A PROTOTYPE USER INTERFACE FOR A BUILDING PRODUCT MODEL IN RENOVATION DESIGN

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Abstract

Despite the fact that several sophisticated building product data model proposals and working prototype applications have been developed, actual practical use of product model applications does not, however, seem a viable prospect for the near future. In our view, the key problem impeding a more widespread use of product model applications is that the user has been neglected. The laboratory of Construction Economics and Management at the Helsinki University of Technology has developed a prototype application for renovation architectural design. The approach taken to this work was to design intelligent user interfaces, the use of which resembles as closely as possible traditional and manual document-oriented design methods. The application consists of four elements: the user interface, a building product model database, library databases and tools for producing output documents. The application is developed on an AutoCAD system integrated with a relational database management system, Paradox for Windows. The user interfaces were designed using AutoLisp, DCL and ObjectPAL. The extensive use of actual case studies in the development of this prototype application has provided valuable input in that it has allowed continuous testing of the system and further refinements based on real-life experience.

1 INTRODUCTION

In recent years, a great deal of mainly theoretical research has been carried out in order to develop conceptual models of a building. This has resulted in the introduction of several sophisticated building product data model proposals[1,2,3,4] as well as some working prototype applications. Actual practical use of product model applications does not, however, seem a viable prospect for the near future.

In our view, the key problem impeding a more widespread use of product model applications is that the user has been neglected:

- The applications should provide the user with direct assistance in the design work for which the application is developed.

- The user interface of the application should be easy to learn and to operate even if the user (designer) is not familiar with product modelling theory and has no particular interest in computers.

- The application should automatically make the user model all the relevant construction information of the building and yet require no increased effort on the part of the user.

The following issues need to be addressed in the design of easy-to-use user interfaces:

- The application is implemented in a commonly used environment (such as Windows, AutoCAD) so that the user interface resembles widely used basic commercial applications.

- The user interface of the application resembles as closely as possible traditional and manual document-oriented design methods.

- The application utilizes parametric CAD draughting and "library" design solution databases. The building product model itself must be updated simultaneously. The efficiency thus gained makes the use of the application attractive.

2 A PROTOTYPE BUILDING MODEL APPLICATION FOR RENOVATION ARCHITECTURAL DESIGN

2.1. INTRODUCTION

The Laboratory of Construction Economics and Management at the Helsinki University of Technology has developed a prototype application for renovation architectural design. The application development began in 1993. Renovation design was chosen to be the primary use of the application as it is, due to its increasing importance, one of the main research areas of the laboratory. Prior experience on product model based application development has been obtained from a prototype application developed for structural design.

2.2. CHOSEN APPROACH

The focus in application development has been on designing intelligent user interfaces. The main goal of this project has been to find the methods of creating a product model based application, that is simple to adopt and which increases the productivity of the design work. Another objective has been to illustrate to potential users the benefits obtainable from product model based applications. This, in turn, should serve to promote more widespread use of these applications. The approach taken is different from that taken in another Finnish project in this field, the OOCAD project at the Technical Research Centre of Finland. The objective of that project was to refine and develop

computerized methods for describing and designing buildings as product models on a conceptual level. The application frameworks developed in that project, on a basis parallel to that of this project, were produced mainly to illustrate the use of the developed formal generic product model.

In contrast, the goals of this project have not included developing or implementing a sophisticated building product data model. Because of this, the building product data model chosen was relatively simple. The building product data model used in the earlier prototype application developed for structural design served as a basis, which was further refined. The building product model of the earlier prototype in turn was designed using the conceptual level RATAS product model scheme. The earlier prototype not only demonstrated that a hybrid CAD - relational database system is at the moment the most practical way to implement a building product model database, but also proved the usefulness of library databases when aiming to decrease the amount of time spent on design work.

2.3. ELEMENTS OF THE APPLICATION

The application consists of the following elements:

- the user interface: the space card user interface designed on Paradox for Windows, and functions developed on AutoCAD. The user interfaces were designed using AutoLISP, DCL and ObjectPAL.

- the building product model database to store information on spaces, surfaces and structural elements, as well as repair activities applied to spaces and surfaces. The spaces, surfaces and the structural elements and their geometry are defined in an AutoCAD drawing as graphical elements and their attributes. Paradox for Windows relational database management system tables contain information on repair activities applied to spaces and surfaces, tasks describing these activities and product structures of building components.

