AN INFORMATION MODEL FOR MANAGING DESIGN CHANGES IN A COLLABORATIVE MULTI-DISCIPLINARY DESIGN ENVIRONMENT

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Abstract

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The presence of incompatibility errors in construction technical documents is a major problem for the construction industry. An analysis of the production process of these documents reveals that managing design changes constitutes a main source for incompatibilities. More specifically, failure to propagate design changes among the design team is a principal cause of problems. The large amount of design data that is generated within a multi-disciplinary design environment makes this task very complex, especially when considering the fact that the involved design disciplines are, in most cases, separated both spatially and educationally. This thesis presents the development of a model that uses information technology to address the problem. The core concept of the model is a central database that functions as a repository of active building components. Each building component in this database not only carries its design data, but is also capable of recognizing the design disciplines that are affected by any change in these data and automatically send them messages. The active building components are able to perform this task because they are equipped with the necessary linking knowledge. Such knowledge is necessary to propagate the effect of a design change by one discipline on

other disciplines involved in the design of the same building. The linking knowledge is acquired from the designers and is implemented in the form of rules. A management database is also developed as part of the model's central database. This management database makes the model easily adaptable to any building configuration, an essential requirement due to the uniqueness of every building project. It also provides the model with the capability for not only tracking past design changes but also planning and scheduling future design changes as well. The model has been successfully implemented on a client-server network environment and validated using both hypothetical and real design cases.

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Table of Contents

CHAPTER THREE

PROPOSED INFORMATION MODEL: A CONCEPTUAL PERSPECTIVE

CHAPTER FOUR

THE CENTRAL PROJECT-DATABASE: A DETAILED PERSPECTIVE

CHAPTER FIVE

MANAGING DESIGN CHANGES: A DETAILED PERSPECTIVE

CHAPTER SIX

VALIDATION OF THE MODEL

CHAPTER SEVEN

SUMMARY, CONTRIBUTIONS, AND RECOMMENDATIONS

APPENDIX A

DATABASE STRUCTURE IN MS ACCESS

APPENDIX B

SUBROUTINES FOR PLANNING AND SCHEDULING DESIGN CHANGES

APPENDIX C

LISTINGS OF LEVEL5 OBJECT MODULES

List of Figures

Nomenclatures

n	Total number of design changes in a change path.
x	A design change.
C_T	Expected impact of a change-path on the building construction costs.
C_x	Value of attribute "DIFFERENCE_IN_BUILD_COST" in Data-Table 5-7.
D_T	Design cost related to a change-path.
h	Cost of man hour in the design firm.
M_x	Value of attribute "REQUIRED_MAN_HOURS" in Data-Table 5-7.
R_T	Level of recommendation for a change-path.
R_x	Value of attribute "RECOMMENDATION_LEVEL" in Data-Table 5-7.
T_T	Additional design time required for a change-path.
T_x	Value of attribute "DURATION" in Data-Table 5-7.

Abbreviations

AEC	Architecture/Engineering/Construction.
AI	Artificial Intelligence.
AACE	American Association of Cost Engineers.
ASCE	American Society of Civil Engineers.
CADD	Computer Aided Design and Drafting.
CIFE	Centre for Integrated Facility Engineering.
CMU	Concrete Masonary Units.
CPM	Critical Path Method.
DBMS	Data Base Management System.
DICE	Distributed and Integrated environment for Computer aided Engineering.
DIS	Draft International Standards.
DXF	Drawing interchange file.
EDM	Engineering Data Model.
HVAC	Heating, Ventilation, Air Conditioning.
IAI	Industrial Alliance for Interoperability.
IBDE	Integrated Building Design Environment.
IFC	Industry Foundation Class.
IGES	The Initial Graphics Exchange Specfications.
ISO	International Organization for Standardization.
IT	Information Technology.
MIT	Massachussette Institute of Technology.
MS	MicroSoft.
NIST	National Institute of Standards and Technology.
OO	Object-Oriented.
SEED	Software Environment to support Early phase in building Design.
SQL	Structured Querey Language.
STEP	STandards for the Exchange of Product data.

Legend for User Interface Diagrams

Symbol	Explanation
Define tracking constraints	New screen
Show building component under modification, its instance, and its modified attribute.	Note
S1	Decision node
Display related messages	Model output
Input the data of the design change	Link to a floating screen
Choose a project	Link to a screen that replaces the current screen
Choose a related attribute	User input in the current screen

CHAPTER ONE
INTRODUCTION

1.1 MOTIVATION AND PROBLEM DEFINITION

1.1.1 BACKGROUND

Construction teams erect buildings on the basis of construction technical documents. Incompatibility errors in these documents result in change orders, contractual disputes, cost overruns, time delays, compromise to quality, frustration and client dissatisfaction. Common types of errors are:

- *Inconsistency in design information.* For example, the location of a specific column is not identical when comparing the architectural and the structural drawings.

- *Mismatch between connected components.* For example, HVAC ducts dimensions, which are given in the mechanical drawings, do not match the dimensions of the related pass-holes in the structural beams which are given in the structural drawings.

- *Components malfunction.* For example, electric supply in a room is designed to serve a classroom activity while architectural drawings indicate that the same room has been re-designed as a computer lab.

Unfortunately, such errors have become very common in the construction industry (Tilley and Barton 1997). Some contractors even depend on these errors for generating their profit margin. Owners, on the other hand, are either discouraged to invest in buildings or try to compensate the effect of these problems in the pricing of services or products realized within the constructed facility. This may negatively affect not only the building industry, but also eventually the national economy.

Construction technical documents are produced by the design team during the detailed design stage of a project life cycle. These documents are the result of collective efforts from specialists who belong to various design disciplines. These specialists, who are usually geographically separated, make autonomous design decisions with respect to their own discipline. These decisions, nevertheless, are inter-dependent and need to be coordinated so as to maintain compatibility among the various systems and components in the building under design. The coordination process which occurs during the detailed design stage is very complicated. This is due to the generation of an enormous amount of design data from the various specialized disciplines. Unfortunately, with escalating complexity in buildings, the increasing specialization in design teams, and the tightening of financial and time resources available to designers, the coordination task is rapidly increasing in complexity. The building industry is in urgent need for research work that addresses the problem and contributes to finding practical solutions. This research is a step towards satisfying that need.

1.1.2 Overview of the Detailed Design Stage

During the detailed design stage, abstract concepts presented in the preliminary design of a building are transferred into technical documents. These documents should contain sufficient design information to enable the erection of the building. The production process of these documents, which appear in the form of working drawings and specifications, is an elaborate one. It requires members of the design team to satisfy many constraints such as owner demands, code requirements and limitations of the project budget. In addition, it requires from them to ensure the compatibility of design information presented in the technical documents. This research is primarily concerned with the common failure of designers to satisfy this last demand. An analytical overview of the production process of construction technical documents is therefore presented. The overview concentrates on current techniques for cross-disciplinary coordination of design information, hence revealing the main problems that cause the process to fail.

Figure 1-1 illustrates the results of the analysis. The figure shows that the production process of technical documents starts by extracting the data available in preliminary design documents. From these documents, the architecture design team develops the main features of the building in the form of drawings (Point 1, Figure 1-1). These main features usually include geometric details of the structural elements, walls, partitions, doors, windows, stairs, elevators, and the function of the various spaces. Several copies are made of these drawings and distributed to other disciplines in the design team (Point 2, Figure 1-1).

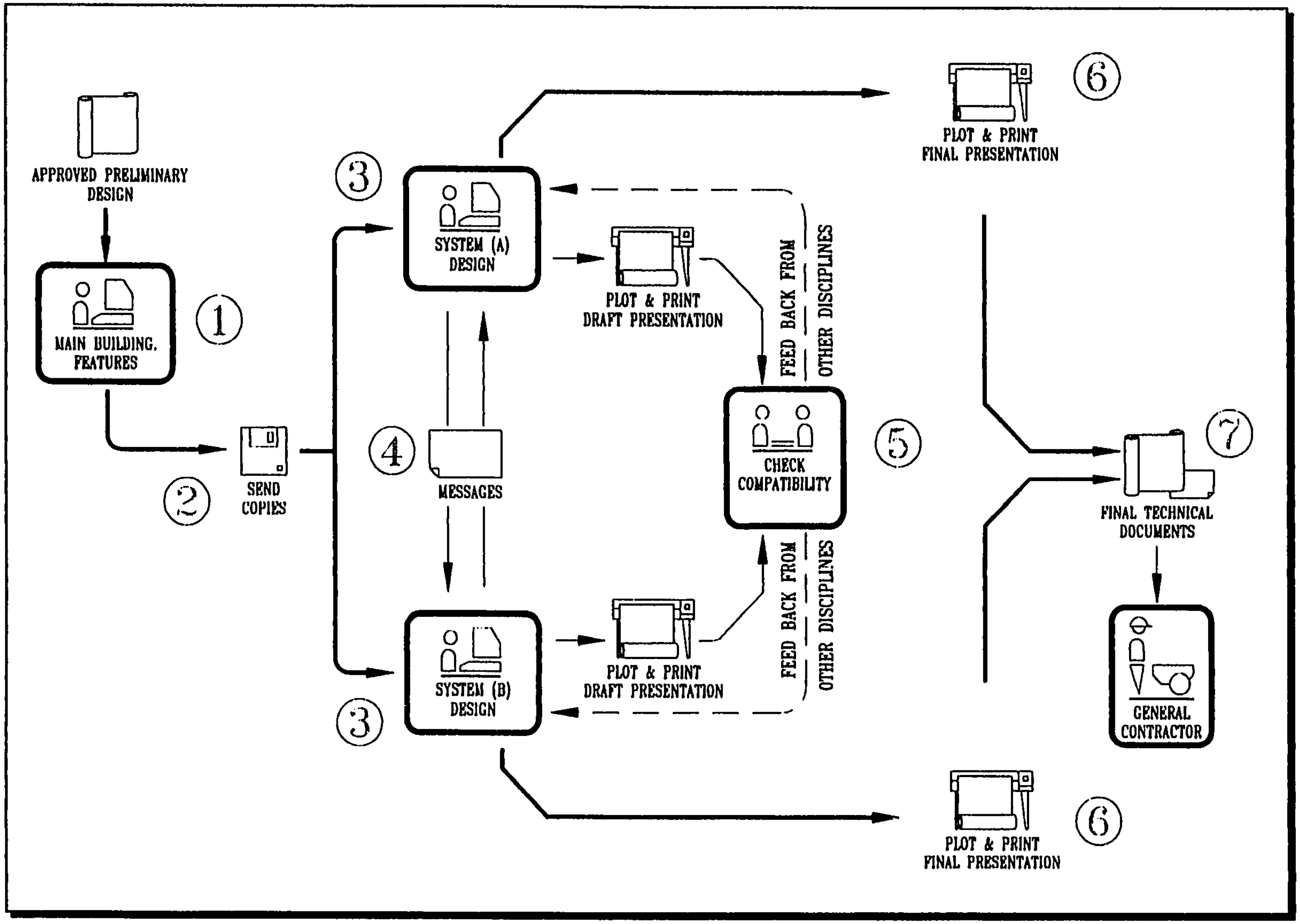


Figure 1-1 Production process of construction technical documents during detailed design stage.

Next, each discipline (including architecture) starts to make design decisions for the detailing of a specific building system (Points 3, Figure 1-1). These decisions aim to satisfy various design requirements and are restricted by codes and regulations. More important to our study, these decisions depend also on design decisions that are made by other disciplines. For example, to design an HVAC component in a certain room, designer "A" searches for the data needed as input to the HVAC design process, e.g. space function, dimensions, heat produced from lighting fixtures, and thermal resistance of external walls. Such input data is actually output data of other disciplines. Both the space function and dimensions are data that is defined by the architect; the lighting fixtures are defined by the illumination engineer; the thermal resistance of the external walls is defined by the envelope designer. Designer A tries to find this data in the drawings that are provided by the architect. Most probably, only the data for the space function and the space dimensions are available in these drawings. To get the rest, designer A needs to communicate with the illumination engineer and the envelope designer (Point 4, Figure 1-1). Once all the input data is obtained, designer A can make design decisions on the HVAC components of the room. As long as all elements of input data remain unchanged, the HVAC component will remain compatible with the other components in the room.

Unfortunately, design changes - inevitably and continuously - occur for many reasons. These include the need to satisfy new or modified requirements by the owner, to reduce construction or maintenance costs, to rectify design mistakes, or to improve the design.

For example, the architect may change the function of the space from an office to a computer lab. Such a change is usually performed by the architecture discipline through renaming the function of the space on the floor plan drawing. Once that "simple" change is performed, the HVAC component - designed by A - instantly becomes incompatible with the architectural design. It remains as such till designer A becomes aware of the design change and modifies the HVAC component using modified input data.

The main problem therefore is how to make designers of any discipline aware of all changes that are performed by other disciplines and that affect their own design. This is a difficult problem to solve because of the lack, in our judgment, of the knowledge that "links" the output of one design discipline to the input of another design discipline. This lack of "linking" knowledge is primarily due to the education and training of professionals in the building industry. It is difficult, for example, for an architect to know the input data for an HVAC engineer. The architect might not know that space function is a critical input for the HVAC system design. Consequently, s/he may change the space function without informing anyone because it seems unnecessary to do so. As a result, the HVAC engineer has no way to recognize that a design change affecting HVAC has been made.

From this simple example, one can foresee the difficulty which design teams face when dealing with a project that has thousands of design data that are mostly interrelated. Not surprisingly, some professionals describe design changes in a multi-disciplinary environment as a "mess". Nonetheless, techniques are used by professionals in order to cope with the problem (Point 5, Figure 1-1). Some of these techniques are:

a) *Regular coordination meetings where designers from various disciplines group together for the purpose of finding out about the important changes that each discipline has done.* Each discipline usually reviews the drawings of the other disciplines to look for modified data. Drawings from different disciplines are sometimes put together for comparison. Recently, with development in computer technology, such meetings become less frequent. Reference drawing files are increasingly used to show the latest drawing version of various disciplines instantly. However, this technique of reviewing the documents of other disciplines has a serious deficiency. It depends on designers to discover the changes that are relevant to their own design, mainly through looking at drawings. As a result, many design changes which do not clearly appear on drawings (e.g. thermal resistance of a wall or a small change in a dimension) are usually missed. Since large projects may include hundreds of drawings, it is impractical to review such a large amount of data regularly.

b) *The designer who makes a change informs every other designer in the design team.* This technique may work fine in small projects, yet in larger or more complex projects, it becomes impractical. Every designer has to issue too many design change memos and will also receive as many. Most of these memos are irrelevant to many designers and soon lose credibility. Designers become discouraged to spend their time writing and reviewing them.

c) *A common technique is to use check lists to verify the compatibility of various components in a project.* The main problem with this technique is that the design modifications that are required when incompatibility errors are discovered may generate in turn other incompatibilities. The technique cannot continuously monitor the effect of design changes. In addition, the check lists are rarely customized so as to adapt to every building project. Many incompatibilities are therefore skipped by this technique.

The production process of construction technical documents (points 3, 4, and 5 in Figure 1-1) is cyclically repeated till deadline for submission is reached. Each discipline then finalizes its own documents (Point 6, Figure 1-1) and all final documents are gathered from the various disciplines and given to the general contractor (Point 7, Figure 1-1).

1.1.3 DIAGNOSIS OF THE MAIN PROBLEMS

From the above analysis of the process, three major problems can be diagnosed as the causes for incompatibility errors.

1.1.3.1 Managing Design Changes

Design changes continuously occur within all disciplines. The current coordination techniques provide weak mechanisms to manage design changes and to accommodate their effect on the design information across participating disciplines. More specifically, there is a lack in the ability of designers for propagating and communicating design changes effectively. Others also support this finding. Hegazy and Khalifa (1996) conducted a survey among 12 leading design firms in Canada and showed that disseminating project information and administering design changes are two important aspects of multi-disciplinary coordination which cause problems in building design. Cornick (1990) states also that "the problems caused in modern buildings seem much more due to deficiencies in managing communication during the design process than to merely technological factors".

1.1.3.2 Communication Media

Drawings are used as the principal media to exchange and document design information. Drawings are excellent for describing shape, geometry, proportions and other visual characteristics of the design. Yet, drawings are very poor to show other characteristics such as heat resistance, load capacity, and price. Such non-visual characteristics are as essential as the visual ones for interdisciplinary exchange of information. Problems with the drawing-centered environment are also reported by others (Voeller 1996).

1.1.3.3 Source of Final Documents

The final construction technical documents are collected from a variety of sources. This can lead to inconsistency in information when the same building element is described in different ways in several documents. For example, the location of a specific column is not identical when comparing the architectural and the structural drawings

Recently, CADD software developers have tackled the second and the third problems. Software such as Bentley Microstation ™, ArchT ™ and Pro-Reflex ™ provide a data-centric environment and central single model for the designed building. Technical drawings are then generated from such models, ensuring consistency among various drawings. Nevertheless, other types of incompatibilities (as given in section 1.1.1 on page 1) continue to exist. These incompatibilities are attributed to the failure to address the first diagnosed problem: managing design changes.

1.1.4 Conclusion

The analytical overview of the detailed design stage shows that a main challenge in maintaining compatible design information resides in the accommodation of design changes. More specifically, propagation of design changes to the affected disciplines constitutes the critical point. The various techniques and software that are currently used by designers to coordinate their design information appear inadequate. There is a clear need for an approach that targets this important problem.

1.2 Research Scope and Objectives

The main objective of this research is to assist the building industry in eliminating incompatibility errors that commonly exist in design information of building projects, a pervasive problem that is very costly to the industry. The research focuses on the design changes during the detailed design stage as these changes remain the main cause of incompatibility errors.

The research aims to develop a computer-based model that uses Information Technology to provide the building industry with a practical solution to the problem. The developed model however is not limited to the propagation of current design changes, rather it is extended to enable the tracking of past design changes and the planning and scheduling of future ones.

The research also aims to implement the model in a client-server computing environment which is similar to that regularly used by building design professionals. Furthermore, it aims to validate not only that the model is able to provide capability to manage design changes but also that the model can actually improve current practices with these capabilities.

The research however does not intend to provide a fully functional information system which should include complete software, hardware specifications, operating procedures, training process for operators, and full collection of the needed data.

The information model developed in this research does not intend to cover all types of information necessary for the design of a building. Codes, regulations, and design constraints are among the design information that are excluded. The model focuses on information needed for design changes. The model is also intended for sequential type of project delivery systems. It is not intended for other types of delivery systems such as fast track system. Designers who will use the model are expected to collaborate using client-server networks and therefore they should be located in the same building or nearby buildings. Other types of networks such as wide area networks, intranets, or internet are beyond the scope of this model.

1.3 OUTLINE OF THE THESIS

This thesis documents the development of an information system model for managing design changes in a collaborative multi-disciplinary building design environment. Chapter one presents the motivation for this research and defines the specific problem. Chapter two reviews research elsewhere in the use of information technology for the design of constructed facilities. Chapter three introduces a conceptual perspective for the proposed information model and discusses the advantages and limitations of this model. Chapters four and five present the detailed development of the main components of the model and show how the model concepts are realized with these components. Chapter four focuses on the central project-database and how it is developed to adapt easily to various building configurations. Chapter five provides the detailed methodologies that make the model capable of managing design changes. Chapter six explains the validation process for the model. Chapter seven summarizes the research and highlights its contributions to the construction industry. It also provides recommendations for future research work.

CHAPTER TWO
INFORMATION TECHNOLOGY IN DESIGN: A LITERATURE REVIEW

2.1 INTRODUCTION

In chapter one, three major problems are diagnosed as the causes for incompatibility errors in construction technical documents. These problems are: managing design changes, communication media, and source of final documents (see section 1.1.3 on page 8). As a first step to find an appropriate solution that overcomes these three problems, this chapter reviews available research work that is concerned with the use of information technology in the design of constructed facilities. This area of research is relatively new and increasingly captures the attention of researchers in many parts of the world. This attention can be attributed to the growing familiarity of the construction industry with CADD (Computer Aided Design and Drafting) systems. It can be also attributed to the potential of CADD systems to address many problems in such a scattered, multi-disciplinary, and information-rich industry. This review is organized into three sections:

- The first section is concerned with approaches that use computer technology to enhance collaborative design environments. Each of the reviewed approaches is evaluated against its ability to provide solution to the previously diagnosed problems.
- The second section focuses on efforts to establish data-structures (data models) that can support design data in a central database. Such a central database is considered to be necessary for ensuring a single source of design information. The literature review

in this group aims to investigate the availability of standards or at least sufficiently advanced models that can be utilized in this research to develop a central database for building data.

- The third section surveys research projects that deal with managing the building design process, an area to which this research belongs, so as to review utilized concepts and techniques.

2.2 COLLABORATIVE DESIGN APPROACHES

The use of computer technology to enhance collaborative design environments is the focus of several research works. The following summarizes the main approaches found in literature, along with discussions regarding their ability to solve the three main problems diagnosed in section 1.1.3.

2.2.1 AGENT-BASED FEDERATED ARCHITECTURE APPROACH

Developed at Stanford University, it connects two or more independent engineering software that need to share information about the current status of a design (Khedro et al. 1994, 1995 and 1996, McGraw et al. 1996, Jones and Riley 1995, Khedro 1994, Huyn et al. 1993, Cutkosky et al. 1993). The system architecture includes several design agents (Figure 2-1). Each design agent is composed of a human designer and a software agent (design software plus communication capabilities). Every software agent interacts with other software agents through facilitators that coordinate the exchange of design information among the software agents. When a designer finishes a design task, s/he sends the design information to the facilitator that s/he is connected to. The facilitator is able to recognize other interested users in each element of that design. It groups the design elements and forwards them to the relevant users. These users receive the information, check it, evaluate its effect on their design, and start negotiation with each other in real time to solve conflicts in design. In view of the diagnosed problems in section 1.1.3, this approach has a fundamental drawback which is the lack of a single source of final design information. However, when it comes to managing design changes, the approach has the advantage of reducing the amount of information received by every user as only the relevant information is sent to the various users. This is an important feature that has been incorporated in the information model proposed in this thesis. The federated architecture approach nevertheless depends on the designers to recognize design changes. This leaves a lot of room for error and is similar to current practice (section 1.1.2). The approach also requires a significant deployment of computing resources and communication links across separate locations, a requirement that would set such an approach beyond the reach of most building designers.

2.2.2 KNOWLEDGE-BASED APPROACH

The Knowledge-based approach has been used to help integrate software that are used in engineering design. Fenves et al. (1990, 1994) introduced a prototype system called the Integrated Building Design Environment (IBDE) at Carnegie Mellon University. The system intends to vertically integrate the various software that are used in the various stages of the life cycle of a constructed facility. Its demonstration and test domain, however, is limited to architectural planning, structural design and construction planning of high-rise office buildings. All the involved software use knowledge-bases that support their functions. Project data is maintained in a project database whereas communication between the different software relies on a message blackboard.

