Net-distributed Co-operation Including Developing Countries, Practical Case Study - Iran

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Summary
The scientific transfer of key technology features to developing countries, together with adequate competence, localisation and adaptation, is the primary purpose of the proposed investigation. It is evident that introducing high-level CAD design and detailing will improve the planning process in developing countries. Successful utilization of applied information technology for the planning process, however, depends on the user-interface of individual software. Therefore, to open the great opportunity embedded in CAD software for clients globally, the language and character-set barrier of traditional user-interfaces must be overcome. A proposal for a research program is given here to address such issue in favour of global civil engineering.

1 Introduction
If efficiency and annual output of building industry in countries like Iran are not significantly improved, they cannot provide sufficient housing for the population. The very limited capacity of building industry in developing countries is mainly due to its undeveloped planning process, including distributed design and detailing. This is even the case in countries like Iran with adequate internet services and widespread use of PC's in academia and industry.

In order to solve the above mentioned problem, computer integrated planning process can be used as a crucial tool for powerful and efficient civil engineering with global competitiveness. Subsequent to CAD design and detailing, all consecutive processes for industrial fabrication can be done using efficient and precise practice of German advanced technology, such as CNC-machines. Successful utilization of applied information technology in CAD/CAM, however, depends on the user-interface of individual software. The interface must be easily understandable by the user and should cause no confusion. Therefore, to open the great opportunity embedded in CAD software for clients globally, the language and character-set barrier of traditional user-interfaces must be overcome. Otherwise, this obstacle definitely prevents deploying high-level software in developing countries, even though the software is a well-proven best practice in today's German building industry.

Software using technical drawings independent of textual languages as user-interface can be understood and used by all engineers globally and, as a result, will add significant value to planning procedures worldwide. This key idea will also improve the planning processes in developing countries and can decisively help to address the issue of limited capacity of their building industry. Hence, the focus here is on the analytical formulation of how user-interfaces for "intelligent objects" of civil engineering software must look like in order to be clear to everyone in building industry without further help. It is equally important to appreciate that building components used in civil engineering differ from country to country for good reasons. Hence, the "intelligent" construction logic of CAD-methods for the detailing of connections and other components must also be established and customised as needed for typical localised solutions in developing countries.

The approach presented here can facilitate the transfer of German high-level technology internationally. Civil Engineers in developing countries are among beneficiaries of the outcomes of this research, because this will lead to a profound innovation of their respective industry and will make them fit for global competition. Building industry in Iran must particularly gear up to use such tools, if they intend to go internationally. This is their chance to make a successful transitional move to global markets and to make the local building industry strong enough for the challenges of the near future.

2 Statement of the Problem

Theoretical models are the basis for computer-aided analysis, design and detailing of structural engineers' tasks. In the building industry new object-oriented methods are used for product modelling, in which most diverse aspects of a building are described to reflect its characteristics, its construction units and their relations. However, the question is "how to build up models with the best proven international civil engineering software, if the engineers around the world do not understand the language of the user-interface?" In order to address this issue, the language and the character-set barrier are the essential obstacles to overcome.

The research approach for this goal, "Leitbild-Forschungsansatz", uses the fact that most information exchange in civil engineering is done by drawings. Technical drawings can be understood everywhere independent of languages or country-specific characters (if necessary, only numbers shown in drawings have to be changed to local characters by an automatic viewer process).

The conception of a specific user-interface for civil engineering independent of text and local character-sets offers the best chance to succeed in global software application. Icons are not enough to avoid languages and character-sets in applied software. For example, in spite of all graphic icons used in software intended for worldwide application (like MS-Windows or AutoCAD), user-interfaces fully independent of local languages and national character-sets cannot be deployed yet. Therefore, it is evidently a difficult scientific problem to conceive user-interfaces without the display of the text.

3 Literature Review

The subject matter is relatively new and has been dealt with differently in several research groups. For example, Chang, in his PhD thesis (2002), gave a full account on intelligent CAD objects of the building industry independent of national languages. The above investigation yielded some encouraging results and was a good start to solve such a scientific problem, which still needs more in-depth investigations.

Recent research has identified compose-ability, extensibility, and tailor-ability as key aspects of systems that support groups of interacting people. Component-based design is a means to achieve these requirements in groupware systems (Slagter *et al.* 2000). Meanwhile, component-based design of systems has evolved rapidly due to the progress in standardisation of component software, e.g., the OMG CORBA Component Model (Mischkinsky 1999).

