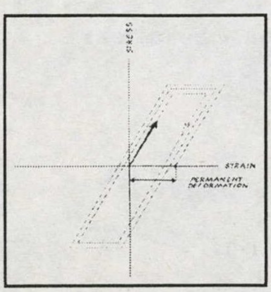

Hysteretic behaviour

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The demand of Eh is an effective measure of the damage potential of the earthquake

The input energy Ei from ground motion depends mainly on the elastic period of the structure and on the seismic record, whereas it is slightly influenced by the viscous damping and by ductility. Therefore the input energy has been assumed as a measure of the energy content of the earthquake.

Main parameters for different records

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Terremoto	Record	PGA [cm/s²]	PGV [cm/s]	PGD [cm]	t_D [s]	I_A [cm/s]	I_D	Ae	Ve	De
Nahanni	S1 – L	1080.5	46.2	10.4	7.92	462.5	5.50	2.2	1.6	0.4
Kobe 1995	JMA - NS	817.8	92.0	71.8	8.34	838.4	6.91	2.3	2.8	0.6
Chile 1985	Llolleo –N	639.5	41.1	14.2	35.68	1520.8	35.84	2.4	2.7	1.3
Ancona 1972	Rocca NS	538.1	10.9	5.5	2.85	67.8	6.94	2.6	2.6	0.6
Montenegro1979	Petrovac - NS	429.3	41.3	8.2	10.52	446.2	15.35	3.0	3.0	3.0
Friuli 1976	Tolmezzo WE	315.2	32.6	4.6	4.93	119.9	7.25	2.7	2.2	1.5
Bucharest	Incerc – NS	192.3	69.0	18.1	15.58	71.4	3.66	2.7	2.3	2.2
Mexico 1985	SCT –EW	167.9	61.8	21.9	38.82	243.8	14.55	3.1	3.4	3.8
Campano-Lucano 1980	Calitri WE	156.0	20.9	19.0	47.17	134.1	17.85	2.9	1.8	1.9

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Main question in seismic engineering

How the ground motion characteristics influence the structural damage ?

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Answer

The ground motion parameters that can be assumed as damage measures depends on structural behaviour in linear and non linear field

In general peak parameters influence response of non-degrading systems

In the degrading systems integral measures and/or duration have an important role