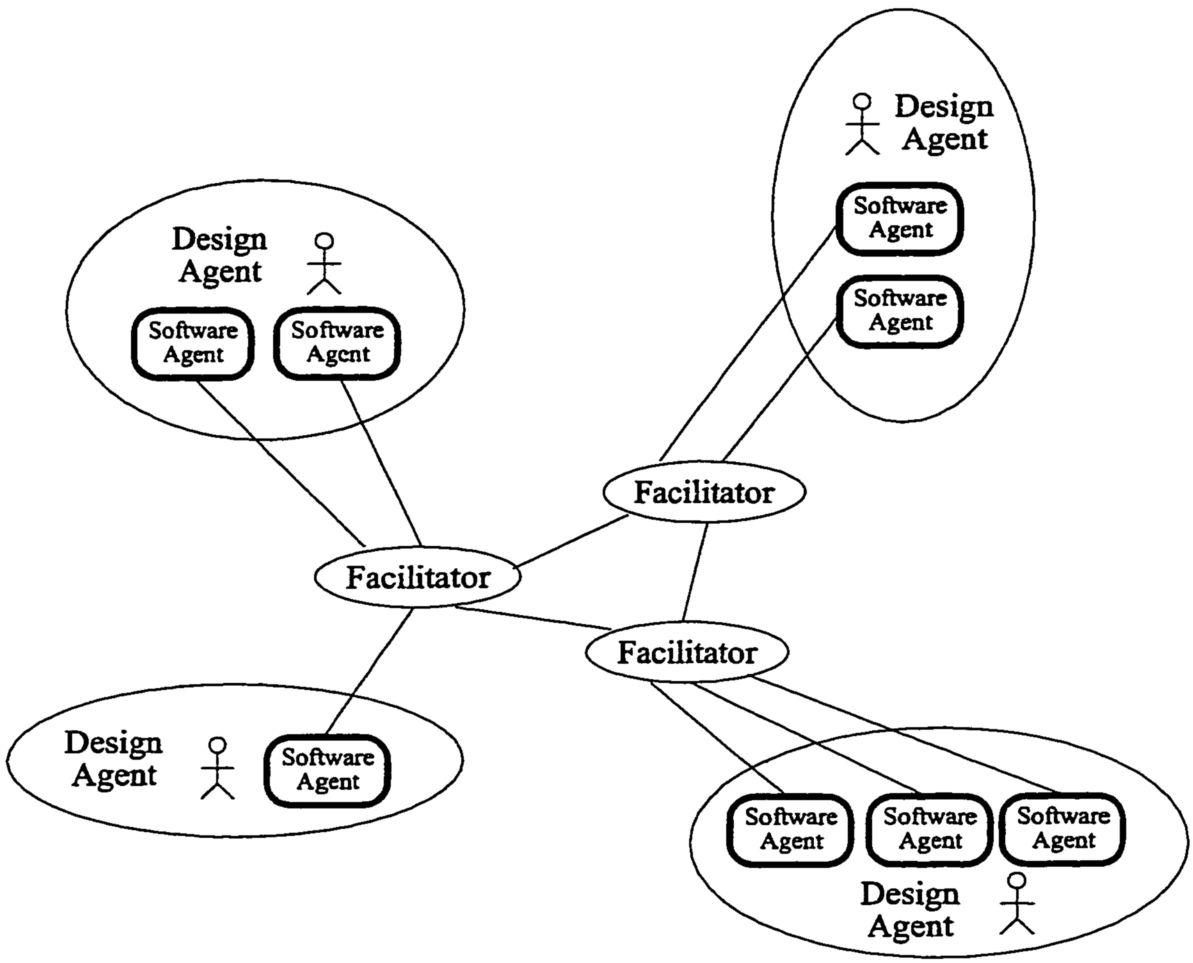


Figure 2-1 Organization of design agents in federation architecture. (Khedro et al. 1994, redrawn)

Another system called DICE (Distributed and Integrated environment for Computer aided Engineering) has been under development at the MIT (Massachussette Institute of Technology) (Sriram et al. 1989, 1990, and 1994, Sriram and Logcher 1993, Ahmed et al.

1992, Wong and Sriram 1993). The focus of the project is on preliminary and detailed structural design. DICE consists of a blackboard, knowledge modules, and control mechanism. DICE blackboard is implemented on a central object-oriented database. This central database does not contain all the product data but is limited to the data used for communication among the knowledge modules.

A more recent model is SEED (Software Environment to support Early phase in building Design) (Flemming and Woodbury 1995) also from Carnegie Mellon University. SEED aims at providing computational support for the early design phase. It addresses specifically architectural programming, schematic layout design and the generation of a fully three dimensional configuration of physical building components like structure and enclosure. SEED contains an object database to store and retrieve different design versions and design alternatives. Designers can specify and modify dynamically and interactively design requirements. Given explicit requirements, SEED can be asked not only to propagate design changes after some interactive modifications by the designer, but also to show other designers feasible ways of solving a design problem using case-based reasoning.

In the knowledge-based approach, collaboration among software is achieved by the use of precoded coordination knowledge. The coordination knowledge is based on the various software meta-knowledge (knowledge about the composition and the computational process of the software) and hence it needs to be updated to reflect any upgrading in the involved software. In order to manage design changes, the knowledge needs to accommodate various possible relations that may exist among different building components, a requirement that is almost impossible to fulfill due to the unique nature of every building project. Such a nature makes these relationships vary from one project to the other. When this is combined with different composition of design teams in different projects, it seems that this approach is not suitable for the complex environment of building design.

2.2.3 CONSTRAINTS MANAGEMENT APPROACH

This approach has been proposed as a method to share design knowledge without linking together design software (El-Bibany and Paulson 1994, El-Bibany 1992 and 1996, Bowen and Bahler 1993). A constraint is taken as a relation which states what should be true about one or more design entities. Managing these constraints is achieved by creating and maintaining data-dependency structures that reflect any changes in the design knowledge and identify specific knowledge items that cause conflicts. The users have the ability to create relations dynamically between entities. Yet, the entities themselves are fixed in the system. We view the ability of this approach to dynamically create relationships between entities as essential to adhere to the fact that every building project is unique in these relationships. However, it is also important to be able to easily change the building entities to reflect the requirements of a specific project. In case of a design change that violates any of the constraints which were previously built, the system sends warning messages to involved parties informing of source of violation. This is also an important feature that is used by the model proposed in this thesis for managing design changes.

The constraints management approach however requires each discipline to provide all necessary equations and functions that define and constrain the design of every building component in order to built the data dependency structures. This requirement results in duplicating most of the equations and the constraints that are already used by the design software. The process as such becomes very complicated when considering the number of disciplines and the number of components involved in the design of a building.

2.2.4 Circle Approach

Aiming to integrate some AEC (Architecture/Engineering/Construction) software that are used by participants in a project, the circle approach (Fischer and Kunz 1995) has each software linked to exactly one predecessor and one successor software. Thus, changes made to the design are propagated automatically to all other software. It is expected that participants will have private copies of all software on the circle for a particular project. The circle approach does not use any form of centralized repository for design data. As such, it cannot satisfy the need for having a single source for the final design documents which can insure the consistency of building information. It propagates new versions of design, but depends on users to recognize any change in the design that might affect them which is similar to current practice.

2.2.5 Discussion

The approaches introduced above for the use of computers in collaborative design environment are not mutually exclusive but rather, share common features. All approaches use data as the means to exchange information among participants. This supports the notion that drawings should not be - in the computer age - the media for recording design information. Both the agent-based approach and the circle approach do not use any form of centralized repository for design data, nor for data coordination knowledge. As such, these approaches cannot insure the consistency of building information. Both the agent-based approach and the circle approach propagate new versions of design, but depend on users to recognize any change in the design that might affect them. The knowledge-based approach coordinates design information using detailed coordination knowledge linked with the used software. As discussed above, this approach seems impractical for the complexity of building design environment. The constraints management approach requires duplicating most of the equations and the constraints that are already used by the design software, which makes its use time-consuming and redundant.

None of the reported approaches appears suitable to provide remedy for all the problems diagnosed in section 1.1.3. However, some reported capabilities are useful to this research such as the capability of sending information to the interested designers only and the dynamic capturing of coordination knowledge from designers instead of exclusively using precoded knowledge. The information model proposed in this thesis include these capabilities.

2.3 PRODUCT DATA MODELING

Product data modeling may also be viewed as one of the approaches to facilitate design collaboration. Because of the wide interest by researchers to develop product data models and the need to have a central database to provide a single source for design information, product data modeling is reviewed in more detail. The purpose is to investigate the availability of standards or at least sufficiently advanced models that can be utilized by this research in developing a central database for building data. The review starts by defining product data models and overviews its successful implementation in some research areas. A description of main product data models follows in order to explore the existence of any common or necessary features for developing these models. Finally, discussion and highlight of finding is presented.

2.3.1 ON DEFINITIONS AND IMPLEMENTATION

A model is a simplified representation of a part of the real world. It captures some, but not all, of the characteristics of that part (Lave and March 1975). For example, an architectural perspective of a building, which can be referred to as a graphical model, represents visual relationships between the various elements of the building envelope. Meanwhile, a group of equations represents the transfer of heat through that envelope and is called a mathematical model. One type of model that has emerged with the development of computers is Data Models which describe a part of the reality in form of its data elements. Data models are divided into three types (Elmasri and Navathe 1994): conceptual models, which tell what kind of information is used to describe some aspect of reality and how such information is internally structured (Björk 1989); implementation models, which are translations of conceptual models for a specific database management system; physical models, which represent how the data is placed on a computer hardware system.

Product Data Models are a distinct category of the conceptual type of data models. These are tailored to represent data of engineering products. There is no single definition that is agreed upon for a product data model. The COMBINE project (Augenbroe 1993) defines it as "a complete conceptual description of a product, capable of structuring all the information necessary for the design, manufacture, and use of the product." Björk and Penttilä (1989) define it as a "conceptual structure specifying what kind of information is used to describe a building (product) and how such information is structured." Tolman, Kuiper, and Luiten (1990) define it as an "information model of a product, describing the 'reality' of a product in its different life cycle stages." Eastman (1992a) defines the product data model as "the database model supporting the design, fabrication, operation and other uses of some type of product." From these definitions, common denominators can be extracted: product data models are conceptual models; these represent all the product data; this representation spans throughout the product life cycle. This conclusion can be confirmed by the International Organization for Standardization (ISO) definition of product data (ISO 1989) as "The totality of data elements required to completely define a product; this includes geometry, topology, relationship, tolerance, attributes, and features necessary to completely define a component, part or an assembly of parts for the purpose of design, analysis, manufacture, test and inspection." Product data models are, therefore, perceived to be good tools for both the exchange and integration of product information.

Because of the potential of product data models to facilitate the integration and exchange of product information, researchers in various parts of the world have adopted them to represent the Building as a product. The AEC Building Systems Model in the USA (Turner 1990), the RATAS model in Finland (Björk 1989), and the COMBINE IDM model in Europe (Dubois and Parand 1993) are examples of that utilization.

Other research work has been conducted so as to create an environment and a set of concepts that link building data models to various aspects of the building delivery process. The available research was in areas like:

- Early design cost control (Tsou 1992),
- Computer-aided architectural design (Turner 1992),
- Conformance with regulations (DeWaard 1992),
- Evaluating building performance (Augenbroe 1992),
- Maintenance information management (Svensson 1993),
- Renovation design (Vahala 1995),
- Design of building envelope (Rivard et al. 1995),
- Design of precast concrete facades (Karhu 1997), and
- Structural synthesis and evaluation (Bakkeren and Tolman 1995, Enseleit et al.

1995).

Another notable effort in using database to record building design data is through the International Alliance of Interoperability (IAI). The IAI is an alliance of groups in the building industry that aims to integrate the AEC/FM (Architecture, Engineering, Construction / Facility Management) industry by specifying Industry Foundation Classes (IFCs) as a universal language to improve the communication, productivity, delivery time, cost, and quality throughout the design, construction, operation and maintenance life cycle of buildings (IAI 1996). IFCs constitute a library of commonly defined objects that create "intelligent" project data such as the properties, behavior, and graphical representation of building components (Herold 1997).

Similar effort is done by ISO which is in the process of establishing a universal standard for the representation and exchange of product data (ISO 1989). This standard is usually referred to as STEP (STandards for the Exchange of Product data), formally ISO 10303 (Froese 1996). Its objective is to provide a mechanism that is capable of describing product data throughout the life of a product independent of any particular computer system. A comparison among current standards to communicate data [e.g. DXF (1995) and IGES (Reed et al. 1990)] and those suggested by IAI and STEP is presented by Arnold and Teicholz (1996).

2.3.2 Analysis of Some Building Product Data Models

The following is a review of some of the major building product data models developed in research. The purpose is to understand the various concepts and approaches that categorize and organize the data that exists in a building.

2.3.2.1 The AEC Building Reference Model

This is a high level conceptual product data model for AEC products that concentrates on Buildings (Turner 1990). It defines a building project as a unique object made of a building and a site. A building is an object with one or more properties such as type, primary activity, and secondary activity. It decomposes into a number of building systems. Building system examples are structural, electrical, circulation, plumbing, heating, and lighting. A site is also an object with one or more properties such as humidity ratio, temperature, and view. It decomposes into site systems which can be electrical, fiesh water and disposal, electric, and gas.

The AEC Building Reference Model adopts a hierarchy of four levels: system, system component, system component port, system component port joint. A system exists to satisfy a human or natural need; an example is the building structural system. A system is a collection of system components. A system component such as a wall may belong to various systems, such as the enclosure system, the acoustical system, and the structural system. The wall component has different functions in each of these systems. System component ports are used to connect components in the same systems or in different systems. A door is a port that connects a room component to a corridor component. Each system component port is joined with another system component port by a system component port joint. The AEC model provides description for only the spatial system, the enclosure system, and the structural system of a building.

2.3.2.2 *The COMBINE IDM Model*

COMBINE IDM stands for "COmputer Models for the Building INdustry in Europe - Integrated Data Modeling" (Dubois 1992, Dubois and Parand 1993). It is part of the COMBINE project which has a primary focus on the energy aspect of buildings. The root object in this model is the Construction Project which may contain one or more Buildings. The Building is seen as an assembly of systems. The systems are: spatial system, fabric system, technical system, functional system, and external environment system. The overall space is divided into a set of zones, and each zone has some homogeneous behavior. A zone is created from the specific view of an expert. Due to the focus of the model (energy analysis), the fabric system main element is the building enclosure, and the HVAC (Heating, Ventilation, Air Conditioning) system is the only one available as a technical system.

2.3.2.3 *The RATAS Model*

RATAS is the basic model for the building products in Finland. It stands for "Computer Aided Design of Buildings" in the Finish language (Björk 1989). It aims to cover the design, production and maintenance stages of the building project. Concepts such as objects, attributes, relationships are used in the model. Objects are collections of data about a "thing", whether physical or abstract. To each object, a number of attributes can be associated that describe the properties of that object. Attribute types in RATAS are:

numeric, text, pictures, codes, and lists which make it capable of containing all kinds of data describing a building. Five functional levels for objects are distinguished in RATAS: building, system, subsystem, part, and detail. There is only one building level object per building. Its attributes are about the site, climate, type of building, construction cost, total size etc. Systems can be spaces, load-bearing, mechanical, electrical, or heating. Subsystems (or Groups) divide systems into functional parts such as floor or hospital ward. Parts constitute the vast majority of objects and are usually tangible entities such as building elements or technical devices. Their typical attributes are location and shape. Detail level includes data of objects that are subdivisions of parts like the different parts of a window. Usually these data will be included in general access databases. The model uses two types of relations: 'Part of' and 'Connected to'. The 'Part of' relation links objects from different levels while the 'Connected to' is more typical in part and detail levels, and usually connects objects at the same level.

2.3.2.4 Other Models

Another product data model is the Construction Project Reference Model (Rezgi and Depras 1995) where the building is described according to five complementary systems: structure, work, space, technical and separation systems. The purpose of this model is to enable the generation of construction documents from a single source of information. A multi-dimensional model of buildings (3P Model) which integrates the process, product, and participants is proposed by Bédard and Rivard (1995). It classifies buildings into structure, envelope, services, and interior systems.

2.3.3 DISCUSSION

The review of the available models shows that classification of building data varies considerably from one model to another. It depends mainly on the purpose of each model. The common feature in the models is the division of a building into group of systems. However, these divisions vary from one model to the other. Each model concentrates on a specific stage on the building delivery process and details a limited number of systems to fit its purposes. Therefore, no standards are currently available to follow nor is there any model that is sufficiently developed to be used in this research. Large groups of researchers have developed some of the models, yet the models still have limited capabilities. This shows the extreme difficulty to represent buildings as data models due to the unique nature of building projects. Therefore, we believe that any data model that represents building projects mainly needs to be flexible and oriented to be suitable for the project at hand. The use of IFCs might achieve this need, however, little information is publicly available now in order to consider their use in this research.

2.4 DESIGN PROCESS MANAGEMENT

Research in the use of information technology for managing the design of a building project, which this research belongs to, is still uncommon. However with growing interest in both the use of information technology in collaborative design and the use of product data modeling in the construction industry, we believe that interest in using information system for managing design will also grow. The following reviews available research in three issues that are important to the design process management.

2.4.1 DESIGN CHANGES

Design changes, which are the main issue addressed by this research, has not yet received much attention in the literature. A project by Krishnamurthy and Law (1995a, 1995b, and 1996 and Krishnamurthy 1996) proposes a three-layered model of versions, assemblies, and configuration. A version is a description of a primitive entity, an assembly describes a composite entity that belongs to a single discipline, while a configuration describes the overall project. The model monitors independent design activities by systematically tracking components descriptions in individual disciplines. It uses the concept of equivalent operations to compute changes. The advantages of this approach is its ability to compute changes between different versions of the design. Yet, it remains for the designer who performs the changes to know whether or not others are affected by the change. Also, designers themselves need to recognize any inconsistencies by reading drawings of the latest design version.

The EDM (Engineering Data Model) which has been developed by Eastman intends to support integrity management among various intelligent design software packages that are connected to the model (Eastman et al. 1995, Eastman 1992b, 1994). The model includes constraints that check the status of rules and specific knowledge embedded in the software. When a design change occurs to an instance, all design instances that use that data of the changed instance are flagged for rechecking. However, no information is given to the user on what data element has changed and why a data element is flagged for rechecking.

2.4.2 Design Information

Management of design information was also the focus of some research work. Platt (1996) focused on civil engineering projects and tried to manage their design information through process modeling rather than product modeling. Process modeling has information on how a product is transformed from its initial state to the final deliverables. Hence, the project information recorded on computer contains not only data about the project component but also about the process used to record this data. Rezgui has developed an approach to tackle the problem of integrity and consistency in the production of construction documents (Rezgi and Depras 1995). It is based on building a construction project reference model and a document reference model. Both models are linked with an association model that indexes building components to documentary items. The research focuses on how to extract construction documents from a project reference model and tries to ensure the integrity of these documents. It does not focus on how to ensure the integrity of the design information itself. The International Organization for Standardization (ISO) is also in the process of establishing a standard layering structure to be used in building design to facilitate the transfer and management of information (Björk et al. 1997).

Exchanging design information among designers has been investigated by Vries and Somers (1995) who developed a process model for that purpose. They suggested that a protocol to exchange information should ensure that both senders and receivers of information should interpret it the same way. Also all the required and correct information should be exchanged. These suggestions are important and are incorporated in the information model proposed in this thesis. The use of the internet to exchange and manage design information has been also investigated. Guenster (1996) discussed the benefits, costs, and lessons from using the internet with a design workgroup. Goodman and Chinowsky (1996) discussed the requirements for managing design information through an inter-disciplinary team when the internet is utilized. Rojas (1997) described a process for developing a web-centric system that enables cooperative engineering.

2.4.3 DESIGN RATIONALE

Several research projects have addressed the issue of acquiring the rationale behind a design decision. Peña-Mora and others (1995) studied the representation, use and communication of design rationale for conflict mitigation. They developed a model that is capable of representing design knowledge in term of the reasoning process used by the designer. The model also provides computer support for capturing designer's reasoning process. This capability appears useful to easily extract required knowledge from designers. The proposed information model in this thesis therefore includes similar capabilities. De la Garza and Alcantara (1997) used parametric dependency networks to represent design rationale. These networks can show how one particular design decision affects other decisions. The use of this type of network requires significant effort and training from the design team. In general, the aim of research work in capturing design rationale is to define the motives for a design decision. The acquired knowledge is different from that needed to propagate design changes. The latter requires knowledge that defines the consequences of a design decision.

2.5 SUMMARY OF FINDINGS

From the literature review, it is evident that the building industry is still at the exploration stage on how to use information technology in design and design management. Several approaches have been tested for collaboration in a multi-disciplinary environment. Each approach is oriented to solve a specific problem. None of them is capable to offer a solution for all problems diagnosed in section 1.1.3. Building product data models are successfully used to solve several research problems. However, different researchers present very different compositions for these data model. No standard is available nor is there sufficiently developed model that can be used. A flexible data model that can be configured for a specific building project appears to be the practical answer. Literature review on managing design process reveals that few research work studied how to deal with design changes. As shown in section 2.4.1, these researches study the problem from a viewpoint which differs from this thesis. Krishnamurthy and Law (1995a, 1995b, and 1996 and Krishnamurthy 1996) focus on comparing various design versions and define embedded differences whereas Eastman (1992b, 1994, 1995) is concerned with how to propagate design changes among intelligent design software. Throughout the literature review, some capabilities appeared useful and will be incorporated in developing the proposed information model. These capabilities are:

- Dynamic capturing of knowledge from designers during the design development.

Such capturing capability should be supported by appropriate computer interface.

- Acquiring and storing some information about the design process itself and not limiting the information used in the model to that describing the building components.
- Propagated design information needs to reach only the interested designers not all the designers.
- Exchange of design information has to be performed in a standard fashion that can be understood clearly.

The following chapters present the proposed information model in both conceptual and detailed perspectives.

CHAPTER THREE
PROPOSED INFORMATION MODEL:
A CONCEPTUAL PERSPECTIVE

3.1 OBJECTIVES AND MODEL CHARACTERISTICS

The analysis for the production process of construction technical documents diagnosed three main problems that result in the inclusion of incompatibility errors. The analysis also revealed that design changes remain as the principal challenge. The information model developed in this research aims to overcome this challenge. The model also needs to provide solution to the other diagnosed problems (see section 1.1.3 on page 8). The information model therefore needs to have the following characteristics:

1. It is capable of managing design changes. This capability is seen not to be limited to help propagation of design changes but it is also expected to cover the need for tracking past design changes and for providing the capacity to plan and schedule future design changes.
2. It uses data rather than drawings as the main media for storing and communicating design information.
3. It has a single source for design information that carries a unique description for every component in a building project.

Through the following sections, the architecture of the model is described in a conceptual perspective so as to reveal the main ideas rapidly (see also Mokhtar, Bédard, and Fazio

1998). The description is supported by simple examples that demonstrate the capabilities of the model. A detailed perspective is presented in the next two chapters.

3.2 The Model Architecture

3.2.1 Basic Parts

The heart of the model, as shown in Figure 3-1, is a central *Project-Database.* Unlike other models, this project-database is uniquely composed of two parts, the *Building-Components-Database* and the *Management-Database*. The building-components-database functions as a repository of all the design data that is necessary to describe every building component in a certain project. Such data is detailed enough to produce construction technical documents that are suitable for erecting the building. The management-database contains data that is required to manage the various functions of the information model. The role of this database will be incrementally revealed throughout the rest of the thesis. To generate the data that populates the building-components-database, each *Designer* is linked to the central project-database by a group of modules called *Designer System*. The *Design Manager*, who is responsible for managing the production of the technical documents, is also linked to the central project-database through a group of modules called *Design Manager System*.