Mischkinsky states that the CORBA Component Model (CCM) provides a platform and language independent component model (computer language and not country-specific). The standard model is still a work-in-progress. CCM components are designed to be interoperable with Enterprise JavaBeans (Mischkinsky 1999). These developments provide opportunities to construct groupware in a modular and extensible fashion and to standardise (interfaces of) common CSCW software components (Slagter *et al.* 2000).

De Farias *et al.* (2000) at Centre for Telematics & Inf. Technol., Twente Univ., Enschede,

Netherlands state that if two cooperative objects are implemented in different languages, their interoperation is hard to achieve unless a middleware platform based on international standards is used. They believe this is the kind of problem that component technologies set out to solve. Slagter *et al.* (2000) discuss in detail the problems that an engineer faces when she/he needs to discuss construction drawings with colleagues at different locations. For remote discussion of construction drawings the designer uses an application sharing tool (e.g. NetMeeting). In order to efficiently utilise this groupware functionality, she/he would like to have a "share" button or menu item in her/his (single user) CAD application. Selecting "share" should directly connect an engineer with the colleague, who authored the current drawing. This is an example, which concerns groupware integration. The interfaces provided by both components determine the ease with which they can be integrated (Slagter *et al.* 2000).

This literature survey reveals that despite the widespread research which has been carried out, there are not many published works available in this new field. Nevertheless, it is evident that software development for global purposes is currently a hot topic.

4 Hypothesis and Research Methodology

High-level civil engineering software contains “intelligent” objects, which behave reasonably after receiving decisive information from the user. This “intelligent” behaviour reduces the amount of necessary input and improves the chances to avoid text in technical drawings. Chang (2002) and Pegels , for instance, showed that “intelligent” CAD-methods can automatically design and detail complex connections of steel structures after obtaining a minimum set of necessary “what-to-do” information through a special user-interface, called “Leitbild” (see figure 1). Following their achievements, therefore, the focus here is on analytical formulation of “how Leitbild-methods for intelligent objects of civil engineering must look like” in order to be understandable for engineers worldwide without further help.