- library databases updated by the designers themselves. The application contains library databases consisting of types of rooms, typical renovation activities of these types, tasks describing the activities, and product structures of building components. The Paradox for Windows database system is used to store and update these databases.

- tools for producing output documents: the application generates design documents needed in a renovation project, such as plan drawings, the bills of quantities, space lists, the space cards and specifications.

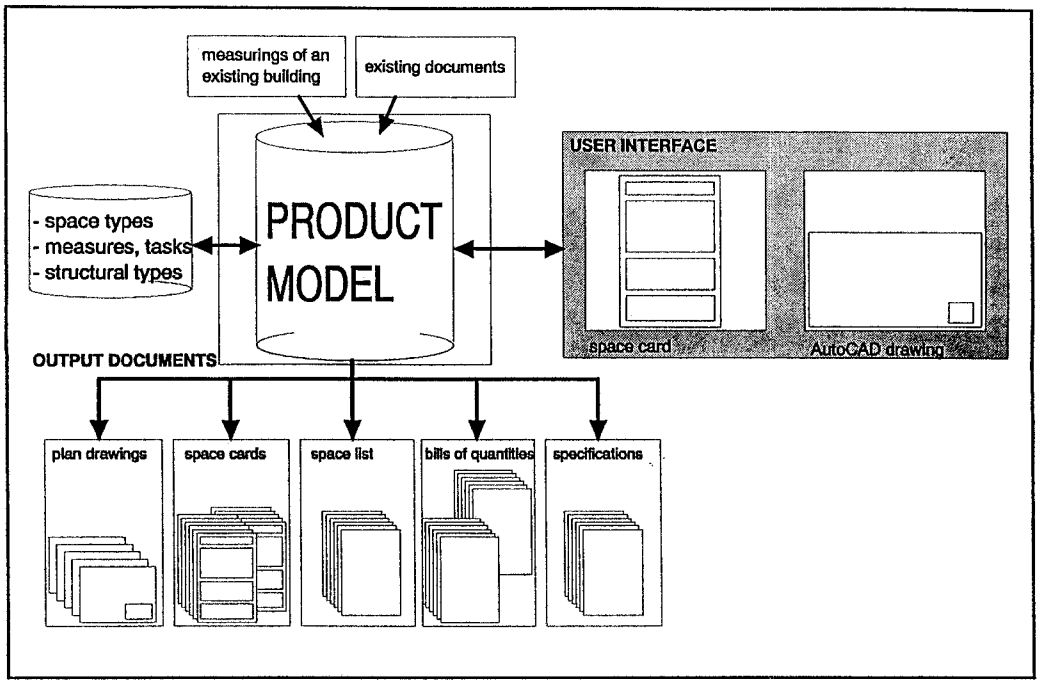

Figure 1. The elements of the prototype application

2.4. USE OF THE APPLICATION

"Unintelligent" AutoCAD lines describing the existing building serve as a basis for the use of the application. These can be easily produced by, for instance, simply scanning existing drawings of the building. The designer defines the spaces (rooms), surfaces and structural elements of the building in an AutoCAD drawing by attaching them to these lines using the AutoCAD functions of application. The application automatically staples a unique instance identifier into all graphical elements. The geometric data of the elements is updated simultaneously into the building product model data base.

The renovation activities applied to spaces and surfaces and the structural types of building elements are defined within user interfaces designed on Paradox for Windows. The user interface for defining activities is designed to look and function in a manner similar to traditional, manual space cards, making it simple to adopt.

In order to minimize the effort required in producing the definitions, the application includes databases consisting of types of rooms, typical renovation activities of these types, tasks describing the activities, and product structures of building components. These databases are updated by the designers themselves. The use of databases not only increases the efficiency of the design process but also makes the design work more rewarding.