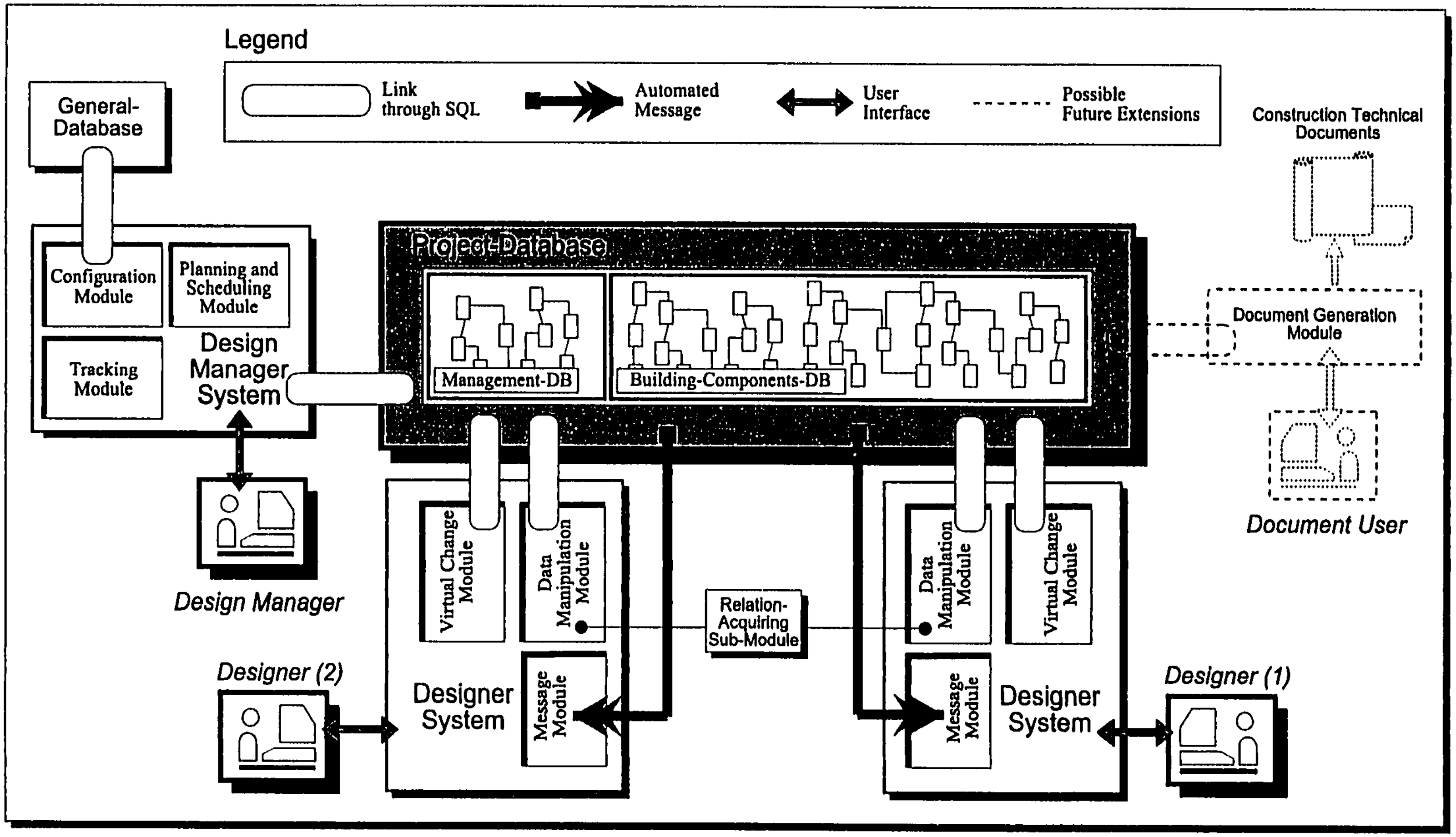


Figure 3-1 Architecture of proposed information model.

When the building components database is fully populated, construction technical documents can be produced with the use of the *Document Generation Module* which can create customizable documents about the project through its link to the project database (Mokhtar and Bédard 1994). This module, shown in dotted lines in Figure 3-1, resides beyond the scope of this thesis.

The detailed design stage starts with the architectural team translating ideas in preliminary design documents into elementary building components such as walls, columns, doors, and windows. Most of the data that describes these components is textual in nature. Therefore, its value can be keyed in the building-components-database. Some of the data is geometric in nature, such as the dimensions, and is usually documented through a computer-aided drafting tool. The function of that tool is to acquire, through its interface, the geometric data and to translate it into alphanumeric characters. The model currently does not include such a tool and the designers therefore are expected to directly key in the geometric data directly in textual format.

Designers interact with design data in the database in order to view, modify, or add values. This interaction is materialized through the *Data Manipulation Module*. As Figure 3-2 illustrates, a designer can - through this module - create a new instance or manipulate the value of any attribute of any instance of any building component. The type of manipulation (view and/or modify) should depend on the authority that a designer has over a specific building component. The data saved in the building-components-database reflects decisions taken by the design team members.

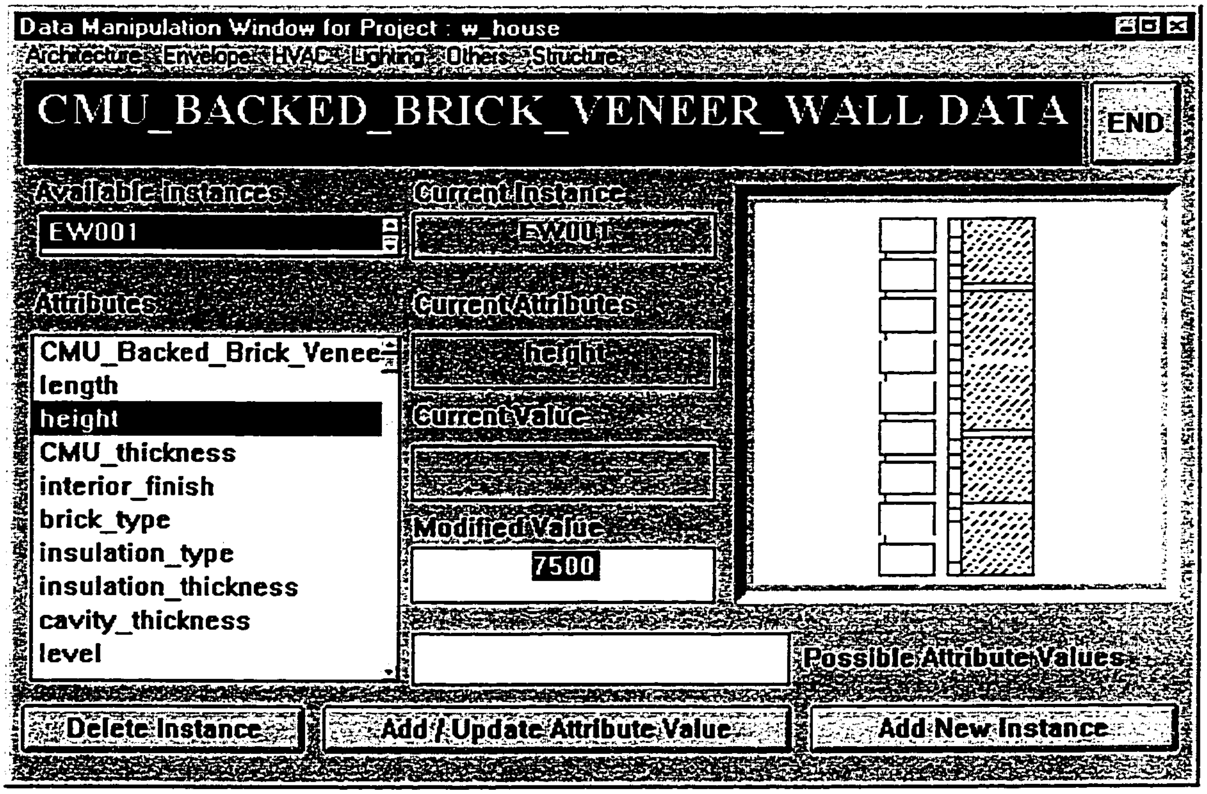


Figure 3-2 Interface for data manipulation module[1].

Yet, to enable the designers to record data about the various building components of a certain project, the building-components-database needs to have a suitable "data-structure" (or "product data model"). This data-structure should echo the type of building components that exist in the project. Because buildings are unique products, every building project contains different combination of building components. Hence, every building project needs a building-components-database with a unique data-structure. The building-components-database therefore should be flexible so as to adapt to the requirement of every project. Such flexibility is realized in the model through the use of the management-database. More details are given in chapter four and also in Mokhtar,

[1] All linear measurement are in mm units.

Bédard and Fazio (1997b). The data-structure of the building-components-database can be manipulated through the *Configuration Module* which is part of the design manager system. Figure 3-3 illustrates part of that module where an attribute (vapor barrier type) is added to the building component "CMU_backed_brick_veneer_wall" as part of creating that component in the building-components-database. Such manipulation, which is carried out by the design manager, is facilitated through the use of a *General-Database.* This general-database functions as a source of data-structure for a large variety of building components. Figure 3-4 illustrates the use of the general-database to retrieve the data-structure of the building components that belong to an HVAC system into the building-components-database. The configuration of the data-structure for the building-components-database needs to be performed before beginning the development of the detailed design. Yet, it can also be updated during that development.

3.2.2 The Concept of Active Building Components

As recognized before from analyzing the production process of construction technical document, design changes constitute a major source of incompatibility errors. The crux of the design change problem is the failure on the design team's part to propagate design changes. As found from the analysis of the detailed design (section 1.1.2), this failure is due to the lack of the "linking" knowledge that is necessary to perform this task. Also, it is due to the large amount of data that is generated and needs to be monitored and communicated during the development of detailed design.

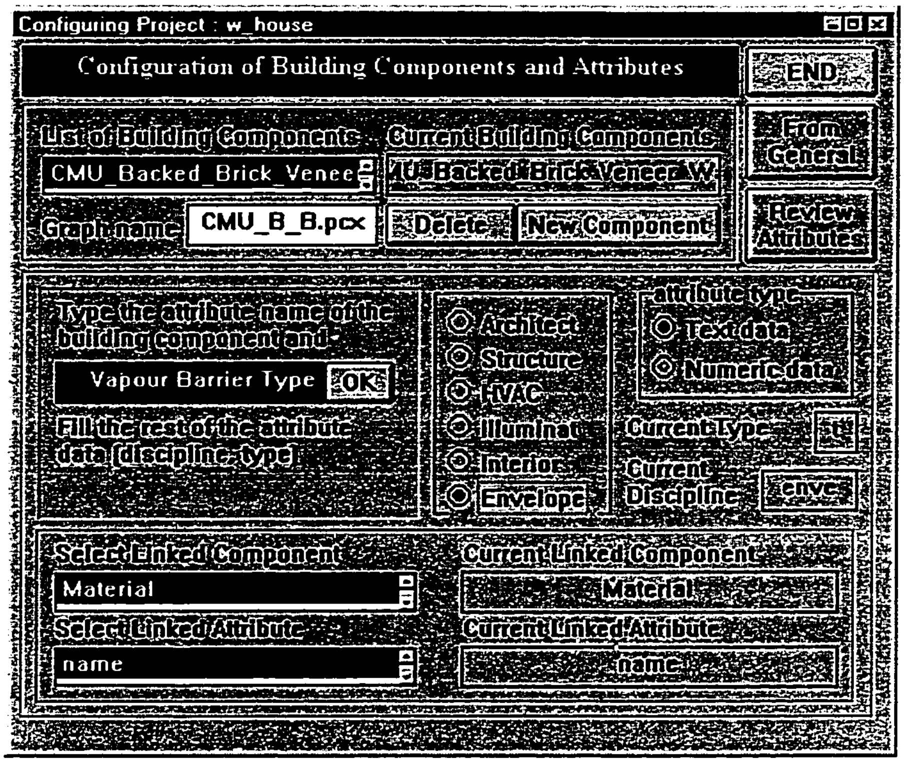


Figure 3-3 Configuration of a building component using configuration module.

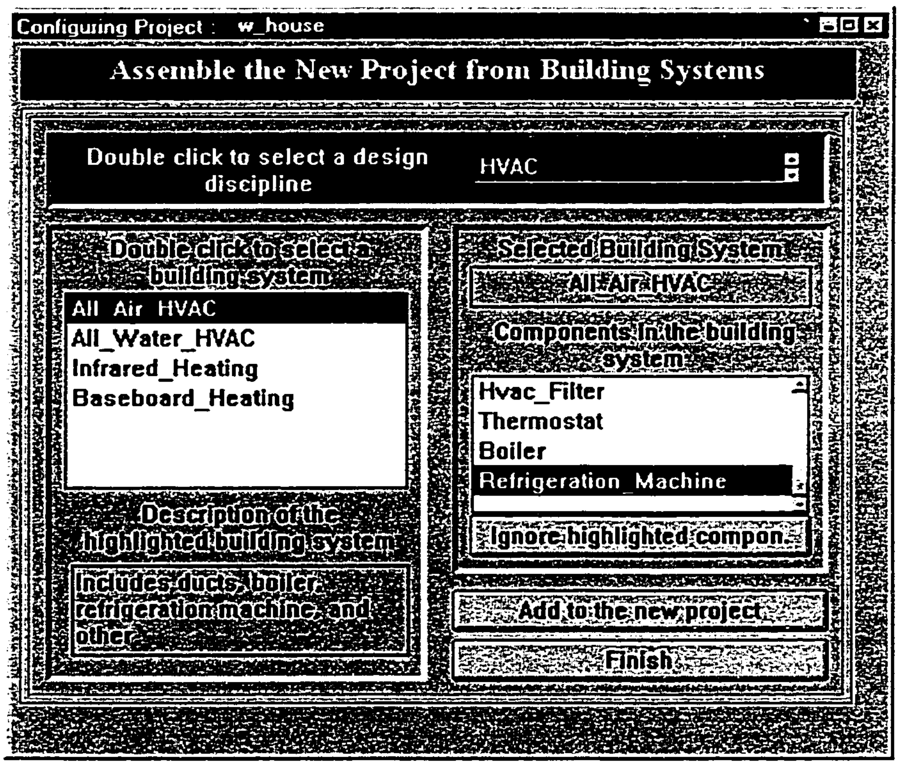


Figure 3-4 Assembly of building components in building-components-database from building systems available in general-database.

The model introduces a concept that directly tackles the crux of the problem. **It assigns the responsibility of propagating design changes to the building components themselves.** As such, when a designer modifies any attribute that describes a property of a building component, the component itself becomes responsible to find out who in the design team is affected by that design change. The component becomes also responsible to send messages to the affected designers. These messages inform them about the design change and advise each one of them on how such a change may have an impact on his/her design (Figure 3-5).

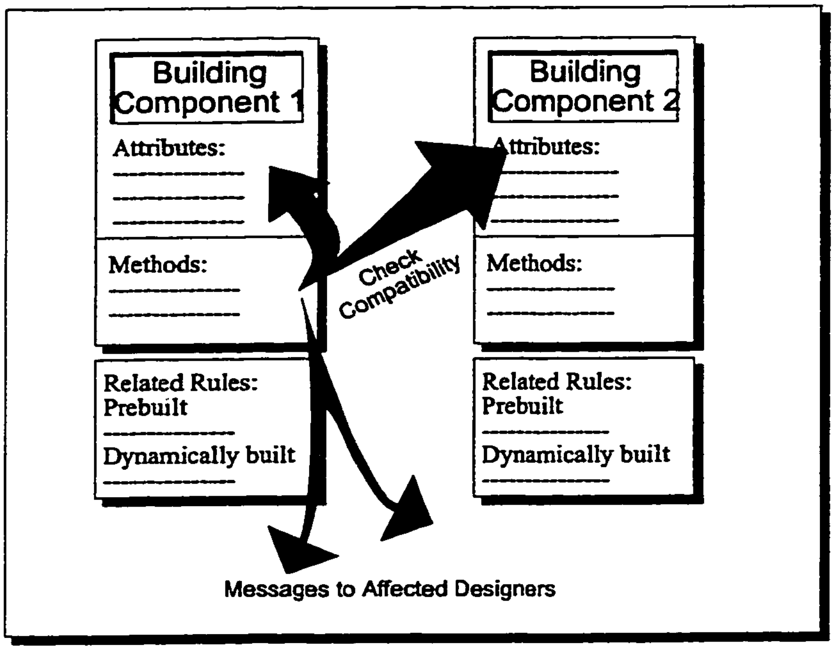


Figure 3-5 Concept of active building components.

For example, if the envelope designer decides to increase the height of a wall, the wall itself notifies the structural engineer of this decision and advises him/her that such a decision may affect the design of the girder that carries this wall. By depending on the building components themselves rather than the designers to propagate design changes, we are eliminating the possibility that the envelope designer, who initiates the change, may forget to propagate the change, think that it is too insignificant to mention, or not be aware that another discipline is affected. We also compensate for the ability of the structural designer to discover such a change when reviewing the wall detail drawings.

On the basis of the above example where only one element of data has changed, it is evident that the proposed concept of having building components propagate design changes becomes highly advantageous in real cases where hundreds of such changes occur daily within the thousands of data elements that exist while developing the detailed design of a building project.

With such concept, the building-components-database is no longer a mere repository of idle data, but rather a repository of "active" building components that help the design team coordinate the building design information.

To make building components active in conducting their assigned task, they are connected with methods (groups of procedures). These methods make a building component active as soon as a design change occurs to any of its attributes. The components are also equipped with the necessary "linking" knowledge which identifies the disciplines that are affected by a specific design change and how they are affected.

The model is developed so as to acquire this knowledge in the form of rules. These rules, like the building components, are customizable so as to reflect the requirements of a specific building project. The model considers two types of rules, *prebuilt* rules and *dynamically built* rules. Prebuilt rules are acquired before the beginning of the detailed design stage while configuring the model. The dynamically built rules are acquired "on the fly" during the detailed design stage (i.e. during the use of the model). For example, a prebuilt rule would reflect the fact that a change in the height of a wall affects the structural system design. An example of a dynamically built rule would be the design decision to make the height of a wall in a one-story building equals the clear height plus 1000mm.

3.2.3 Propagating Current Design Changes

When a design change occurs to a building component attribute, the component becomes active and checks all relevant prebuilt and dynamically built rules. If any of these rules applies to the design change, the component automatically sends messages to the affected designers.

Figure 3-6 gives an example of a message that is automatically sent to the envelope designer as a result of a design change made by the architect. The designer receives the message through the *Message Module* (see Figure 3-1 on page 36). This module allows the designer to review and modify the rules that cause messages to be sent, thus providing the model with the flexibility to adopt new relations that designers may develop among building components. When the envelope designer in turn takes a corrective action, another message (Figure 3-7) is automatically sent to any other affected designer.

With the concept of active building components, we are now in a position to propose a solution to the main source of problems when design changes occur. Naturally, we expect that the involved designers will assume the responsibility to take the necessary actions as soon as they are informed of design changes.

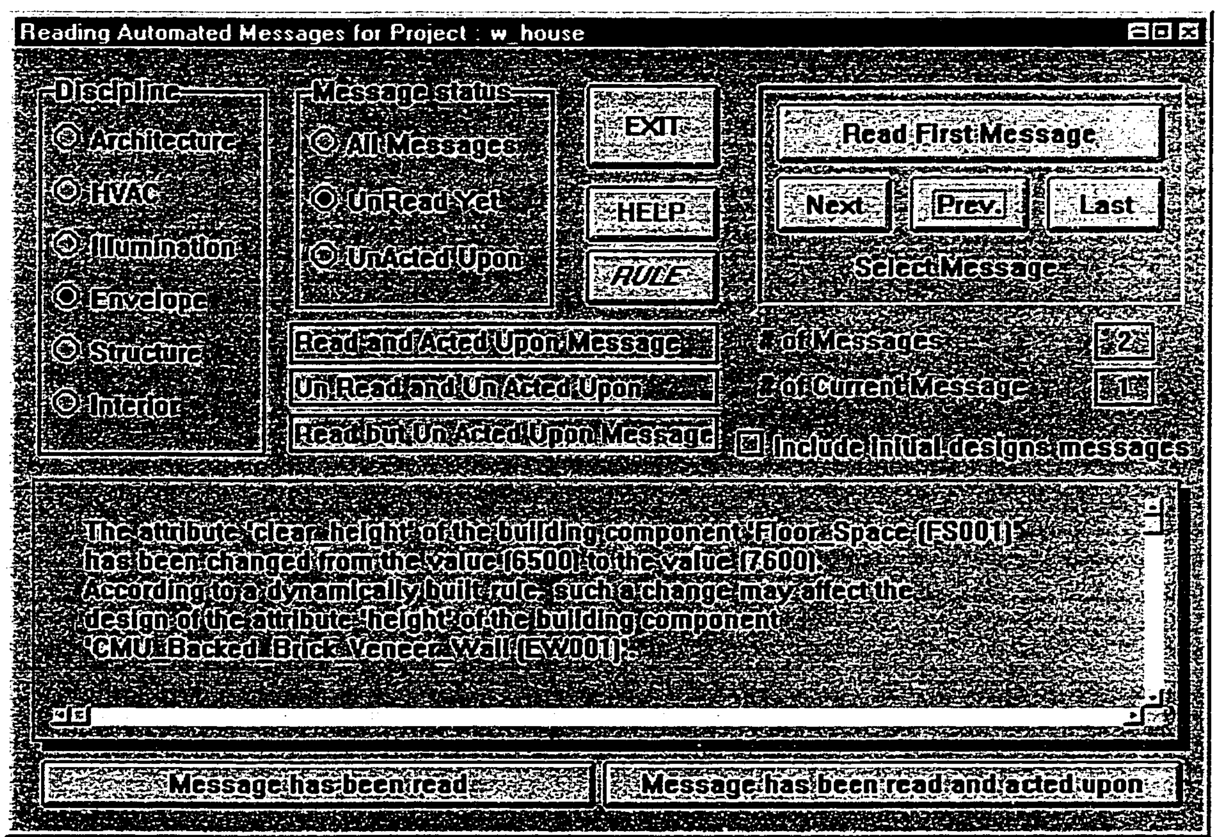


Figure 3-6 Message received by envelope designer informing of design change made by architect.

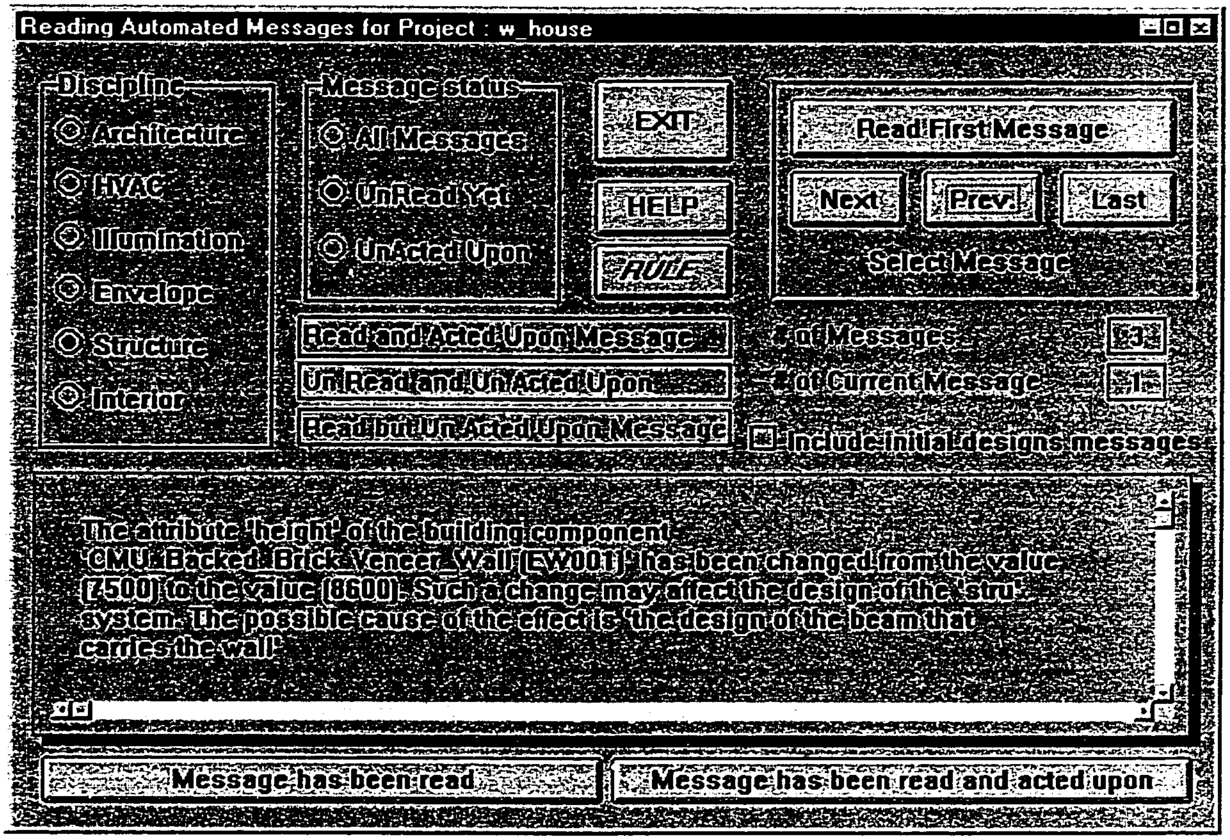


Figure 3-7 Message received by structural engineer informing of design change made by envelope designer.