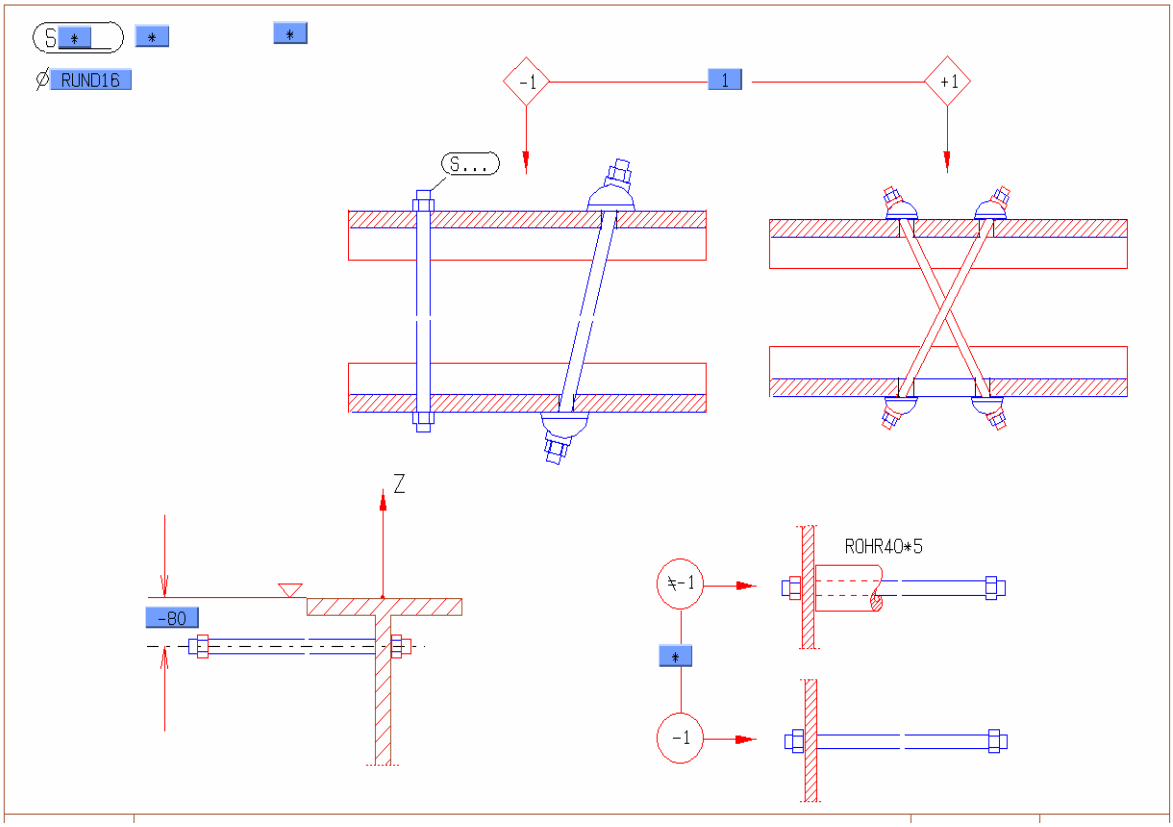

Figure 1: Leitbild - online documentation and input fields at the same time (Chang 2002).

In order to select variations almost text-free, the Leitbild-approach is already close to offer both online documentation and input fields via deliberately designed and arranged graphic views of an object. The user can enter any specific dimension directly into the input fields between the appropriate dimension lines of any object in the technical drawing. The object will readjust itself accordingly following the "intelligent" logic of its own. A specific construction component or a connection principle can also be selected just by a mouse-click on the selected variation. For example, figure (2) indicates that modification of building objects, such as beams, can be supported by specific grip-symbols, which are self-explanatory without the need for text and character-sets.

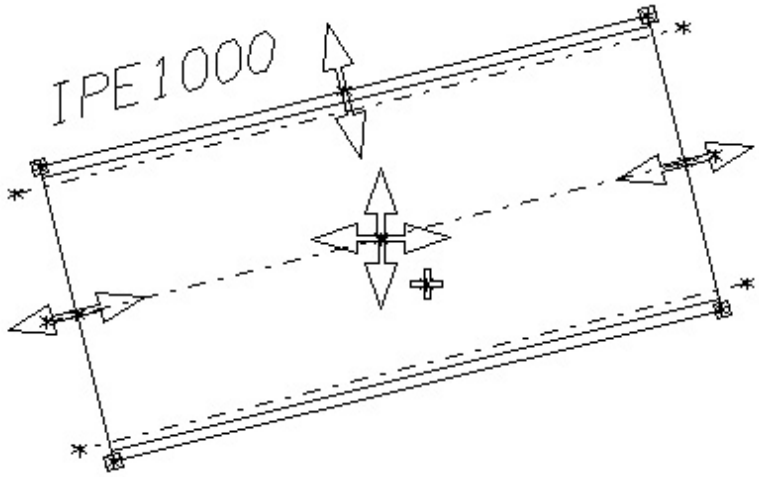

Figure 2: Text-free grip symbols to extrude, modify, move and copy beam objects (Chang 2002).

The conception of "how to globalise the user-interface of civil engineering software" is only one part of a complete solution, because components used in civil engineering differ from country to country for good reasons. In developing countries, building components and their connections should usually be more simplified and less sophisticated due to the lack of highly skilled manpower on site. Hence, the "intelligent" logic of CAD-methods for the detailing of these components and connections must also be found out and adapted, respectively. In order to do this, experienced judgement of facts and situations in developing countries as well as the theoretical principles of how to establish design logic is needed.

5 Beneficiaries

Iran immensely needs most advanced, applied computer science for civil engineering. The growth in population in Iran (65% of the population under 30 years) asks for very powerful and efficient building and construction processes to fulfil the basic needs of building and housing. By official estimates about 800,000 new residential houses and industrial buildings need to be built each year in Iran. Making civil engineering and the local building industry in Iran fit for this demanding task and simultaneously creating new jobs in civil engineering for the young generation can be among the benefits of this investigation.

The proposed formulation facilitates the transfer of German applied science and high-level technology internationally. Appropriate amendments for adaptation of global software to particular necessities of local labour force in each country can be made by continued joint research and development. Specific CAD-macros will be embedded into the software to carry out the detailing of components and connections. For localisation purposes these individual macros must be specifically designed and customised to make fabrication and construction straightforward. The basic environmental and industrial conditions (including tools used in each country) must also be brought into account.

This research also seeks a self-explanatory user-interface solution to the following issues:

- Connections and components used for steel structures in developing countries differ significantly from the ones embedded as CAD-macros in most high-level software. Therefore, the design and detailing logic of these lower level components needs to be found out and embedded into the software as CAD-macros. Furthermore, to use these components for the day-to-day design and detailing process in the environment of developing countries, a universal user-interface (Leitbild) based on specific technical drawings needs to be conceived for each relevant CAD-macro. A typical Leitbild for column footings as used in Germany is shown in figure (3). Note that just technical drawings with no text are used here.