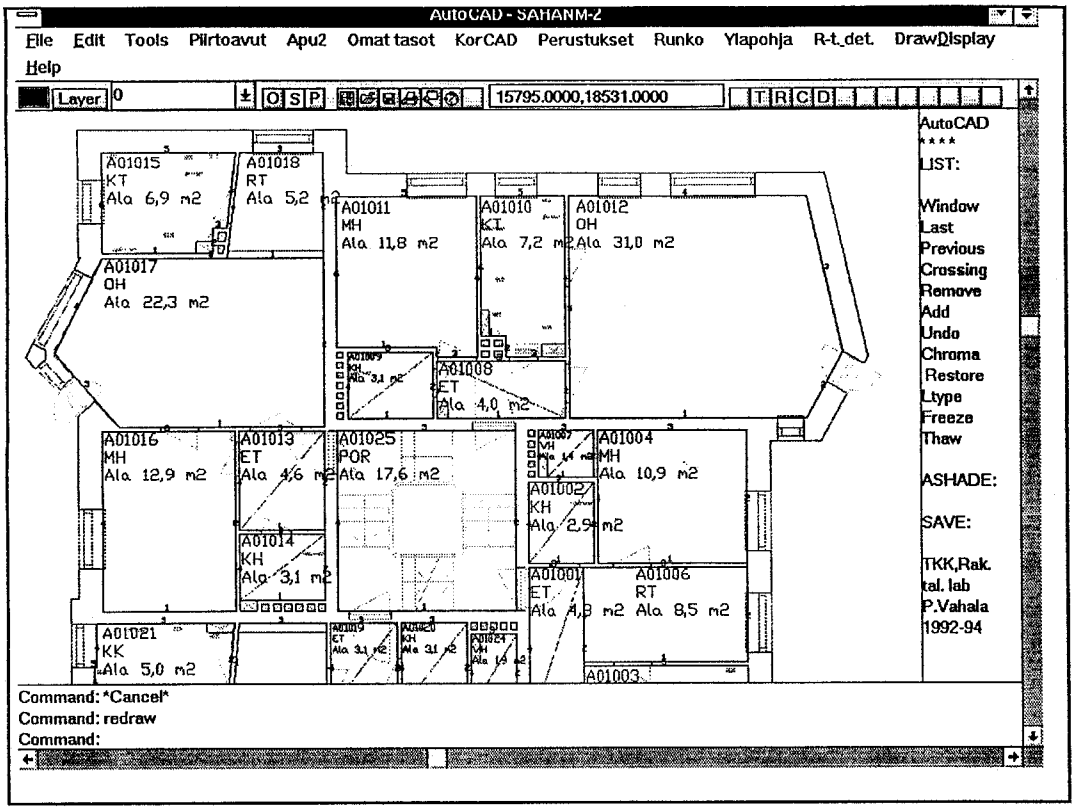

Figure 2. AutoCAD drawing of an actual case study

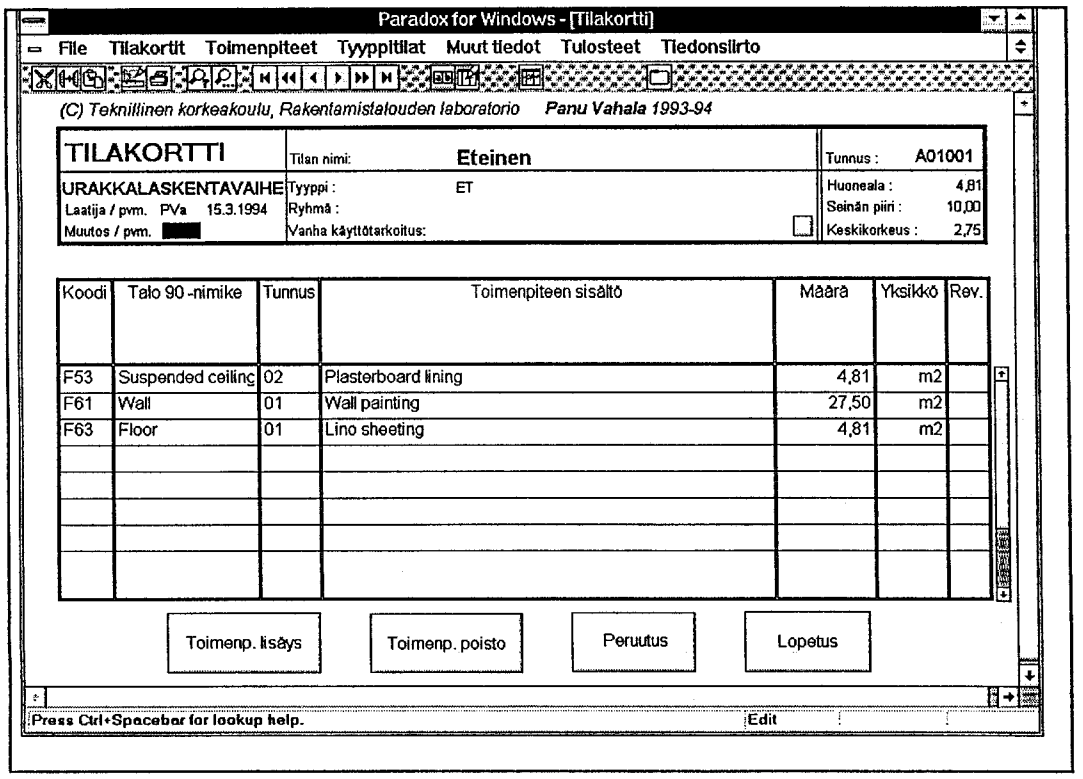

Figure 3. The space card user interface

Drawings are produced on AutoCAD databases, while the bills of quantities, space lists, space cards and specifications are produced on a Paradox for Windows database. In keeping with the approach taken to the user interfaces, the output documents, too, are designed to resemble traditionally used design documents.

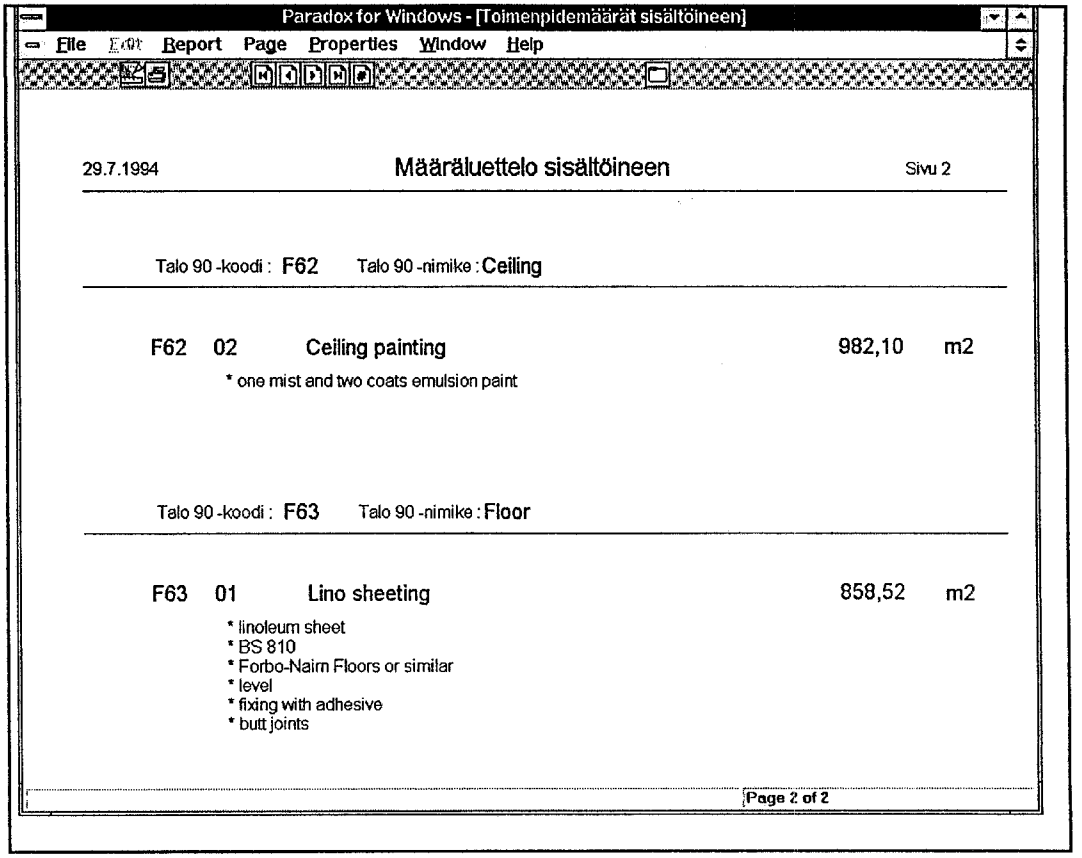

Figure 4. Bill of quantities produced by the application

2.5 WORKING METHODS, EXPERIENCE OBTAINED SO FAR

The extensive use of actual case studies in the development of this prototype application has provided valuable input in that it has allowed continuous testing of the system and further refinements based on real-life experience. So far this has been done using existing manually created design documents of renovation projects already completed. The basic principle of the application and its user interfaces have proven viable. Further real-time design work testing done by associated architects is now getting underway and will show not only the actual relevance of the application but also whether use of this prototype application increases the efficiency of the design process.

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