3.2.4 TRACKING PAST DESIGN CHANGES

For design managers to manage the production of construction technical documents at the detailed design stage better, the history of design changes in a project represents an important source of information. The tracking of such history enables design managers to analyze the development of the production process. They can then evaluate the performance of the various designers in a project (e.g. designers who make poor design decisions which need to be later modified, costing the design team time and money), and can also determine responsibilities for design incompatibilities. With this in mind, the model is developed to provide the following capabilities through its *Tracking Module* (see Figure 3-1 on page 36):

- Retrieval of design changes that are:

  made by a discipline (e.g. structure),

  made to a building component (e.g. concrete beams),

  made to an instance of a building component (e.g. concrete beam001),

  made to a single attribute of a specific instance of a building component (e.g. depth of concrete beam001).

  The retrieved design changes can also be limited over a period of time.

- The model can show the design manager all automated messages that have been sent by a specific building component in response to the design changes affecting it. The model also indicates which discipline has received each message and whether designers of this discipline have read the message and taken corrective action.

Figure 3-8 shows the design manager interface to the tracking module while Figure 3-9 gives the result of a request to monitor the design of a building component. Figure 3-10 shows one of the messages which were automatically sent to a member of the design team (as in Figure 3-7) because of a specific design change. The color of the message determines whether the designer who received the message read it and whether a corrective action was taken or not.

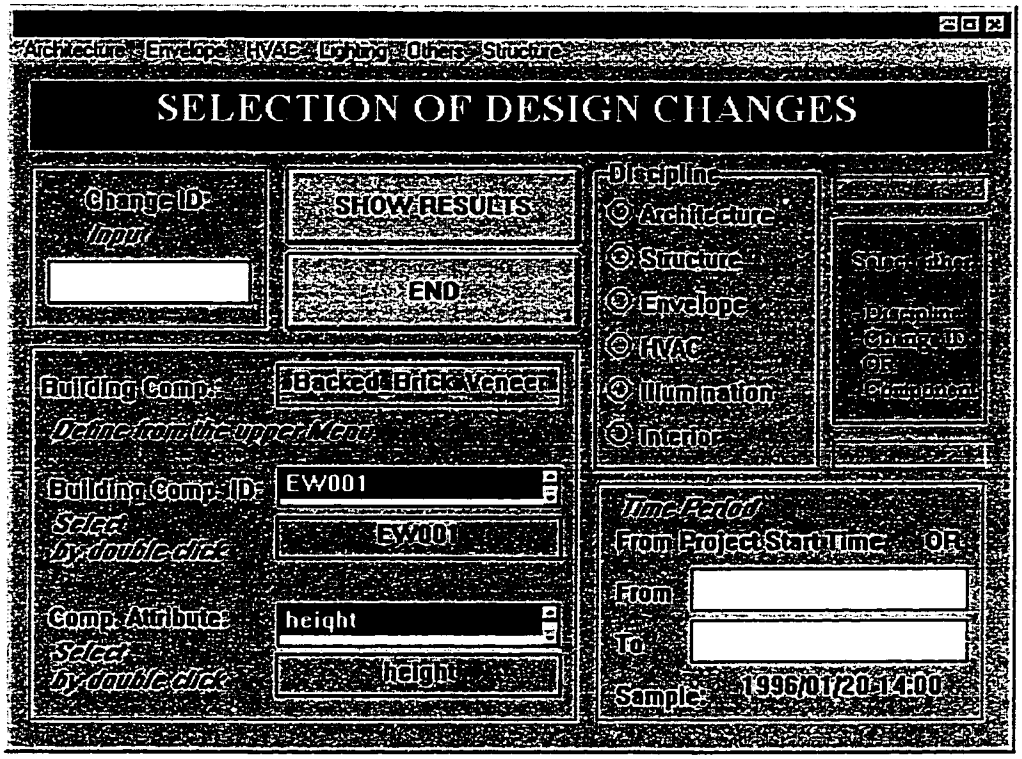


Figure 3-8 Interface for tracking module.

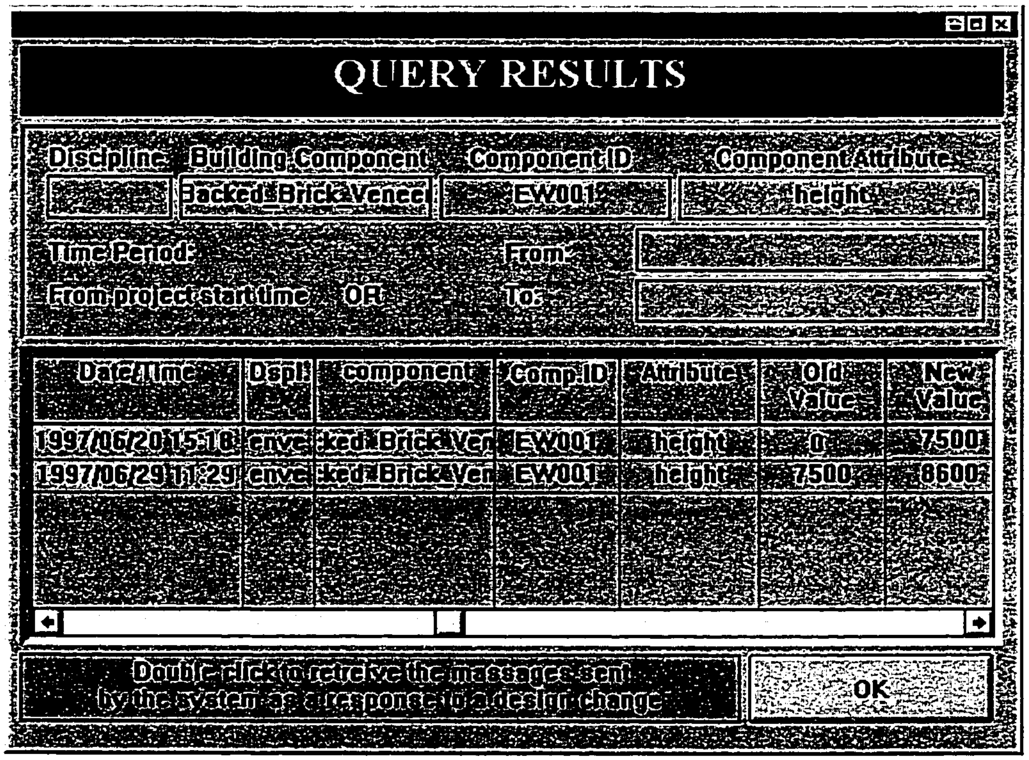


Figure 3-9 Results of request made by design manager to track design changes made to a building component.

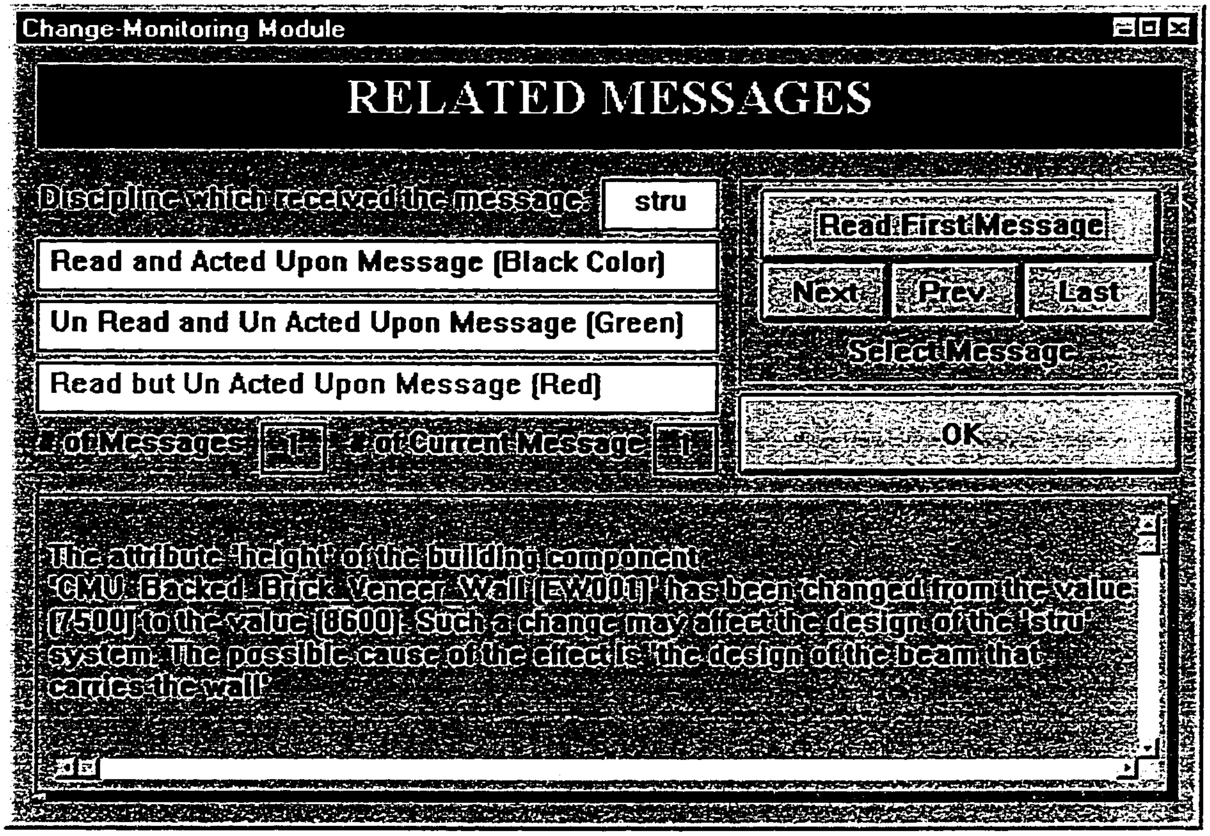
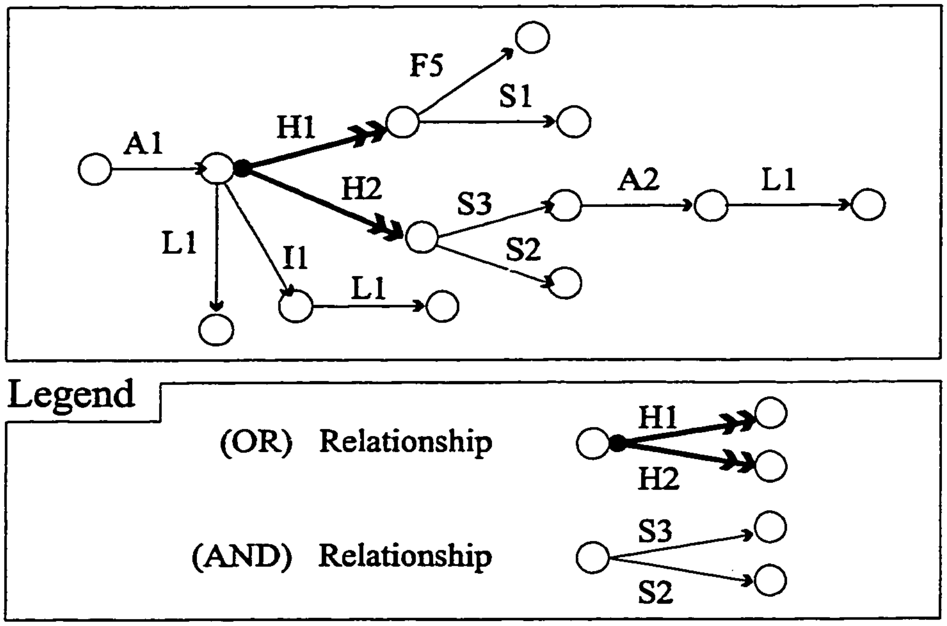


Figure 3-10 Results of request made by design manager to track automated messages that are sent because of a design change.

3.2.5 PLANNING AND SCHEDULING FUTURE DESIGN CHANGES

Many design changes impact only a limited number of building components. Yet, some changes result in a sequence of design changes to related building components. For example, in a specific building project, the owner needs to change the function of a certain space from an executive office to a computer lab. Such a change (indicated as A1 in Figure 3-11) which is to be performed by the architect leads to several other changes that need to be performed by other disciplines. The lighting designer needs to modify the type of luminaires that are used in the space (L1). The interior designer needs to change the wall finishing (I1). The HVAC designer needs to increase the size of the supply duct to the space. S/he has the option to do that by increasing the width of the duct (H1) or the depth of the duct (H2).



Change in:

A1. Space function (*Architecture*) (from executive office to computer lab)
A2. Reduce clear height (*Architecture*)
I1. Wall finishing (*Interior Design*) (from dark mahogany wood to white paint)

F5 Location of sprinkler outlets (*Fire Safety)*
H1. HVAC duct width (*HVAC*)
H2. HVAC duct depth (*HVAC*)
L1. Luminaire type (*Lighting*)
S1. Width of hole in structural beam (*Structure*)
S2. Height of hole in structural beam (*Structure*)
S3. Depth of beam (*Structure*)

Figure 3-11 Scenario for interrelated design changes

When these design changes (L1, I1, and H1 or H2) are performed, each of them will result in the need for further design changes. As the wall finishing changes (I1), the type of luminaires (L1) needs to be reevaluated and may be changed. If the width of the duct is changed (H1), then the location of the sprinkler outlet needs to be changed (F5) and the width of the hole in the structural beam, where the duct passes, needs to be changes (S1). However, if the depth of the duct is changed (H2), different changes are needed. The height of the hole in the structural beam will be changed (S2) as well as the depth of this beam (S3). The later change will result in lowering the suspended ceiling level and reducing the clear height (A2). Due to the lowered clear height, the type of luminaires (L1) needs to be reevaluated and may be changed.

This scenario illustrates the "domino" or interrelated effect that a design change in one discipline can have on several other disciplines. For simplicity, changes that recursively affect each other in closed loop fashion are omitted. Such types of design changes represent a challenge for the design team, specially the design manager, in many aspects. Among these aspects is how to predict the interrelated design changes that result from an initial design change such as (A1). The lack of the linking knowledge that enables such prediction makes this task very difficult. Another aspect is the possibility to have more that one solution to accommodate a design change as in the case of the HVAC designer who has the alternative to follow change (H1) or change (H2). Each alternative results in different "group of design changes" (or change-path). It is difficult not only to determine all the possible change-paths to accommodate an initial design change but also to select which one of them is the best to follow. Another aspect of the challenge is the possibility that some design changes such as (L1) may be repeated several times. It is hard to know when such a change should be performed in order to avoid the repetition.

To assist the design team in facing the challenges of interrelated design changes, the capability of planning and scheduling future design changes is built in the model. A methodology has been developed and implemented for this purpose using both the

Virtual Change Module and the *Planning and Scheduling Module* shown in Figure 3-1 on page 36. Figure 3-12 shows the result of applying the methodology on the example given in Figure 3-11. The figure illustrates that the methodology identifies the possible change-paths and properly locates design changes so as to avoid repetitions. Figure 3-13 shows the same result as it is displayed to the design manager for one of the possible change-paths. The detailed development of the methodology is presented in chapter five and in Mokhtar, Bédard and Fazio (1997a).

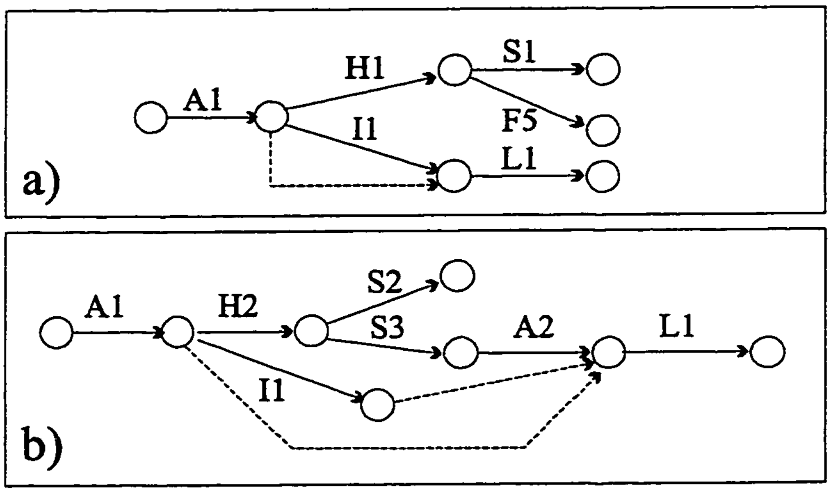


Figure 3-12 Alternate change-paths for scenario in Figure 3-11

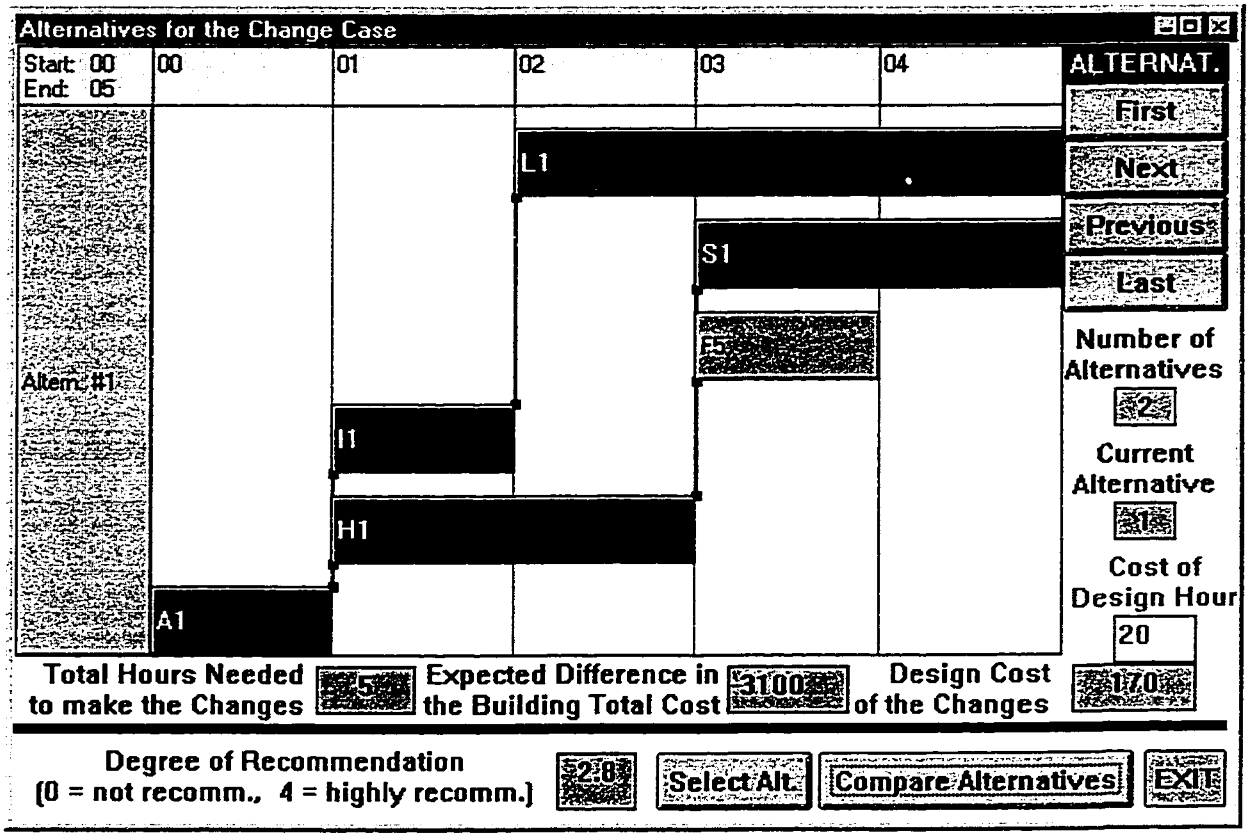


Figure 3-13 Bar chart for alternate change-path (a) in Figure 3-12

3.3 DISCUSSING THE MODEL ADVANTAGES AND LIMITATIONS

The architecture of the model provides a data-centric rather than a drawing-centric environment. It also provides a single repository of the design data. As such, the model architecture solves two of the diagnosed problems (section 1.1.3) that cause incompatibility errors in construction technical document. The capability of the model to automatically propagate design changes solves the main design change problem. This capability ensures that every member of the design team is updated with the data that s/he is using as input to the design of his/her building system. The quality of the input data is absolutely essential to the quality of the design of any building system and its compatibility with other building systems. There is no way for a good designer to provide suitable design with wrong or outdated data. However, the model does not guarantee that a design decision that is taken by a designer is the appropriate one.

Some approaches to address the design change problem help designers in recognizing these changes through providing them with the updated drawings of the other disciplines. These approaches depend on the designers to recognize the design changes through comparing the updated and old drawings. The approach taken here is to directly inform only the affected designers with textual data that clearly shows the change. As such, no room is left for failure to recognize small changes or non graphical changes.

The approaches that use knowledge-based systems to coordinate design information depends on built-in coordination knowledge that should automatically correct any incompatibility errors. It is mainly oriented to help inexperienced designers who may not be able to take correct decisions. In contrast, the approach of this model is to recognize the experiences of the involved designers. Yet, it supports them with correct and updated information that they need to make their design decisions. We see this as a more realistic approach. It uses computers in what they excel at, which is dealing with large amounts of data, and designers in what they excel at, which is creativity that is built on experience. Because of its dependence on knowledge that is provided by the developers, the knowledge-based approach will always have a limited capacity to coordinate design data (El-Bibany 1992). Such knowledge is difficult to reflect the relationships among different building components which vary from one building to the other. This model uses only linking knowledge and does not use any induction knowledge.

The model is developed in such a fashion that provides flexibility to both the data-structure of the building components and the linking knowledge that define the relations among these components. Such dual flexibility is a great advantage to the model as it reflects the nature of building projects. However, this flexibility requires the model to be configured to suit every project. This consumes extra time from the design team. Nevertheless, this time is seen as an investment that will pay off in reducing the long time that is usually consumed in coordinating and in solving incompatibility problems.

The model capability to plan and schedule future design changes is unique and has not been addressed before to our knowledge. This capability, however, depends on collaboration among members of the design team.

The architecture of the model currently lacks a tool to accept and show graphical data. The inclusion of such a tool will greatly ease the use of the model. The problem of data security and control of access is not addressed by the model nor the problem of the legal boundaries among the various involved disciplines. The model is more oriented toward design firms that include all the needed design disciplines under one legal entity. However, with the growing use of "Partnering" in the construction industry, this limitation may be overcome. The model is developed with a vision to use client-server networks and therefore limited to be used within one building or close-by buildings. It is also oriented to sequential type of project delivery systems. It cannot function, for example, in a fast track delivery system.