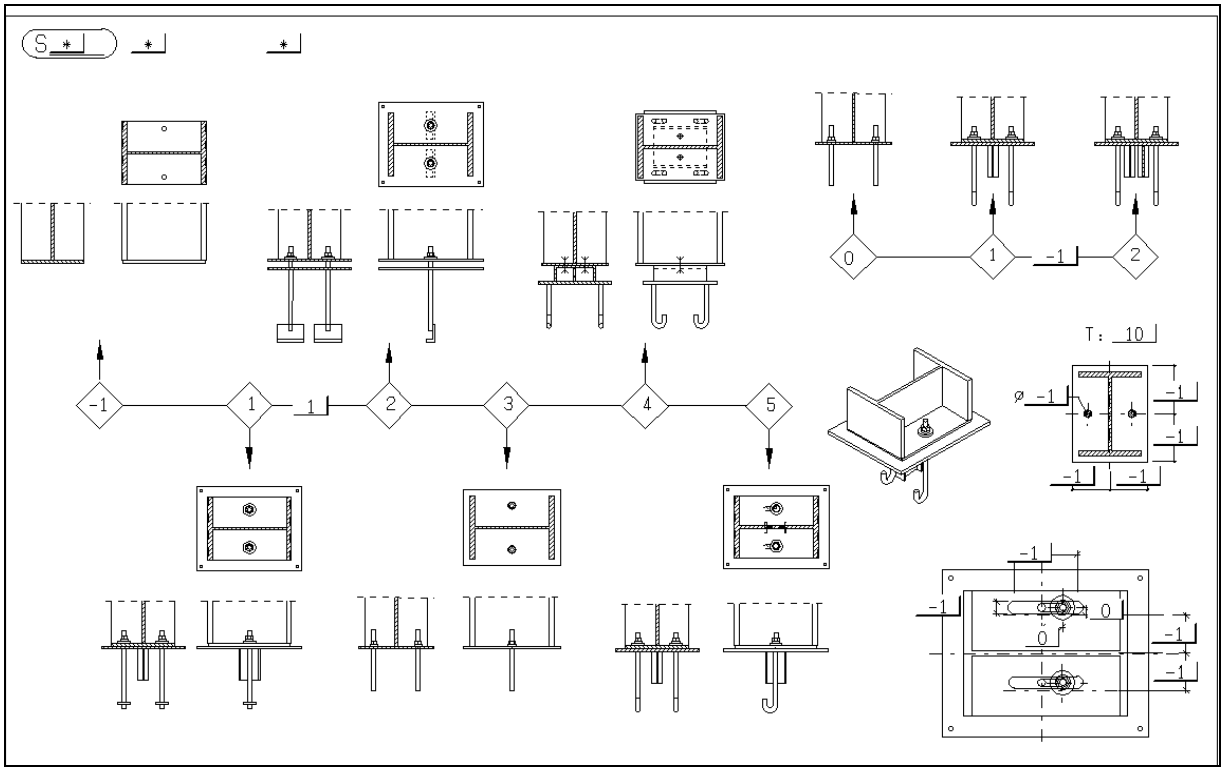

Figure 3: Leitbild to select principles of column-footings to be applied on column objects (Chang 2002).

- This scientific approach will present an extra added value for the countries with high earthquake hazard, like Iran. It can offer a specific variety of CAD-macros for components and connections following earthquake-safe design principles. A global user-interface that is really easy to use (as conceived in this research program for this specific variety) will enhance the preferential application of earthquake-safe solutions right from the beginning of the planning process.

6 Anticipated New Findings

Notable deliverables of this investigation include: (i) globalising civil engineering software without the need for localising user-interfaces; (ii) developing an approach to technology transfer into the industry with innovative consequences for the international construction industry; (iii) paving the way for adaptation of theoretical methods and engineering processes of Bauinformatik to practical situation in developing countries such as Iran; and (iv) contributing to the achievement of global collaboration and the development of a "technical culture" among civil engineers worldwide. Further descriptions are given below.