3.4 SUMMARY

The crux of the design change problem, which is propagation of design changes, is directly tackled by the proposed information model. The model introduces the concept of active building components where each component is responsible for propagating design changes that occur to any of its attributes. The model is also developed with a unique management-database. This management-database allows the model to have flexible data-structure that is adaptable to the requirements of any building project. It also provides the model with the capability to track past design changes and plan and schedule future design changes. In this chapter, the overall architecture of the model is presented in conceptual perspective. The following two chapters detail the development of these concepts.

CHAPTER FOUR

THE CENTRAL PROJECT-DATABASE: A DETAILED PERSPECTIVE

4.1 INTRODUCTION

The heart of the proposed information model, as shown in Figure 3-1 on page 36, is the central project-database. This project-database is composed of two parts, the management-database and the building-components-database. The management-database contains data that is required to manage the various functions of the information model. The building-components-database functions as a repository of all the design data that is necessary to describe every building component in a certain project. To enable recording this data by the design team, the building-components-database needs to have a suitable "data-structure" that echoes the nature of building components that exist in a certain project. However, the building-components-database is not a mere repository of idle data, but rather a repository of "active" building components that help the design team coordinate the building design information.

This chapter shows the used technologies and the detailed development for the project-database so as to built it as a flexible repository of active building components. The chapter also shows the process of assembling and configuring the project-database through the use of the configuration module and with the assistance of the general-database (see Figure 3-1 on page 36).

4.2 Flexible Repository of Active Building Components

The primary function of the central project-database is to be a repository of active building components. Because of this function, structuring the project-database needs to satisfy two main requirements. The first requirement is to make the database flexible enough to accept the design information of any building. The second requirement is to have the building components in this database active in managing design changes as this is the main objective of the model. This section shows how the model is developed so as to satisfy these two requirements.

4.2.1 Providing Flexibility

Buildings are unique products. A hospital contains very different components from those of a warehouse. Furthermore, a warehouse may share some components with other warehouses but not all. For example, an air-heated warehouse may contain air distribution ducts while a radiant heated warehouse will not. Therefore, the definition of a data-structure (data-model) for the building-components-database may follow either one of the following two strategies. The *first* strategy is to create a universal data-structure for the building-components-database that covers all possible building projects. The *second* strategy is to customize the data-structure of the building-components-database to suit individual building project. The *first* strategy should result in a reusable and therefore desirable data-structure, yet it requires the inclusion of a complete set of available and newly introduced building components. As the number of these components is virtually unlimited, this strategy rapidly becomes impractical. In this research, the *second* strategy is used to define the data-structure of the building-components-database which is the flexible part of the project-database. The management-database, on the other hand, has a fixed data-structure. For reference purposes, appendix "A" displays the conceptual data-structure of the management-database. Copies of its data-tables are also used through this chapter to facilitate the explanation.

To fulfill the flexibility requirement, the *Relational Database* technology is utilized to structure the project-database. This technology allows dynamic and transparent manipulation of data-structure and data values through an interface program by using the Structured Query Language (SQL). With such technology, each *building component* (e.g. window, beam, duct) is represented as a *data-table*. Each data-table has a different data-structure that represents the attributes describing each component. Data-Table 4-1 shows a sample of the structure for the data-table that represents the building component "Window". The *instances* of a building component (e.g. window001, window002) are stored in their own data-table. Figure 4-1 shows how these instances are stored in Data-Table 4-1.

Data-Table 4-1 WINDOW
WINDOW_ID WIDTH HEIGHT FRAME_WIDTH SILL_HEIGHT NO_OF_LEAVES

Window_ID	width	height	frame_width	sill_height	no_of_leaves
Window001	3000	1200	200	900	3
Window002	2500	1200	200	900	2

Figure 4-1 Sample of data in data-table "Window" which describes instances of the building component "Window".

The use of SQL statements enables adding, deleting and modifying data-tables that represent various building components in the building-components-database. For example, if the architect decides to use circular windows in addition to rectangular windows, s/he needs to have a data-table that contains the attribute "Radius" instead of the attributes "Width" and "Height" that are in Data-Table 4-1. Asking the design manager to create such a data-table, s/he specifies the name and the attributes of the data-table. Using SQL, the data-table "Circular_Window" is created in the building-components-database. The SQL statements for this operation include these shown in the zigzag[1] frame. The first statement builds a new data-table with an initial attribute "Circular_Window_ID" that accepts alphanumeric values. The second and the third statements modifies the created data-table by adding two other attributes, "Radius" and "Frame_width" that accept numeric values.

```
CREATE TABLE [Circular_Window] [Circular_Window_ID] TEXT;
ALTER TABLE [Circular_Window] ADD [Radius] NUMERIC (5);
ALTER TABLE [Circular_Window] ADD [Frame_width] NUMERIC
(5);
```

The interface program (the configuration module) creates these SQL statements

[1] Text within a zigzag frame is extraction from the program code.

automatically, the design manager needs only to provide the name of the building component and its attributes (Figure 4-2). S/he does not need to know how this data is structured in the building-components-database. The created data-table (Data-Table 4-2) can now carry the data of all the circular windows in the project. The configuration module also enables the modification of the data-table at any later time to accommodate the need to describe the building component with further details.

[illegible] CIRCULAR_WINDOW
CIRCULAR_WINDOW_ID RADIUS FRAME_WIDTH SILL_HEIGHT

Yet to enable the use of SQL in providing this capability, a specially developed data-table (Data-Table 4-3) in the management-database is used[1]. This data-table records data that describes the data-structure of the various data-tables in the building-components-database. As such, the structure of these data-tables can be tracked and manipulated. Figure 4-3 shows sample data of Data-Table 4-3. The sample shows the data that describes the data-table "Window" and the data-table "Circular_Window".

[1] Names of all data-tables that belong to management-database start with MNG.

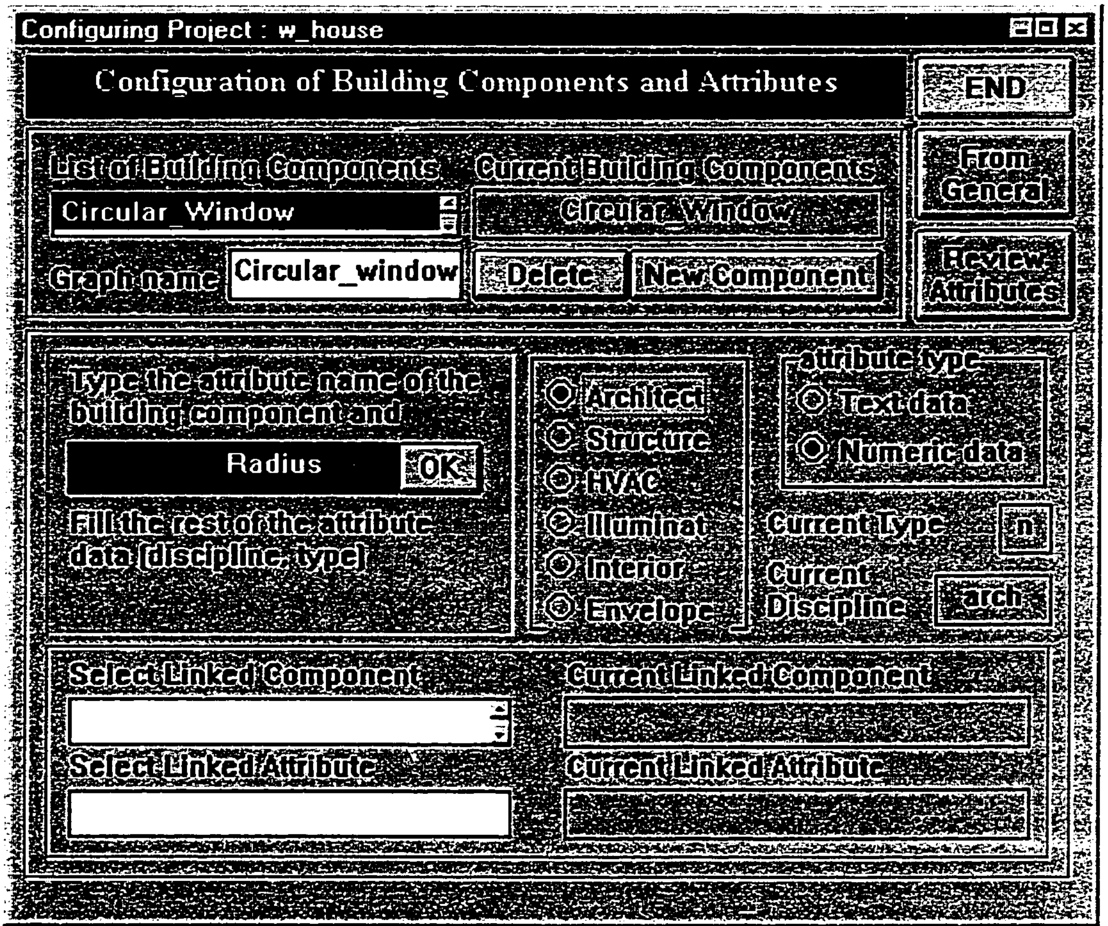


Figure 4-2 Configuration of the building component "Circular_Window" using configuration module.

Data-Table 4-3
MNG-BUILDING-COMPONENTS-ATTRIBUTES

ID
BUILDING_COMPONENT
ATTRIBUTE_OF_BUILDING_COMPONENT
ATTRIBUTE_TYPE
DESIGNING_DISCIPLINE
LINKED_BUILDING_COMPONENT
LINKED_ATTRIBUTE_OF_BUILDING_COMPONENT
GRAPH_NAME

19	Window	Window_id	T	Arch			Window.pcx
20	Window	Width	N	Arch			
21	Window	Height	N	Arch			
22	Window	Frame_width	N	Arch			
23	Window	Sill_height	N	Arch			
24	Window	No_of_leaves	N	Arch			
25	Circular_Window	Circular_Window_id	T	Arch			Circular_Win
26	Circular_Window	Radius	N	Arch			
27	Circular_Window	Frame_width	N	Arch			

Figure 4-3 Sample of data in Data-Table 4-3 that describes data-structure of the building components "Window" and "Circular_Window"[1].

4.2.2 Making the Building Components Active

The second requirement for the design of the central project-database is to make the building components active in managing design changes. To fulfill this requirement, the Object-Oriented (OO) technology is adopted. In this technology, an object is a collection of related variables and procedures (Taylor 1992). Objects encapsulate methods, which are groups of procedures. When a designer modifies the design of a building component (e.g. window), the attributes of this building component (e.g. width, height) are retrieved into an OO environment (Figure 4-4). Each attribute is temporarily represented as an

[1] The headings are truncated and some may have been removed in order for the figure to fit on the page.

object and consequently becomes encapsulated with a method. The method is triggered when a design change occurs to the value of the attribute. The method retrieves some rules that are related to the attribute (e.g. a 20% change in window height affects the daylight design) and checks the applicability of the rules to the design change. If any of the rules is applicable, the method automatically sends messages to the affected designers informing them about the change and asking for an appropriate response (more details in chapter five). The rules are stored in specially developed data-tables that are part of the management-database (for example, see Data-Table 5-1 on page 84 and Data-Table 5-2 on page 84).

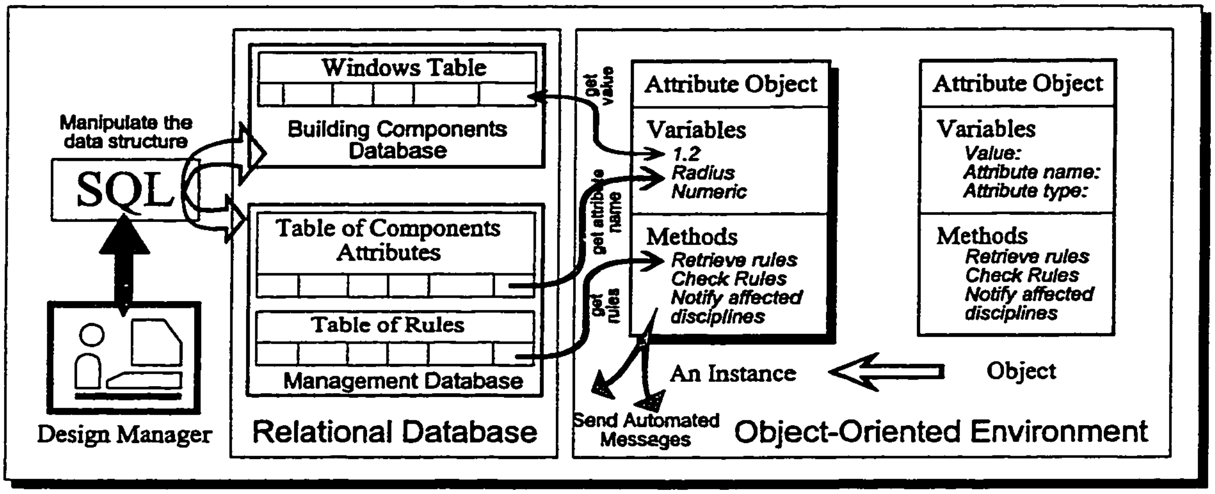


Figure 4-4 Combination of relational database and object-oriented technologies.

With such a combination of the relational database and OO technologies, only the relational database structure needs to be modified so as to accommodate the requirements of a project. Building components can be added, deleted, or modified. Their properties can be also changed. Rules can also be added or modified in the relational database.

The problem of flexibility and extendibility of data-structure may be approached with the sole use of the OO technology. This approach will ultimately face the shortcomings of this technology, mainly (Elmasri and Navathe 1994):

- No high level query language is available so as to allow the dynamic and transparent manipulation of data-structure and data values by the end user through an interface software. The end user therefore needs to know how to use the development environment (usually an OO database management system). Such a requirement will severely limit the practicality of the model.

- Behavior rigidity, where a fixed set of rules has to be pre-determined and pre-specified during the model development, makes it unfeasible to add and modify rules to building components during execution to suit specific project requirements.

The approach, which combines both the relational database and the OO technologies, provides a more practical solution.

4.3 ASSEMBLY AND CONFIGURATION

As shown in the previous section, the project-database is built to be a flexible repository of active building components that suits the requirements of individual building projects. As such, the building-components-database part of the project-database needs to be assembled for every new project. The management-database also needs to be configured for the project at hand. While the design team uses the model, some reconfiguration may be required as well to reflect the changing requirement of a project.

This section shows how the configuration module is developed to enable the design manager perform these tasks. Figure 4-13 on page 78 is a diagram that can be used as a reference to show the user interface through the configuration module.

4.3.1 ASSEMBLY OF THE BUILDING-COMPONENTS-DATABASE OF A NEW PROJECT

When starting a new project, the design manager activates the configuration module. As the configuration module is instructed for a new project, it creates a new project-database file with the name of the project as provided by the design manager. The new project-database file is created as a copy of an already built standard database that only includes unpopulated data-tables of the management-database (section A.1.2). No data-table exists a priori in the building-components-database. The design manager is then required to define the data-structure of every building component that exits in the project at hand so as to enable members of the design team to record design information.

Because a building consists of a large number of components, such task is extremely difficult and time consuming. It will definitely discourage the use of the model. Therefore, a general-database is developed to provide assistance to design managers in performing this task. The general-database as shown in Figure 3-1 on page 36 is not part of the central project-database, rather a supporting resource that exists separately and can be used simultaneously by several design managers for different projects.

4.3.1.1 <u>The General-Database</u>

The purpose of the general-database is to provide assistance to design managers in assembling the building-components-database. It is able to do so by containing data-structure for a large pool of building components. Three main observations influence the development of the general-database:

- The first observation is that *building components are repeatedly used.* As most of the building components are manufactured, they have to be widely used to reduce their cost. Nevertheless, only a limited number of the available building components are used in a certain project.

- The second observation is that *building components can be grouped into systems*. For example, a column and beam structural system will contain components such as concrete foundation, concrete column, concrete beam, and concrete slab.

- The third observation is that *some buildings resemble other buildings in most of their building components*. For example, most wood construction homes will share most of their components.

The general-database development, as shown in Figure A-2 in Appendix "A", reflects these observations through assembling building parts into three levels of increasing complexity: Components, Systems, and Configurations. Members at the Components level such as doors, beams, ducts, and luminaries are the primary ingredients in a building. Each component is described through its attributes. The description is recorded in a special data-table (Data-Table 4-4[1]) which carries data about the data-structure of a variety of building components. Figure 4-5 shows a sample of the data in the Data-Table 4-4. The next level is the Systems level. Examples for members of this level are cast-in-place flat slab concrete structural system, all-water HVAC system, and restroom system. Each system contains a group of related components that form the system. The restroom system, for example, includes lavatory, toilet, urinal, sink, partition, and mirror. Each of these components is fully described in the components level (Data-Table 4-4). A special data-table in the general-database (Data-Table 4-5) carries the data which identifies the building components in various building systems. Figure 4-6 shows a sample data in the Data-Table 4-5. The highest level is the Configurations level. Members of this level are complete building configurations. Examples are a concrete structure low-rise office building with all-air HVAC system, or a steel structure warehouse with infrared heating. Such configurations are required when a data-structure for a similar project needs to be assembled. The general-database carries a list of existing projects in Data-Table 4-6. Figure 4-7 shows a sample of the data in Data-Table 4-6.

[1] Names of all data-tables that belong to general-database start with GNL.

Data-Table 4-4 GNL-BUILDING-COMPONENTS-ATTRIBUTES
ID BUILDING_COMPONENT ATTRIBUTE_OF_BUILDING_COMPONENT ATTRIBUTE_TYPE DESIGNING_DISCIPLINE LINKED_BUILDING_COMPONENT LINKED_ATTRIBUTE_OF_BUILDING_COMPONENT GRAPH_NAME

Data-Table 4-5 GNL-COMPONENTS-OF-BUILDING-SYSTEM
ID BUILDING_SYSTEM BUILDING_COMPONENT

id	building_component	attribute_of_building_compo	attribu	designin	linked_buil	linked_attribut	graph_name
389	Lavatory	Lavatory_id	t	arch			Lavatory.pcx
390	Lavatory	model	t	arch			
391	Lavatory	color	t	arch			
392	Lavatory	width	n	arch			
393	Lavatory	depth	n	arch			
394	Lavatory	height	n	arch			
395	Lavatory	mounting_level	n	arch			
396	Lavatory	located_in_space	t	arch	Space	Space_id	

Figure 4-5 Sample of data in Data-Table 4-4 that describes data-structure of variety of building components.

id	building_system	building_component
48	Restroom_Components	Restroom_Partition
49	Restroom_Components	Restroom_Door
50	Restroom_Components	Mirror
51	Restroom_Components	Toilet
52	Restroom_Components	Urinal
53	Restroom_Components	Lavatory

Figure 4-6 Sample of data in Data-Table 4-5 that defines building components that belong to a building system.

Data-Table 4-6 GNL-CURRENT-PROJECTS
ID PROJECT_NAME DESCRIPTION

id	project_name	description
5	commer_1	3 story commercial building with columns and beams concrete structure and all water HVAC system
6	w_house	2 story ware house building with open web steel joist structure on steel columns and all air HVAC

Figure 4-7 Sample of data in Data-Table 4-6 that records current projects.

The role of the general-database is not limited to be a large pool of data-structure. As the prebuilt rules are usually valid for most buildings (for example, a change in the thermal resistance of an external wall affects the HVAC system design), they are considered reusable pieces of information and can be included, with some minor modifications, in every new project. The general-database therefore includes this type of rules. The prebuilt rules are stored in Data-Table 4-7. Figure 4-8 shows a sample of the data in Data-Table 4-7.

Data-Table 4-7 GNL-PREBUILT-RULES
PREBUILT_RULE_ID BUILDING_COMPONENT ATTRIBUTE_OF_BUILDING_COMPONENT AFFECTED_DISCIPLINE PERCENT_CHANGE_TO_HAVE_AN_EFFECT RESULT_IN_MAJOR_MODIFICATION_? RULE_IGNORED_? CAUSE_OF_THE_EFFECT

19	Window	thermal_resistance	hvac	0.15	No	No	Heat gain or loss through the window
20	Window	width	hvac	0.25	No	No	Heat gain or loss through the window
21	Window	width	illu	0.25	No	No	Daylight entering the space

Figure 4-8 Sample of data in Data-Table 4-7 that describes some prebuilt rules.

The general-database is also implemented with the use of the relational database technology. The configuration module uses the SQL capabilities to pick a component, a system, or a configuration from the general-database and reconstruct it in the building-components-database of a new building project.

4.3.1.2 The Assembly Process

As the design manager activates the configuration module to assemble the building-components-database of a new project, s/he is provided with three options (selection icon S2 in Figure 4-13). The design manager can perform the assembly task through building components, systems, or existing projects. These options follow the same rational used in developing the general-database.

In case the design manager decides to assemble the building-components-database from another project, the configuration module connects itself to the project database of that project. It reads the data in Data-Table 4-3 (page 62) in the management-database of that project and creates in the building-components-database of the new project all the data-tables that represent the building components and their attributes. The configuration module also populate the Data-Table 4-3 in the management-database of the new project with data that describe the created building components. The prebuilt rules are retrieved as well from the existing project and recorded in the new project.

In case the design manager decides to assemble the building-components-database of the new project from the building systems (in the general-database), the configuration module recognizes, from Data-Table 4-5 (page 68) in the general-database, all the building components that belong to that system. The configuration module retrieves the data-structure of each of these building components from Data-Table 4-4 (page 68) in the general-database. It creates in the building-components-database of the new project all the data-tables that represent these components. It also populates Data-Table 4-3 (page 62) in the management-database of the new project with data that describe the created building components. The relevant prebuilt rules are also retrieved from Data-Table 4-7 (page 69) in the general-database and recorded in the management-database of the new project in Data-Table 5-1 (page 84).

In case the design manager decides to use the components level in the general-database, the configuration module retrieves the data-structure of the needed component from Data-Table 4-4 (page 68) in the general-database and creates a data-table for that component in the building-components-database. Similar to the previous cases, the configuration module populates the Data-Table 4-3 (page 62) in the management-database of the new project with data that describe the created building component. The relevant prebuilt rules are also retrieved from Data-Table 4-7 (page 69) in the general-database and recorded in the management-database of the new project in Data-Table 5-1 (page 84).

Using the general-database in assembling the building-components-database facilitates the task considerably. However, the assembled data-structure has to be fine-tuned for the requirements of a specific project. Such fine-tuning is performed using the same capabilities that exist to configure an existing project (project that already uses the model). Next section shows how the configuration module is developed for this purpose.

4.3.2 Configuring the Project-Database of an Existing Project

During the development of detailed design, the requirements of a building project slightly vary. Some new building components may need to be added, some existing building components may need to be described in further detail, or the rules that link some building component may need to be modified. Because the project-database is built to be flexible, such variations can be accommodated in the model.

The configuration module is developed to provide the design manager with the ability to configure the project-database. As Figure 4-13 shows (selection icon S3), there are three categories of configuration to an existing project. These are the configuration of building components, the configuration of prebuilt rules, and the configuration of the project menu which allows designers to access the building components in the project-database.

4.3.2.1 Configuring Building Components

The configuration module provides the design manager with several options to configure building components. As selection icon S4 in Figure 4-13 shows, the design manager can create data-structure for a new building component, modify or delete the data-structure of an existing building component.

When creating data-structure for a new building component, the design manager is assisted with an access to the general-database. If the needed building components is available in the general-database, the design manager simply pick the component. Similar to the process in section 4.3.1.2, the configuration module uses the capability of SQL to retrieve the data-structure of the new component from the general-database and to build it in the building-components-database. Data-Table 4-3 in the management-database is also populated with data that describes the newly created building component. However, If the needed building component does not exist in the general-database, the design manager creates through the configuration module a new data-table in the building-components-database. The new data-table represents the new building components. The design manager needs to specify all the attributes that describe the component. This is similar to the creation of the Circular_Window in section 4.2.1.

In case the design manager needs to modify the data-structure of a certain building component (example in Figure 3-3 on page 40), the configuration module shows the design manager the current data-structure of the data-table that represent this building component. It does this by retrieving the relevant data from Data-Table 4-3 (page 62) in the management-database. As the design manager modifies the data-structure of the building component, the configuration module using SQL capabilities adds, deletes, and modifies attributes of the data-table of the building component in the building-components-database. The changes are also reflected in Data-Table 4-3 in the management-database.

In case the design manager wants to delete unused building component, the configuration module also uses SQL to remove the data-table of this component from the building-components-database. It removes the corresponding data from Data-Table 4-3 as well.

4.3.2.2 Configuring Prebuilt Rules

The design manager can also manipulate the prebuilt rules (Figure 4-10 on page 76). S/he has an access to all the attributes of all the building components in the building-components-database. For each attribute, s/he is able to browse through all the rules that are related to the attribute. The design manager is able to make modifications in any rule and update the rule. S/he is also able to temporarily ignore a rule (selection icon S6 in Figure 4-13). For a certain attribute, the design manager is able to create new rule and define all the data element of this new rule. The configuration module, in each case, makes modifications in Data-Table 4-7 (page 69) in the management-database using SQL capabilities.

4.3.2.3 Configuring the Project Menu

Another necessary configuration that is needed for the model to function is the project menu. This menu enables thc designers to access the building components in the building-components-database through the modules of the model as shown in Figure 4-11. The design manager classifies the building components into groups as shown in Figure 4-12. Each group has a menu heading (e.g., Architecture, Structure). Data about the contents of a menu is stored in Data-Table 4-8 in the management-database. Figure 4-9 shows a sample of the data in Data-Table 4-8. The same menu items appear in all modules that require access to the building components in the building-components-database as in Figure 4-11.

Data-Table 4-8 MNG-MENU-CONFIGURATION
ID LABEL MAIN_MENU_LABEL

[illegible]	[illegible]	main_menu_label
8	Concrete_Topped_Steel_Decking	Structure
12	Steel_Angle_Connection	Structure
13	Steel_Plate_Connection	Structure
35	Open_Web_Steel_Joist	Structure

Figure 4-9 Sample of data in Data-Table 4-8 that describes configuration of project menu.

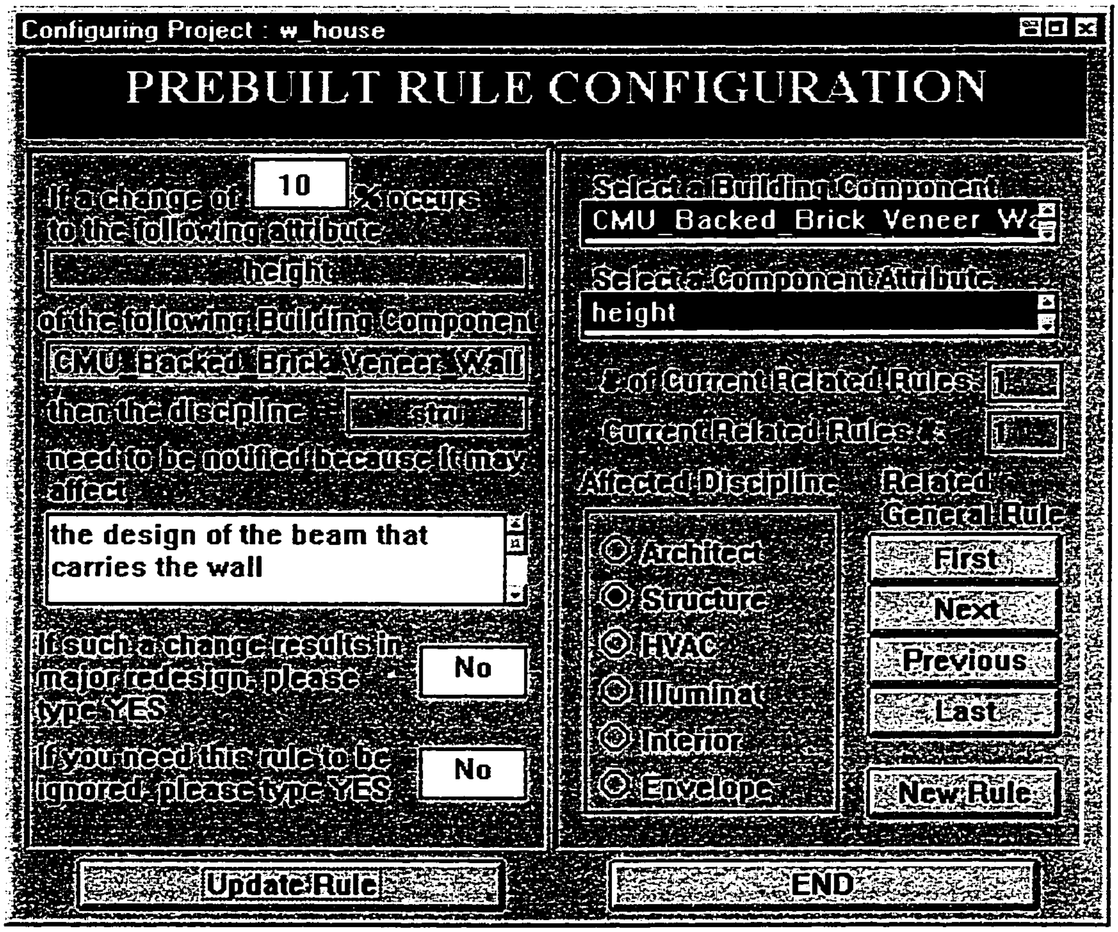


Figure 4-10 Configuration of a prebuilt rule using configuration module.

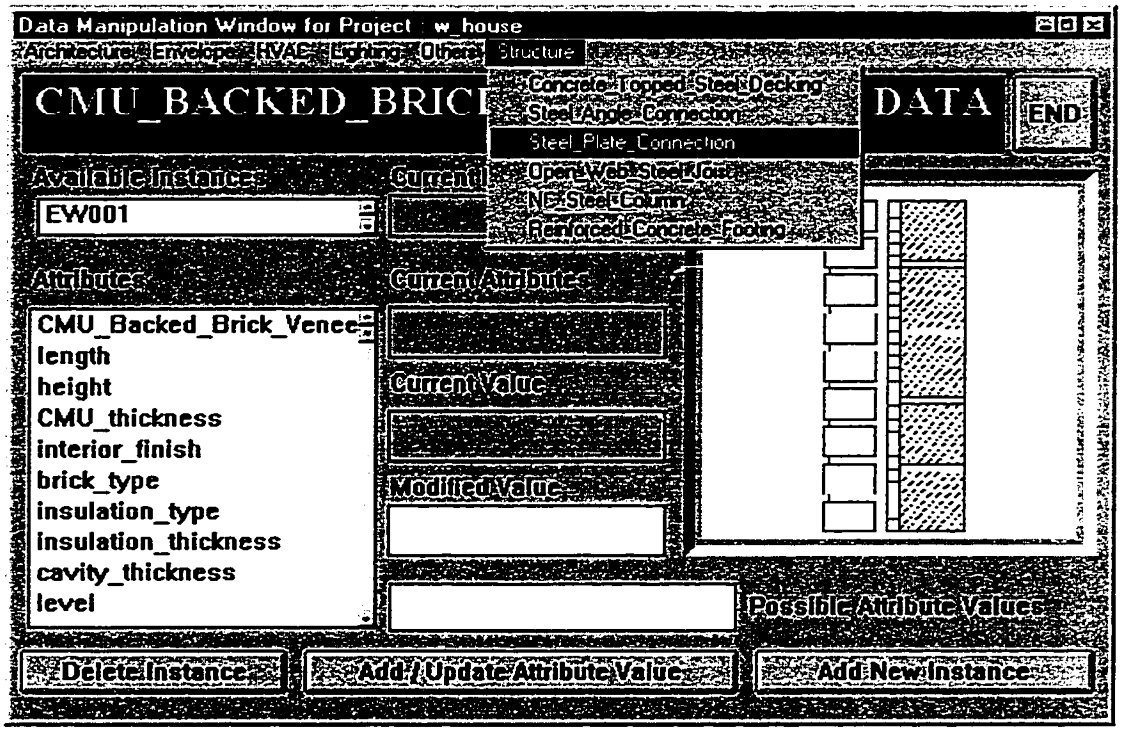


Figure 4-11 Project menu as it functions in data manipulation module.

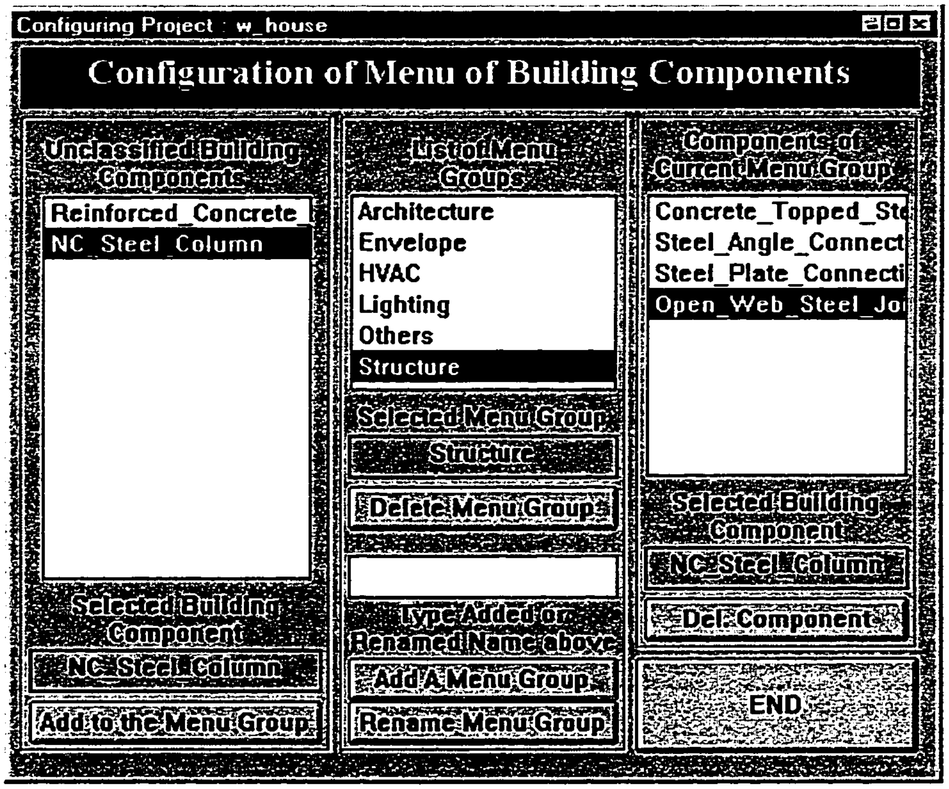


Figure 4-12 Interface to configure project menu to allow access to available building components.

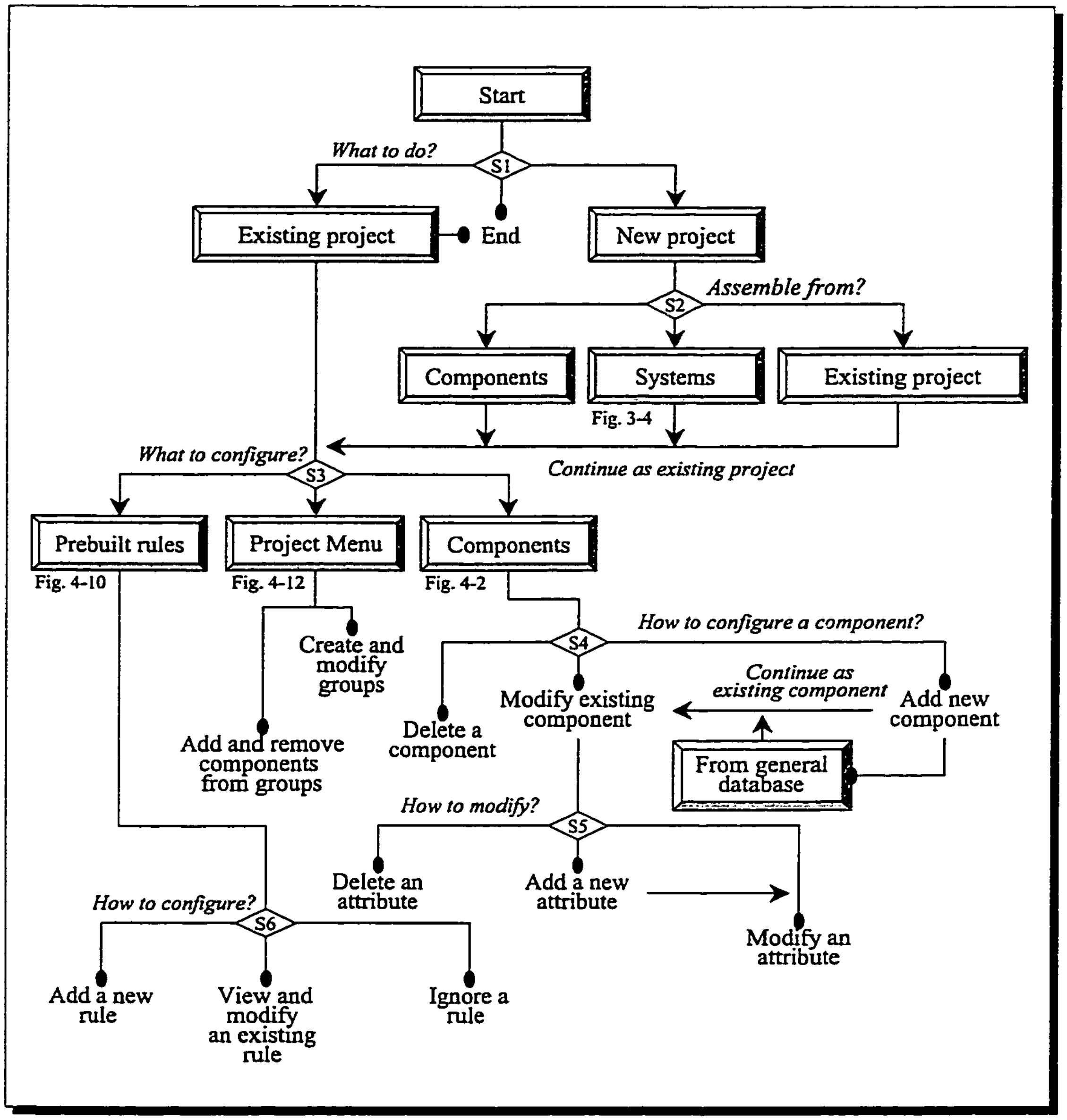


Figure 4-13 Diagram to illustrate user interface in configuration module[1].

[1] Please refer to the "Legend for User Interface Diagrams" on page XV.

4.4 SUMMARY

The building-components-database that carries the design data for the various components in a building project needs to be flexible in its data-structure so as to adapt to the variety of building designs. In addition, to conform with the core concept of the information model, the components in this database need also to be active in helping the management of design changes. The use of a management-database that carries information about the data-structure of the various building components, plus the use of combined Object-Oriented and Relational Database technologies, enable the satisfaction of these requirements. The development of a general-database with three levels of building components assembly facilitates the data-structure of the building-components-database. As such, the capability of the model to manage design changes can be utilized in virtually any type of projects. This is seen to be vital for the professional utilization of the model.

CHAPTER FIVE

MANAGING DESIGN CHANGES:

A DETAILED PERSPECTIVE

5.1 INTRODUCTION

In chapter three, a conceptual perspective of the developed information model was presented. The perspective exhibited the model capabilities to manage design changes. These capabilities are not limited to propagating current design changes; rather they are extended to include tracking past design changes and planning and scheduling of future ones. This chapter exhibits the development of these capabilities in detail. For each capability, the objective is stated, the developed methodology is described, and the user interface is illustrated.

As will be shown throughout this chapter, the management-database plays a key role in the development of the model capabilities to manage design changes. For reference purposes, appendix "A" displays the conceptual data-structure of the management-database. Copies of its data-tables are also used throughout this chapter to facilitate explanations.

5.2 PROPAGATING CURRENT DESIGN CHANGES

5.2.1 OBJECTIVES

As discussed in section 1.1.3 on page 8, a major cause of failure to accommodate design changes in a multi-disciplinary design team is the lack of an effective mechanism to propagate design changes. The objective of providing the model with this capability – which is key to the model development – is to overcome this cause of failure. The aim is to provide the design team with an effective methodology that assists in accommodating design changes.

5.2.2 METHODOLOGY

Based on our professional experience, we argue that the inability of the design team to propagate design changes is due to two difficulties. The first difficulty is the large number of building components data that exists in a project. It is almost impossible to manually follow the changes that are experienced by the individual data items in a project. The second difficulty is the lack of the linking knowledge which tells what disciplines are affected by a specific design change in a building component and how they are affected. The lack of such linking knowledge is mainly due to the different educational background of the designers who belong to the various design disciplines.

To overcome the first difficulty, the model (as illustrated in section 3.2.2 on page 39) assigns the task of propagating design changes to the building components themselves, hence reducing the need for the inefficient human monitoring of the design changes. To overcome the second difficulty, the building components are provided with the required linking knowledge.

However, the main challenge that remains is in acquiring the linking knowledge. How can we know the design disciplines that are affected by a design change, for example, in the height of the wall? Whoever attempts to answer this question should have design experience in all the disciplines in the design team, a requirement that is almost impossible to satisfy.

5.2.2.1 Acquire the linking knowledge

The developed methodology overcomes this challenge through **reversing the knowledge acquisition process**. Instead of trying to define the disciplines that are affected by a change in the value of every attribute of every building component, we define the building components attributes that are needed by every discipline. Unlike the normally required process, the reversed process is easily performed by asking each designer about the input data that s/he uses during the design of a certain building system. This input data is then translated into the form of attributes of building components. For example, the structural engineer defines that one of the input that is needed to design beams is the weight of the brick walls that are carried by the beams. The input data "weight of the brick wall" is then translated to the attributes "height, width, and brick type" of the building component "brick wall". If the value of any of these attributes is changed (by the architect or the envelope designer), then the structural engineer needs to be notified.

The input data acquired from the designers is stored in specially structured data-tables that are part of the management-database (Data-Table 5-1 on page 84 and Data-Table 5-2 on page 84). A sample of the data used in these data-tables is shown in Figure 5-1 (page 84) and Figure 5-2 (page 84). The acquired data are used in "if-then" rules that constitute the linking knowledge. The rules are developed in such a fashion that makes them adaptable for the requirements of individual buildings. They contain variables that are later replaced by values during the execution of the model. A sample of these rules is shown in the following zigzag frame[1]. The variables are %n, %nOld, and %nNew. The rule indicates that any change that is more than the percentage %n should result in sending a message.

```
%n := PERCENT_CHANGE_TO_HAVE_AN_EFFECT
%nOld := ATTRIBUTE_OLD_VALUE
%nNew := ATTRIBUTE_NEW_VALUE
IF (%n = 0) OR (%nOld * (1 - %n) > %nNew) OR (%nOld * (1 +
%n) < %nNew) THEN SEND_MESSAGE_ELEMENTS
```

The values that replace the rules' variables are obtained from the design data and vary from one project to the other. The rules are classified into two categories, *prebuilt* rules and *dynamically built* rules. The prebuilt rules are acquired during the configuration process of the model. These usually represent general linking knowledge that is known beforehand. For example, a prebuilt rule would reflect the fact that a change in the height of a wall affects the structural system design. The dynamically built rules are acquired during the use of the model to represent the linking knowledge that can only be defined during design. An example of dynamically built rules would be the design decision to make the height of a wall in a one-story building equal to the clear height of the floor space plus 1000mm.

[1] Text within a zigzag frame is extraction from the program code.

Data-Table 5-1
MNG-PREBUILT-RULES

PREBUILT_RULE_ID
BUILDING_COMPONENT
ATTRIBUTE_OF_BUILDING_COMPONENT
AFFECTED_DISCIPLINE
PERCENT_CHANGE_TO_HAVE_AN_EFFECT
RESULT_IN_MAJOR_MODIFICATION_?
RULE_IGNORED_?
CAUSE_OF_THE_EFFECT

pr	buildi[illegible]	attribute_of_buildin[illegible]	affect	perc	[illegible]	rule_	cause_of_the_effect
12	Space	used_for_activity	hvac	0	No	No	heat gain and HVAC requirements in the space
34	CMU_Ba	height	stru	0.10	No	No	the design of the beam that carries the wall
50	Open_W	length	stru	0.20	Yes	No	major impact on the joists design

Figure 5-1 Sample of data in Data-Table 5-1 that describes some prebuilt rules[1].

Data-Table 5-2
MNG-DYNAMICALLY-BUILT-RULES

DYNAMICALLY_BUILT_RULES_ID
BUILDING_COMPONENT
BUILDING_COMPONENT_ID
ATTRIBUTE_OF_BUILDING_COMPONENT
RELATED_BUILDING_COMPONENT
RELATED_BUILDING_COMPONENT_ID
RELATED_ATTRIBUTE
RELATIONSHIP
WRITING_DATE
RULE_IGNORED_?

dy	building_component	building_	attribu	related_bu	related	related_att	relationship
1	Open_Web_Steel_Joist	OW001	depth	Boiler	B001	weight	Boiler.weight<=2000
6	CMU_Backed_Brick_V	EW001	height	Floor_Spac	FS001	clear_heigh	Wall.height=Floor_Space.clear_height+1000

Figure 5-2 Sample of data in Data-Table 5-2 that describes some dynamically built rules.

[1] The headings are truncated and some may have been removed in order for the figure to fit on the page.

To acquire the prebuilt rules, the design manager requests from the senior designer of each discipline to define all the input data needed to design the building system under his/her responsibility. Also defined is the percentage of change to each of these inputs that can affect the design. For example, the structural engineer defines that the "height" of "CMU_backed_brick_veneer_wall" is one of the input to design the beams that carry these walls. He also defines that a change of 10% of the "height" would impact the design of the beams. The design manager – using the configuration module (Figure 4-10 on page 76) – keys in this data. The data is stored transparently to the design manager as data elements of a prebuilt rule in Data-Table 5-1 as shown in Figure 5-1.

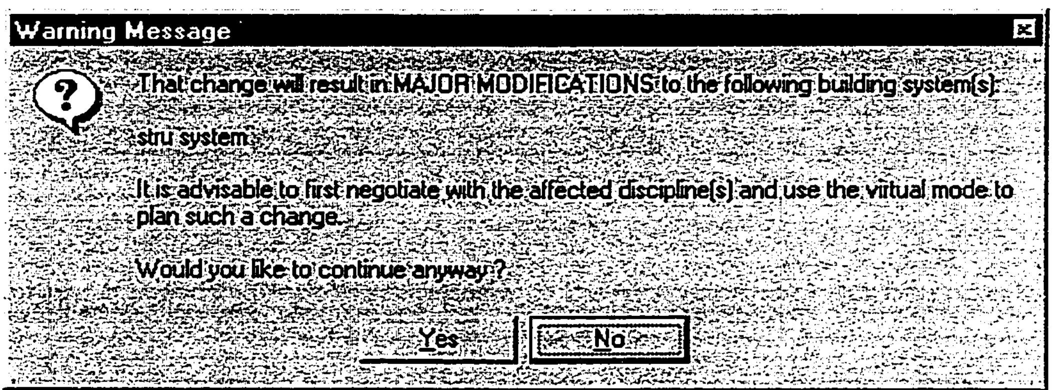


Figure 5-3 Sample of warning message about design change that results in major design modifications.