The main aim of this research program is to formulate a new concept on how to design the user-

interface of universal software, independent of text and local character-sets. This is achieved by using the fact that civil engineers all over the world understand technical drawings. Hence, the objective of this research program is of crucial importance for the transfer of civil engineering software to developing countries like Iran. When the research in this field is successfully completed, the obstacle of language and character-sets for engineers in developing countries will be removed and textual comment or help function containing text will not be needed. This offers an opportunity for global cooperation in science and consulting.

In the whole process of civil engineering, the planning procedure is the key-factor in the transfer of high-level technology. Software packages for planning, design, detailing and fabrication can easily be deployed in developing countries as a consequence of this research. Consecutive fabrication and construction processes can then use German high-level technology such as CNC-machines for steel structures. With support from the building industry, both in Germany and in Iran, the work has wide objectives including conceptual design, as well as engineering analysis/design, detailing and manufacturing.

7 Concluding Remarks

Both, technology insertion into industry and technology transfer to developing countries are of particular interest in this proposed investigation. A review of the existing literature is given here in order to provide a better understanding and to identify the key areas of research and potential problems. The research notion based on construction drawings rather than text and character-sets is the focal of this paper. This approach is called “Leitbild-Forschungsansatz”. The proposed study will assist the adaptation of this attempt to developing countries with all the necessary local skills.

Furthermore, the language in Iran (Persian) is written from right to left, except numbers embedded that are written from left to right. In an attempt to make the user-interfaces of civil engineering software as much independent of text as possible, Persian and its character-set pose a very typical problem. Therefore, addressing the issue of text-free user-interface for civil engineers in Iran will be a very good case-study to find out the utmost limits.

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9 Bibliography

Alvarado, C. (2000); “A natural sketching environment: Bringing the computer into early stages of mechanical design”. Master's thesis, MIT.

Chang, Y. (2002); “Eine von Landessprachen unabhängige Nutzoberfläche mit intelligenten CAD-Objekten des Bauwesens”, PhD Dissertation, Wuppertal, Germany. Volltext: http://elpub.bib.uni-wuppertal.de/edocs/dokumente/fb11/diss2002/chang

De Farias, C.R.G., Pires, L.F., and van Sinderen, M. (2000); “A Component-Based Groupware Development Methodology”, Fourth International Enterprise Distributed Object Computing Conference (EDOC'00), p. 204, September 25 - 28, Makuhari, Japan.

Eslimy-Isfahany, S.H.R. and Azadnia, H.R. (2003); “Information Technology in Structural Design - A Literature Review and a Call for Practical Deployment”, Proceedings of the 6th International Conference on Civil Engineering, Isfahan University of Technology, Iran, May, Vol. 6, pp. 479-486.

Eslimy-Isfahany, S.H.R. and Pegels, G. (2003); “Globalise Software for Civil Engineers in Developing Countries, Using Construction Drawings Independent of Text and Language”, Research Proposal for Alexander von Humboldt Foundation.

Hammond, T., and Davis, R. (2003); “LADDER: A Language to Describe Drawing, Display, and Editing in Sketch Recognition”, Proceedings of IJCAI (International Joint Conference on Artificial Intelligence).

Mischkinsky, J. (1999); “CORBA 3 New Component Chapters. OMG CORBA Component Model” FTF drafts ptc/99-10-04. Retrieved September 22, 2000 from the World Wide Web: http://www.omg.org/cgibin/doc?ptc/99-10-04

Pegels, G., and Azadnia, H.R. (2003); “Best Practice Worldwide of Computer-Aided Design, Detailing and Fabrication”, Proceedings of the 6th International Conference on Civil Engineering, Isfahan University of Technology, Iran, May, Vol. 6, pp. 23-34.

Pegels, G., Eslimy-Isfahany, S.H.R. and Azadnia, H.R. (2003); “A Proposal for Best Practice in Design, Detailing and Fabrication of Steel Structures in Iran Based on Worldwide Experience”, Asian Journal of Civil Engineering, Vol. 4, No.2-3, accepted for publication.

Pegels, G., Huhn, M., and Koch, A. (2002); Praxiserfahrungen mit vernetzt-kooperativen Planungsprozessen an Bauprojekten des Stahl-, Holz- und Glasbaus und ihre Forschungskonsequenzen, VDI-Tagung "Bauen mit Computern – Kooperation in IT-Netzwerken", VDI-Berichte 1668, VDI Verlag, 11./12. April, Bonn.

Slagter, R.J., Hofte, G.H., and Stiemerling, O. (2000); “Component-Based Groupware: An Introduction, Proceedings of CBG2000”, the CSCW2000 workshop on Component-Based Groupware, December 2, Philadelphia, USA.