A designer can also define if a given change in an input data can result in a major redesign in his or her system. For example, the structural engineer defines that an increase of more than 20% of the span of the open web steel joists will require a complete redesign of all the joists. If the architect attempts to increase the distance between the supporting column by more than 20%, s/he will be immediately notified by a warning message that such a change has a major impact on the structural system (Figure 5-3). S/he then has the choice to continue with the change or consult first with the structural engineer.

To acquire the dynamically built rules, a technique has been developed. When a designer inserts or changes a value of a building component attribute, s/he is automatically asked to provide relationships with other building components (if they exist) which represent the constraints that govern the inserted or changed value. Figure 5-4 (page 87) shows a sample of a relationship that the envelope designer defines after inserting the value of the attribute "height" of the building component "CMU backed brick veneer wall". The relationship states that the "height" of the "CMU backed brick veneer wall" should equal the "clear height" of the "floor space" + 1000mm. The data is stored transparently to the designer in Data-Table 5-2 (page 84) automatically. The component that is currently under design is stored in the data field "BUILDING_COMPONENT" along with the current instance and attribute in the fields "BUILDING_COMPONENT_ID" and "ATTRIBUTE_OF_BUILDING_COMPONENT" consecutively. The building component, which the envelope designer makes a relationship with, is stored in Data-Table 5-2 in the field "RELATED_BUILDING_COMPONENT" along with its instance and attribute in the fields "RELATED_BUILDING_COMPONENT_ID" and "RELATED_ATTRIBUTE" consecutively.

The "clear height" of the "floor space" is a design decision that is taken by another discipline (the architect). The architect may not be aware that the envelope designer took a design decision that is based on his/her design decision for the clear height of the floor space. The architect may later change the clear height without being aware of the effect on the envelope designer. However, the linking knowledge acquired from the envelope designer makes the building component "floor space" aware of the envelope designer dependency on its clear height. The "floor space" will immediately inform the envelope designer when the architect changes its "clear height".

As the designers of various disciplines populate the building-components-database, the linking knowledge is also built up to deal with any potential design changes that may be later performed.

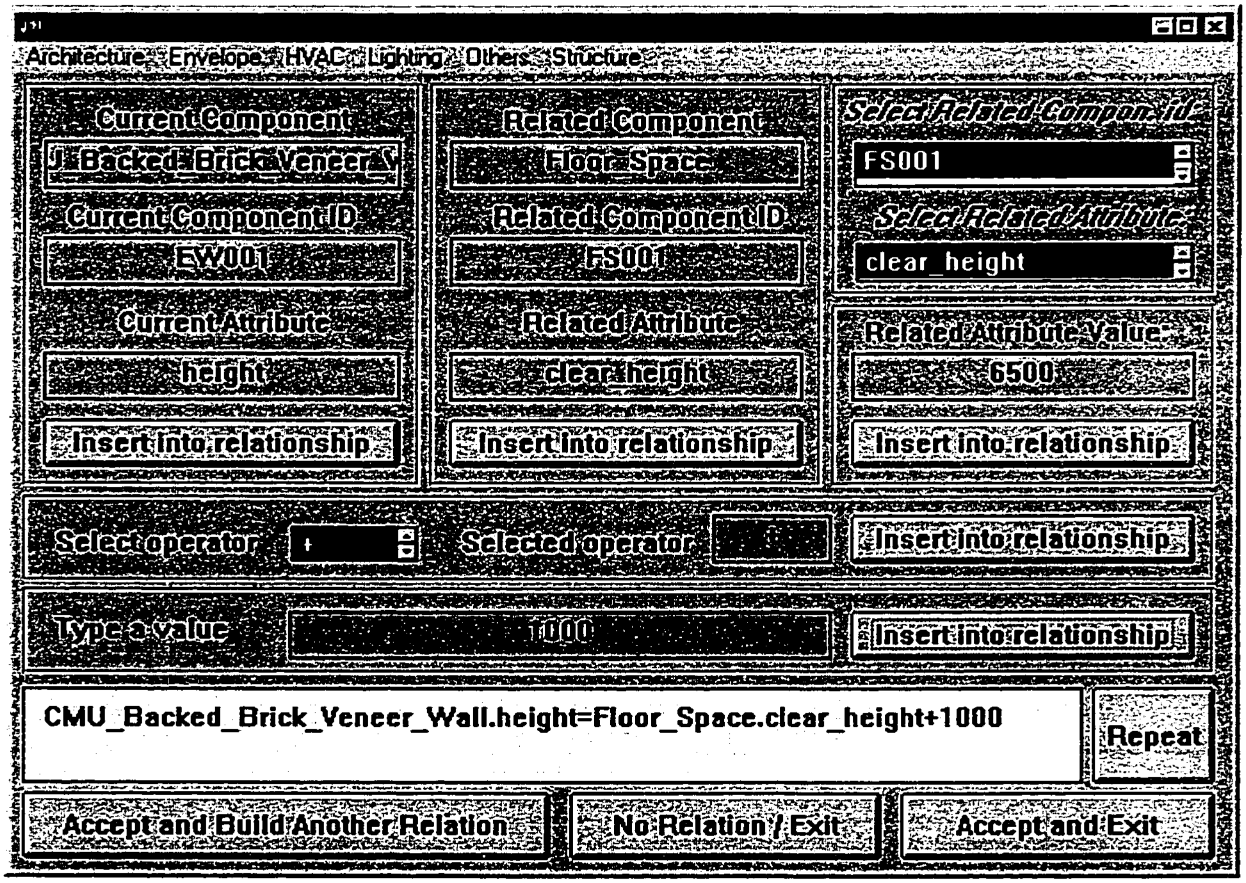


Figure 5-4 Acquisition of dynamically built rule using relation-acquiring sub-module.

5.2.2.2 React to Design Changes

When a designer performs a design change, for example, to the attribute "Attr_X" of the instance "Inst_Y" of the building component "Comp_Z", the component becomes active and automatically reacts to the change as follows:

1. It retrieves from Data-Table 5-1 (page 84) and Data-Table 5-2 (page 84) all the data rows that are relevant to the design change. In Data-Table 5-1, the relevant rows are those with the field "BUILDING_COMPONENT" which have the value "Comp_Z" and the field "ATTRIBUTE_OF_BUILDING_COMPONENT" which have the value "Attr_X". In Data-Table 5-2, the relevant rows are those with the field "RELATED_ BUILDING_COMPONENT" which have the value "Comp_Z"; the field "RELATED_ BUILDING_COMPONENT_ID" which have the value "Inst_Y"; and the field "RELATED_ATTRIBUTE" which have the value "Attr_X". A SQL statement similar to the following is used:

```
SELECT * FROM [MNG-PREBUILT-RULES] WHERE
BUILDING_COMPONENT = "Comp_Z" AND
ATTRIBUTE_OF_BUILDING_COMPONENT = "Attr_X" AND
RULE_IGNORED_? = No
```

2. The data in each of the retrieved rows is used to check if some rules are violated by the design change.

    a) In case of data from Data-Table 5-1 (prebuilt rule), the percent change in value of the changed attribute is evaluated. If it exceeds the value specified by the senior designer (and saved in the field "PERCENT_CHANGE_ TO_HAVE_AN_EFFECT"), then the process continues as in part 3. If not, then the data of the next row is examined. Statements similar to the following are used.

```
%n := PERCENT_CHANGE_TO_HAVE_AN_EFFECT (from
            Data-Table 5-1)
%nOld := OLD_VALUE OF "ATTR_X" (retrieved from the
            building-components-database using SQL)
%nNew := NEW_VALUE OF "ATTR_X" (input from the
            designer)
IF (%n = 0) OR (%nOld * (1 - %n) > %nNew) OR (%nOld *
(1 + %n) < %nNew) THEN SEND_MESSAGE_ELEMENTS
```

b) In case of data from Data-Table 5-2 (dynamically built rule), the relationship built by the designer is examined. If it fails then the process continues as in part 3. If the relation continues to be valid then the data of the next row is examined. Statements similar to the following are used (based on the data in the second row in Figure 5-2 on page 84 and the changed attribute is the height of the floor space FS001). The statement search for the height of the instance "EW001" of the component "CMU_Backed_Brick_Veneer_Wall" under the condition that the height is 1000mm higher than the clear_height of the instance "FS001" of the component "Floor_Space".

```
SELECT CMU_Backed_Brick_Veneer_Wall.height from
CMU_Backed_Brick_Veneer_Wall, Floor_Space where
(CMU_Backed_Brick_Veneer_Wall.CMU_Backed_Brick_Ve
neer_Wall_id = 'EW001') AND
(Floor_Space.Floor_Space_id = 'FS001') AND
(CMU_Backed_Brick_Veneer_Wall.height=Floor_Space.cle
ar_height+1000)

IF no value is retrieved THEN
SEND_MESSAGE_ELEMENTS
```

3. Messages are automatically sent by the building component to inform the affected designer about the change. The messages are saved in the form of data values that are recorded in a specially structured data-table (Data-Table 5-3) in the management-database. The data field that are to be filled depend on the type of rule that is used by the changed building component.

Data-Table 5-3
MNG-MESSAGE-ELEMENTS

ID
CHANGED_ATTRIBUTE
CHANGED_BUILDING_COMPONENT
CHANGED_BUILDING_COMPONENT_ID
OLD_VALUE
NEW_VALUE
AFFECTED_ATTRIBUTE
AFFECTED_BUILDING_COMPONENT
AFFECTED_BUILDING_COMPONENT_ID
RELATIONSHIP
WRITING_DATE
BEEN_READ_?
BEEN_ACTED_UPON_?
DISCIPLINE_TO
DISCIPLINE_FROM
SENT_BECAUSE_CHANGE_ID
PREBUILT_OR_DYNAMICALLY_?
RULE_WRITING_DATE
VIOLATED_RULE_ID
RULE_IGNORED_?
CAUSE_OF_THE_EFFECT

id	changed_att	changed_build	changed	old_va	new_v	affecte	affecte	affected	Disci	disci	se	prebuilt_or	vi	[illegible]
65	clear_height	Floor_Space	FS001	6500	7600	height	CMU_	EW001	Enve	arch	27	Dynamically	6	
71	height	CMU_Backed_	EW001	7500	8600				Stru	enve	28	Prebuilt	34	

Figure 5-5 Sample of data in Data-Table 5-3 that describes some message elements.

a) In case that a prebuilt rule is violated, the following data are sent to the Data-Table 5-3.

- CHANGED_ATTRIBUTE
- CHANGED_BUILDING_COMPONENT
- OLD_VALUE *(of the changed attribute)*
- NEW_VALUE *(of the changed attribute)*
- WRITING_DATE *(from the computer clock)*
- DISCIPLINE_TO *(AFFECTED_DISCIPLINE as in Data-Table 5-1 on page 84)*
- DISCIPLINE_FROM *(DESIGNING_DISCIPLINE as in DATA-TABLE 4-3 on page 62)*
- SENT_BECAUSE_CHANGE_ID *(CHANGE_ID from DATA-TABLE 5-4 on page 99)*
- PREBUILT_OR_DYNAMICALLY_? *(prebuilt)*
- VIOLATED_RULE_ID *(PREBUILT_RULE_ID from Data-Table 5-1)*
- CAUSE_OF_THE_EFFECT *(form Data-Table 5-1)*

b) In case that a dynamically built rule is violated, the following data are sent to the Data-Table 5-3

- CHANGED_ATTRIBUTE
- CHANGED_BUILDING_COMPONENT
- CHANGED_BUILDING_COMPONENT_ID
- OLD_VALUE *(of the changed attribute)*
- NEW_VALUE *(of the changed attribute)*
- AFFECTED_ATTRIBUTE *(ATTRIBUTE_OF_BUILDING_COMPONENT as in Data-Table 5-2 on page 84)*
- AFFECTED_BUILDING_COMPONENT *(BUILDING_COMPONENT as in Data-Table 5-2)*
- AFFECTED_BUILDING_COMPONENT_ID *(BUILDING_COMPONENT_ID as in Data-Table 5-2)*
- RELATIONSHIP *(RELATIONSHIP as in Data-Table 5-2)*
- WRITING_DATE *(from the computer clock)*
- DISCIPLINE_TO *(DESIGNING_DISCIPLINE of the affected BUILDING_COMPONENT as in DATA-TABLE 4-3 on page 62)*
- DISCIPLINE_FROM *(DESIGNING_DISCIPLINE of the changed BUILDING_COMPONENT as in DATA-TABLE 4-3 on page 62)*
- SENT_BECAUSE_CHANGE_ID *(CHANGE_ID from DATA-TABLE 5-4 on page 99)*
- PREBUILT_OR_DYNAMICALLY_? *(dynamically built)*
- RULE_WRITING_DATE *(WRITING_DATE as in Data-Table 5-2)*
- VIOLATED_RULE_ID *(DYNAMICALLY_BUILT_RULES_ID form Data-Table 5-2)*

A sample of part of these message elements is shown in Figure 5-5.

5.2.2.3 Deliver Design Change Messages

As the model is currently implemented, designers are expected to regularly check their message modules to find out about any design change messages. Sound and/or visual alert can be adopted to inform about the arrival of a new message. In any case, once a certain discipline starts the message module, the data in the Data-Table 5-3 that has the name of that discipline in the field "DISCIPLINE_TO" are automatically retrieved. From this data, messages are automatically built using a standard message structure that embeds variables. For example, the standard message that is sent as a result of a dynamically built rule is as follows:

```
"The attribute '", CHANGED_ATTRIBUTE, "' of the building
component '", CHANGED_BUILDING_COMPONENT, " (",
CHANGED_BUILDiNG_COMPONENT_ID, ")' has been changed
from the value (", OLD_VALUE, ") to the value (", NEW_VALUE,
").

According to a dynamically built rule, such a change may affect
the design of the attribute '", AFFECTED_ATTRIBUTE, "' of the
building component '", AFFECTED_BUILDING_COMPONENT, "
(",AFFECTED_BUILDING_COMPONENT_ID, ")'.              Variable

It is advisable to take some of the following steps:   Standard
  * Redesign the affected building component.          advice
  * Negotiate the change with designing discipline.
  * Modify the rule that caused this message.

If you need more information, please push the HELP button.
If you want to see and edit the rule that caused this automated
message to be sent, please push the RULE button"
```

This standard message is shown to the designer (Figure 3-6 on page 44) after replacing the variables with values from Data-Table 5-3 as follows:

> The attribute 'clear_height' of the building component 'Floor_Space (FS001)' has been changed from the value (6500) to the value (7600).
>
> According to a dynamically built rule, such a change may affect the design of the attribute 'height' of the building component 'CMU_Backed_Brick_Veneer_Wall (EW001)' Value
>
> It is advisable to take some of the following steps:
> * Redesign the affected building component.
> * Negotiate the change with designing discipline.
> * Modify the rule that caused this message.
>
> If you need more information, please push the HELP button.
>
> If you want to see and edit the rule that caused this automated message to be sent, please push the RULE button

The message as shown has the following characteristics:

1. It is sent only to the affected designers.
2. It is unambiguous, it defines exactly the attributes and the building components that have changed. It also informs about the old value of the attribute and the new value.
3. When the message is initiated through a prebuilt rule, it defines what are the possible effects of the design change on the affected building system.
4. When the message is initiated through a dynamically built rule, it defines only the attributes and the building components that are affected by the design change.
5. Finally, it provides advice on how to react to the design change.

The affected designer who receives the message is expected to take a corrective action in response to the design change. The message module allows the designer to review and modify the rules that cause messages to be sent, thus providing the model with the flexibility to adopt new relations that designers may develop among building components. Such capability is possible because of the link between Data-Table 5-3 (page 90) and both Data-Table 5-1 (page 84) and Data-Table 5-2 (page 84) (Data-Table 5-1 and Data-Table 5-2 are not linked). This link is through the field "VIOLATED _RULE_ID" in Data-Table 5-3 and each of the field "PREBUILT_RULE_ID" in Data-Table 5-1 and "DYNAMICALLY_BUILT_RULES_ID" in Data-Table 5-2.

5.2.3 USER INTERFACE

Two modules of the information model are used to realize the model capability to propagate design changes. The first module is the data manipulation module. Through this module, a designer records design decisions into the building-components-database. S/he also defines the dynamically built rules by accessing the relation-acquiring sub-module. The second module is the message module where designers receive automated messages from the building components.

The interface of the data manipulation module starts by providing the designer with access to all projects that are currently under design so as to select one of them. When a designer selects a project, the data manipulation module is connected to the project-database of this project. The interface allows the designer to select a specific building component and manipulate any instance of this component. The interface therefore provides access to all the building components that exist in the building-components-database. Because every project contains different building components, the interface has a customizable project menu that provides access to the various building components. The configuration module enables such customization in the project menu as shown in Figure 4-12 on page 77. Once a building component is selected, the designer has the option to create new instances of the component or work with existing ones (selection option [S1] in Figure 5-6). The designer is also able to delete the selected instance or modify the value of its attributes [S2]. Therefore the interface shows all the attributes of any selected building component as they are structured in the building-components-database. Figure 3-2 on page 38 shows a sample of the interface of the data manipulation module.

Once a designer changes the value of any attribute, the relation-acquiring sub-module starts. The interface for this module shows the building component, the instance, and the attribute that are currently under change. The interface provides the designer with the ability to select any attribute of any instance of any building component in the building-components-database which can have a relation with the component that is currently under design. The interface also provides the designer with the capability to build any relation between the components. It also allows multiple relations. Figure 5-4 on page 87 shows a sample of interface for the relation-acquiring sub-module.

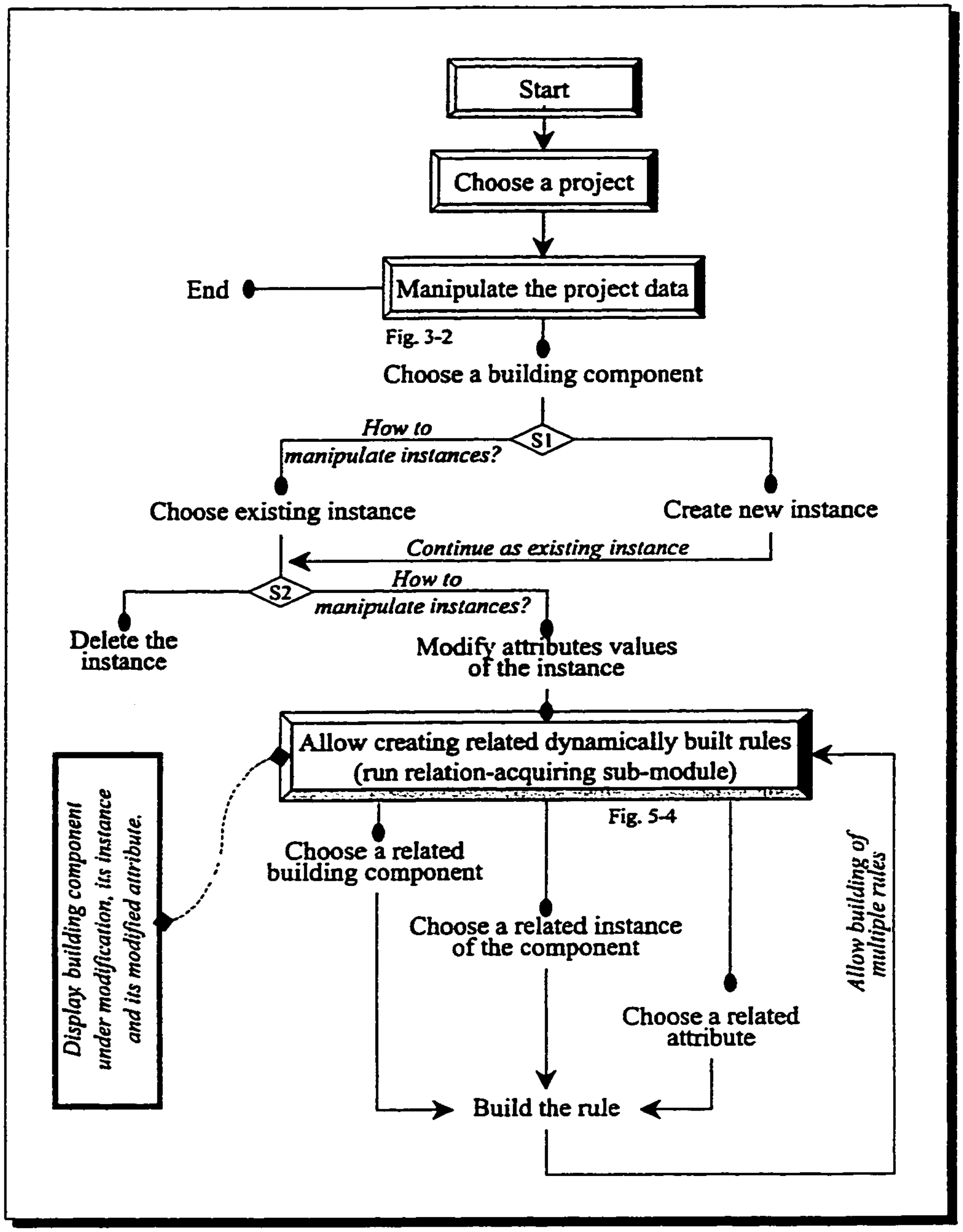


Figure 5-6 Diagram to illustrate user interface in data manipulation module[1].

[1] Please refer to the "Legend for User Interface Diagrams" on page XV.

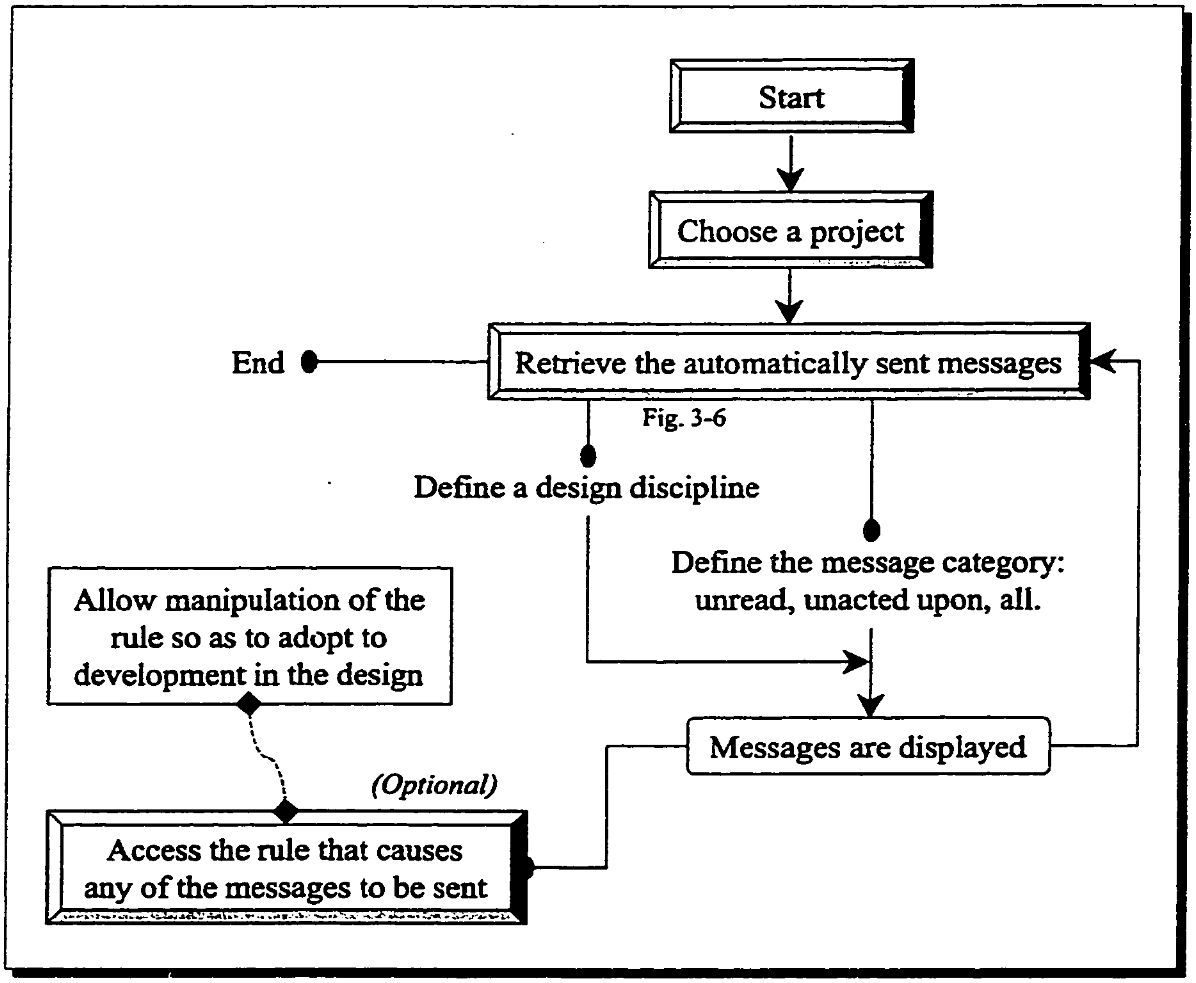


Figure 5-7 Diagram to illustrate user interface in message module.

The message module also starts by allowing the designer to choose between all the projects that are currently under design. The module is then connected to the relevant project database. The interface to retrieve the required messages is able to get only the messages that are related to a specific discipline. The designer can choose among retrieving all the messages since the start of the project, only the unread messages, or the messages that are read but have not yet been reacted to (unacted upon). The designer also has access to the rule that causes any message to be automatically sent. Such access allows the designer to modify the rule so as to be updated with current relations in the project. The designer can make the building component ignore a certain rule if it is temporary or no longer applies to the design. Figure 3-6 on page 44 shows a sample interface for the message module.

5.3 TRACKING PAST DESIGN CHANGES

5.3.1 OBJECTIVES

By tracking past design changes of a project, managers of design teams are provided with the capability to:

1. Observe and analyze the development of the detailed design.
2. Evaluate the performance of the various designers in a project. Some designers make ad hoc design decisions which need to be later modified, costing the design team time and money.
3. Determine responsibilities for design incompatibilities in case of failure.

5.3.2 METHODOLOGY

The model keeps record of every design change that is initiated by any member of the design team. When a designer performs a design change, the changed building component automatically connects to a specially structured data-table in the management-database (Data-Table 5-4 on page 99). The component sends data elements about the design change that include the changed attribute, the building component, and the instance of this component. The component also sends the value of the changed attribute before and after the design change. In addition, the component recognizes - from the computer clock – the day and time of the design change and records them in Data-Table 5-4. It also recognizes the discipline that is responsible for the change through contacting Data-Table 4-3 on page 62 and records the result in Data-Table 5-4. A sample of the data used in Data-Table 5-4 is shown in Figure 5-8.

[illegible]
CHANGE_ID DATE_TIME DISCIPLINE BUILDING_COMPONENT BUILDING_COMPONENT_ID ATTRIBUTE OLD_VALUE NEW_VALUE PRECEDING_CHANGE_ID

chan	date_time	discip	building_componen	building_i	attribute	old_value	new_value	preceding_chan
27	1997/06/29 11:14	arch	Floor_Space	FS001	clear_height	6500	7600	26
28	1997/06/29 11:29	enve	CMU_Backed_Brick	EW001	height	7500	8600	27

Figure 5-8 Sample of data in Data-Table 5-4 that describes some design changes and enables their tracking.

With the data-structure of Data-Table 5-4, the data-table can be queried according to the requirements of the design manager. The following is a sample query statement using SQL to extract data. The query obtains all the design changes that occur to the height of the instance “EW001” of the component “CMU_Backed_Brick_Veneer” during a one month period starting from June 20, 1997 at noon.

```
SELECT * FROM [MNG-DESIGN-CHANGES] WHERE
building_component = "CMU_Backed_Brick_Veneer" AND
building_component_ID = "EW001" AND attribute = "height"
AND date_time >= "1997/06/20 12:00" AND date_time <=
"1997/07/20 12:00"
```

The design manager needs not to build such a query. It is automatically and transparently built inside the tracking module. The design manager needs only to provide the query data through the interface with the tracking module (see Figure 3-8on page 47).

The management-database is developed with links between the design changes and the related automated message that are sent by the changed building component. This link is made through the attribute CHANGE_ID in Data-Table 5-4 which is referenced by the attribute SENT_BECAUSE_CHANGE_ID in Data-Table 5-3 on page 90. When the building component records the design change data in Data-Table 5-4, the data-table automatically assigns a CHANGE_ID to the design change. This CHANGE_ID is retrieved and utilized by the building component when recording the automated messages that result from that design change in Data-Table 5-3 (page 90). Through such a link, all the messages that are automatically sent by the changed building component are shown to the design manager (sample in Figure 3-10 on page 48). The messages are retrieved from Data-Table 5-3 using SQL. A sample for a utilized SQL statement is shown in the following zigzag frame. The statement extracts all the message elements that were sent because of the design change number 28.

```
SELECT * from MNG-MESSAGE-ELEMENTS WHERE
SENT_BECAUSE_CHANGE_ID = 28
```

The design manager is also shown whether the designer who receives any of these messages has read it or not and whether he has taken a corrective action or not. Such capability helps design managers define responsibilities in case of failure in the compatibility of design information due to design changes.

5.3.3 USER INTERFACE

Tracking of past design changes is performed through the tracking module. The interface of the tracking module starts with allowing the design manager to select from all the projects that are under design (Figure 5-9). The tracking module is then connected to the appropriate project-database. The design manager can then define the constraints that limit the tracking of the change data according to his/her requirements. The first constraint, which is optional, is the time period for the design change. The design manager is then able to select between tracking all the design changes that are done by a certain design discipline or tracking the design changes of a certain component (selection [S1] in Figure 5-9). In case of selecting a specific building component, the design manager has the option to further limit the component to one of its instances and/or one of its attributes. Because every project contains different building components, the interface has a customizable project menu that provides access to the various building components. The configuration module provides the capability to make such customization in the project menu as shown in Figure 4-12 on page 77. Figure 3-8 on page 47 shows a sample interface of the tracking module. Once the constraints are defined, the required design changes are shown. For each change, the interface shows the time, the discipline, the building component, the instance, the attribute, the old value, and the new value of the design change.

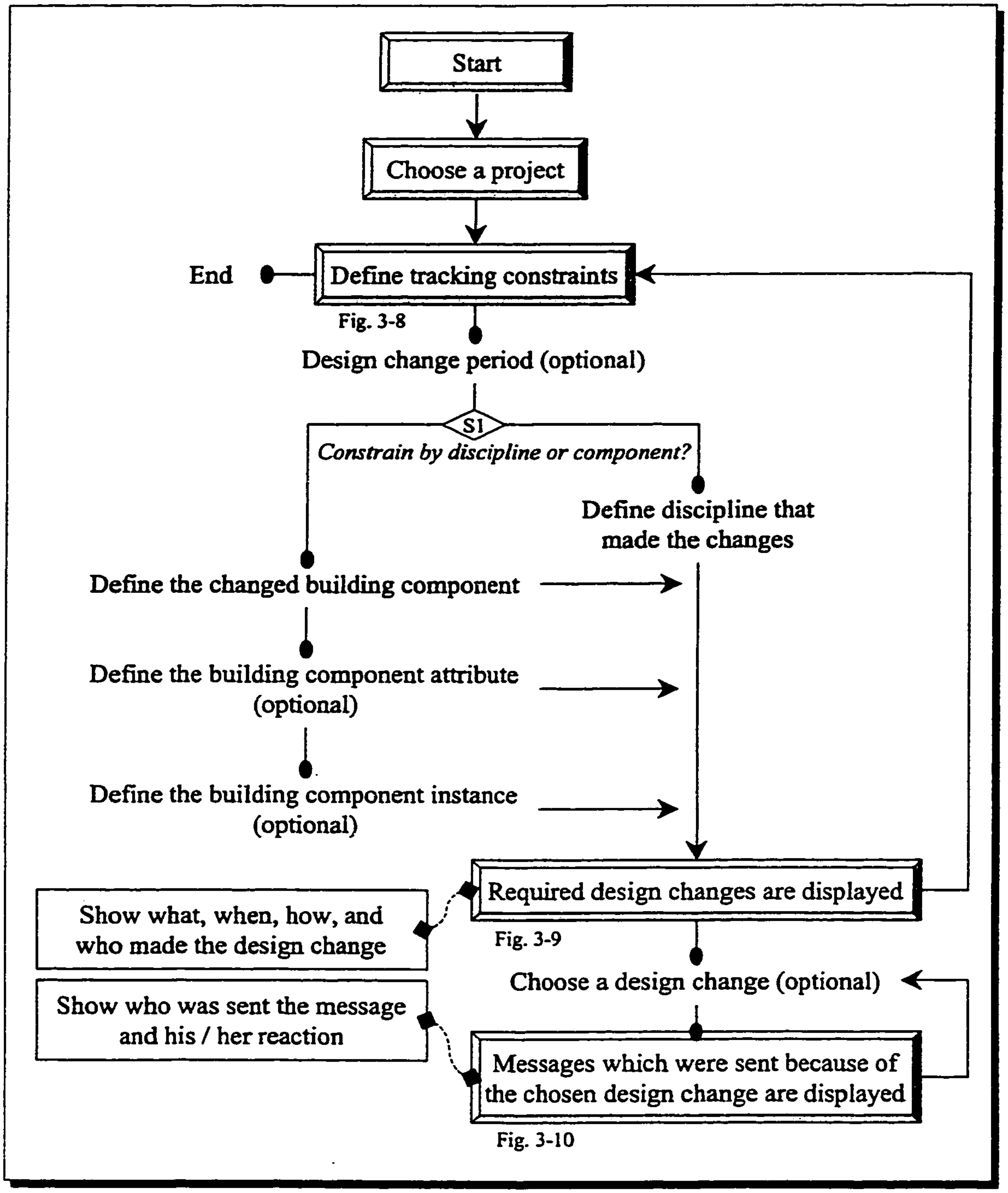


Figure 5-9 Diagram to illustrate user interface in tracking module.

The constraints that define the shown design changes appear to the design manager. Figure 3-9 on page 47 shows a sample of the interface for the results of a tracking query. The design manager can select one of the displayed design changes and track all the automated messages that are sent by the changed building component to the affected designers. This is achieved by double clicking on one of the shown design changes. Figure 3-10 on page 48 shows a sample of the interface that shows such messages. The interface provides the design manager with the total number of messages and enable him/her to browse through the messages. For each message, the design manager sees which discipline received the message, the text of the message, and whether the message was read and acted upon or not.

5.4 Planning and Scheduling Future Design Changes

5.4.1 Objectives

As discussed in section 3.2.5 on page 48, some design changes have interrelated effects on several other building components in an extended fashion. Figure 5-10 on page 105 shows a sample of such changes (Figure 5-10 is a copy of Figure 3-11 on page 49 and is explained in section 3.2.5). Design managers need answers to some important questions before the design team is engaged in that type of changes. These questions are:

I. What are the interrelated design changes necessary to accommodate an initial design change?

II. Are there alternative ways to accommodate the initial change? In the example in Figure 5-10, the HVAC designer can accommodate the change in two different ways. Each alternative, composed of a sequence of changes, is termed as a change-path.

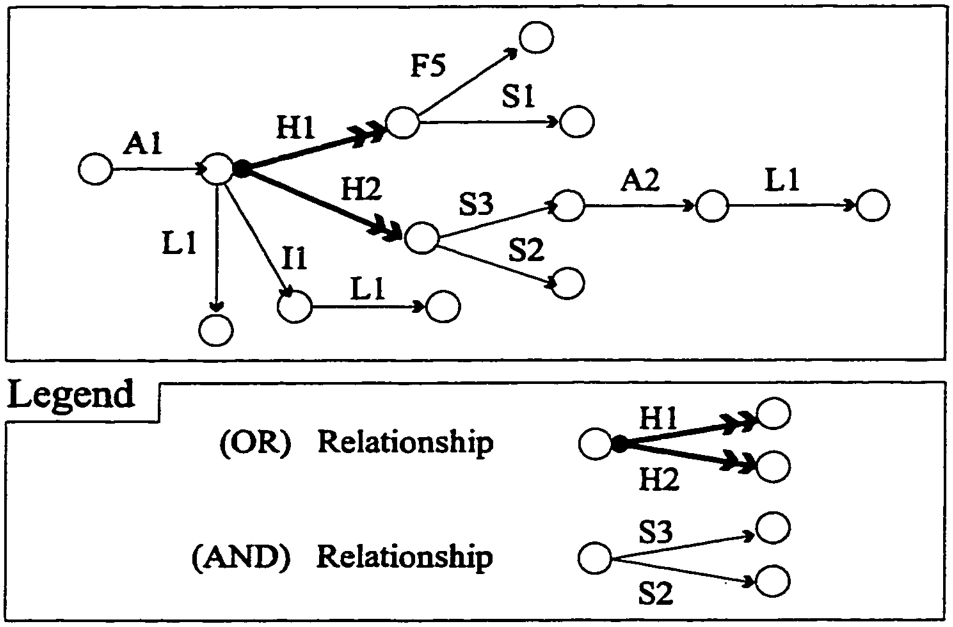
III. Are there design changes that may be repeated within a change-path and how to avoid these repetitions? In the example in Figure 5-10, the type of luminaires (L1) is redesigned several times.

IV. Ultimately, how long will it take to fully accommodate the initial design change through a sequence of interrelated design changes or change-path? Are some of these changes critical to determine the total duration along a given change-path? These are important questions especially when the initial design change is requested by the owner. The design manager can then ask for a penalty-free extension for submitting the working drawings late.

V. How many design man-hours are required to accommodate the initial change? The answer to this question can help determine additional design fees.

VI. How much is the change expected to impact the construction costs of the building? Some interrelated design changes in the change-path may incur so much expenditure as to have the initial change reconsidered.

VII. What level of recommendation is assigned to every change in a change-path by the designer? A level of recommendation indicates whether or not a designer sees the change improving the building system that s/he is responsible for. It can also indicate that the change is impossible.



Change in:	**F5** Location of sprinkler outlets (*Fire Safety*)
	H1. HVAC duct width (*HVAC*)
A1. Space function (*Architecture*)	**H2.** HVAC duct depth (*HVAC*)
(from executive office to computer lab)	**L1.** Luminaire type (*Lighting*)
A2. Reduce clear height (*Architecture*)	**S1.** Width of hole in structural beam (*Structure*)
I1. Wall finishing (*Interior Design*)	**S2.** Height of hole in structural beam (*Structure*)
(from dark mahogany wood to white paint)	**S3.** Depth of beam (*Structure*)

Figure 5-10 Scenario for interrelated design changes.

The objective of the planning and scheduling capability of the model is to provide answers to these questions. Consequently, an informed decision can be taken about whether or not the change is to be done and the best way to do it.

In traditional design environments, answers to these questions are not easy to obtain. Two types of difficulty are identified. The first type is due to the lack of information. This is apparent when trying to answer question # I on page 103. It is hard for the design manager and for individual team members to identify all the disciplines that are affected by a specific change in a given building component. Change-paths as shown in Figure 5-10 are difficult to define because there is a scarcity of knowledge regarding how design changes are linked to one another. The second type of difficulty stems from the fact that some information exists but is scattered among various disciplines that work independently and are separated geographically, and there is no structured methodology to collect and organize this data.

5.4.2 METHODOLOGY

The methodology proposed uses the active components of the project-database in order to overcome these two types of difficulties. The methodology consists of four stages which are described below:

a) Collect data.
b) Organize changes.
c) Schedule changes.
d) Calculate costs and durations.

5.4.2.1 Collect Data

Collecting the data is accomplished through the *Virtual Change Module* of the information model (Figure 3-1 page 36). When interrelated design changes need to be studied, the designer who is responsible for the initial change starts a 'New Case' in the virtual change module. S/he defines what needs to be changed as shown in Figure 5-11 where the architect selects the attribute "used_for_activity" of the instance "space009". The architect changes the function of that space from an executive office to a computer lab as shown in Figure 5-12. Such a change is not actually done in the building-components-database; nevertheless, the linking knowledge embedded in the management-database (Data-Table 5-1 on page 84 and Data-Table 5-2 on page 84) is used to recognize the disciplines that are affected by the change. Automated messages are sent to these disciplines by populating a specially structured data-table (Data-Table 5-5 on page 109) with data about the virtual change. The elements of this message (called virtual message) are similar to those of the regular automated messages that are used in propagating design changes (Data-Table 5-3 on page 90). The only difference is in including a field for CASE_ID. The CASE_ID is automatically generated when a designer selects a new case (Figure 5-11). Its function is to link all the data and messages that belong to a group of interrelated virtual design changes in the various data-tables in the management-database.

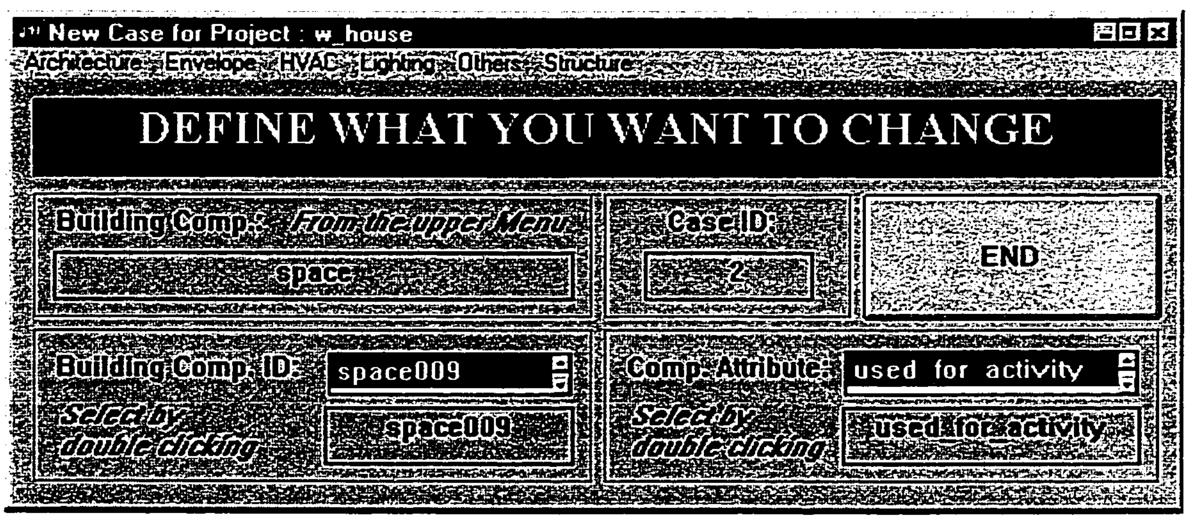


Figure 5-11 Starting a new case in virtual change module.

The affected designers receive the messages also in the virtual change module (Figure 5-13 on page 110). The messages notify the designers about the initial change and ask for a response. In Figure 5-13, a sample message to the HVAC designer would read as follows:

> "In VIRTUAL MODE, The attribute 'used_for_activity' of the building component 'space (space009)' has been changed from the value (Executive Room) to the value (Computer Lab). Such a change may affect the design of the 'HVAC' system. Please indicate the expected modifications in the building components."

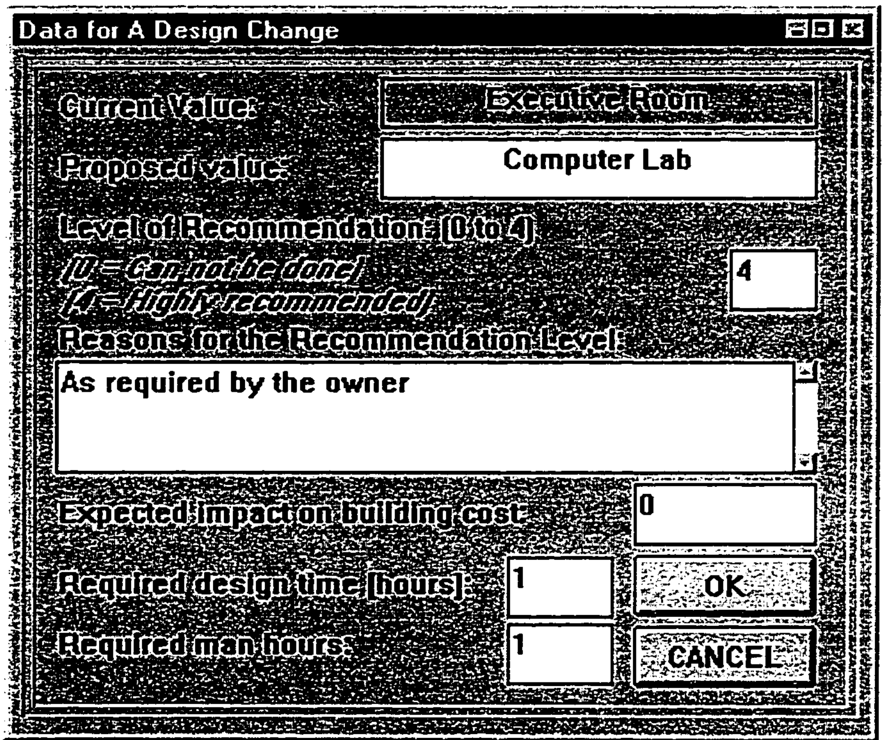


Figure 5-12 Data provided by designer for proposed design change.

Each affected discipline defines what components in its system need to be changed and also how they are to be changed. For example, the HVAC engineer, using his/her design experience, defines that the change in the space activity requires a minimum 30% increase in the supply duct size. S/he can do that in two ways: either by increasing the width (dimension_x) of the duct from 600 mm to 800 mm (Figure 5-13 and Figure 5-14) or by changing the duct depth from 400 mm to 550 mm. Once the HVAC designer specifies the two possibilities, automated messages are sent to the disciplines that are affected by each of these changes. The affected disciplines read the messages and react to them in similar fashion.

Data-Table 5-5 MNG-VIRTUAL-MESSAGE-ELEMENTS
ID
CHANGED_ATTRIBUTE
CHANGED_BUILDING_COMPONENT
CHANGED_BUILDING_COMPONENT_ID
OLD_VALUE
NEW_VALUE
AFFECTED_ATTRIBUTE
AFFECTED_BUILDING_COMPONENT
AFFECTED_BUILDING_COMPONENT_ID
RELATIONSHIP
WRITING_DATE
BEEN_READ_?
BEEN_ACTED_UPON_?
DISCIPLINE_TO
DISCIPLINE_FROM
SENT_BECAUSE_CHANGE_ID
PREBUILT_OR_DYNAMICALLY_?
RULE_WRITING_DATE
VIOLATED_RULE_ID
CASE_ID
CAUSE_OF_THE_EFFECT

The data specifying the sequence of changes and the alternatives are collected in a specially structured data-table (Data-Table 5-6 on page 111). Each design change is automatically assigned a code (e.g. A1, H1) that is used in the data-table. The details of the design change are stored in Data-Table 5-7 on page 112. Both Data-Table 5-6 and Data-Table 5-7 are linked through the design change code. A sample of the collected data is illustrated in Figure 5-15 on page 111 which represents the sequence of design changes that appear in Figure 5-10 on page 105.

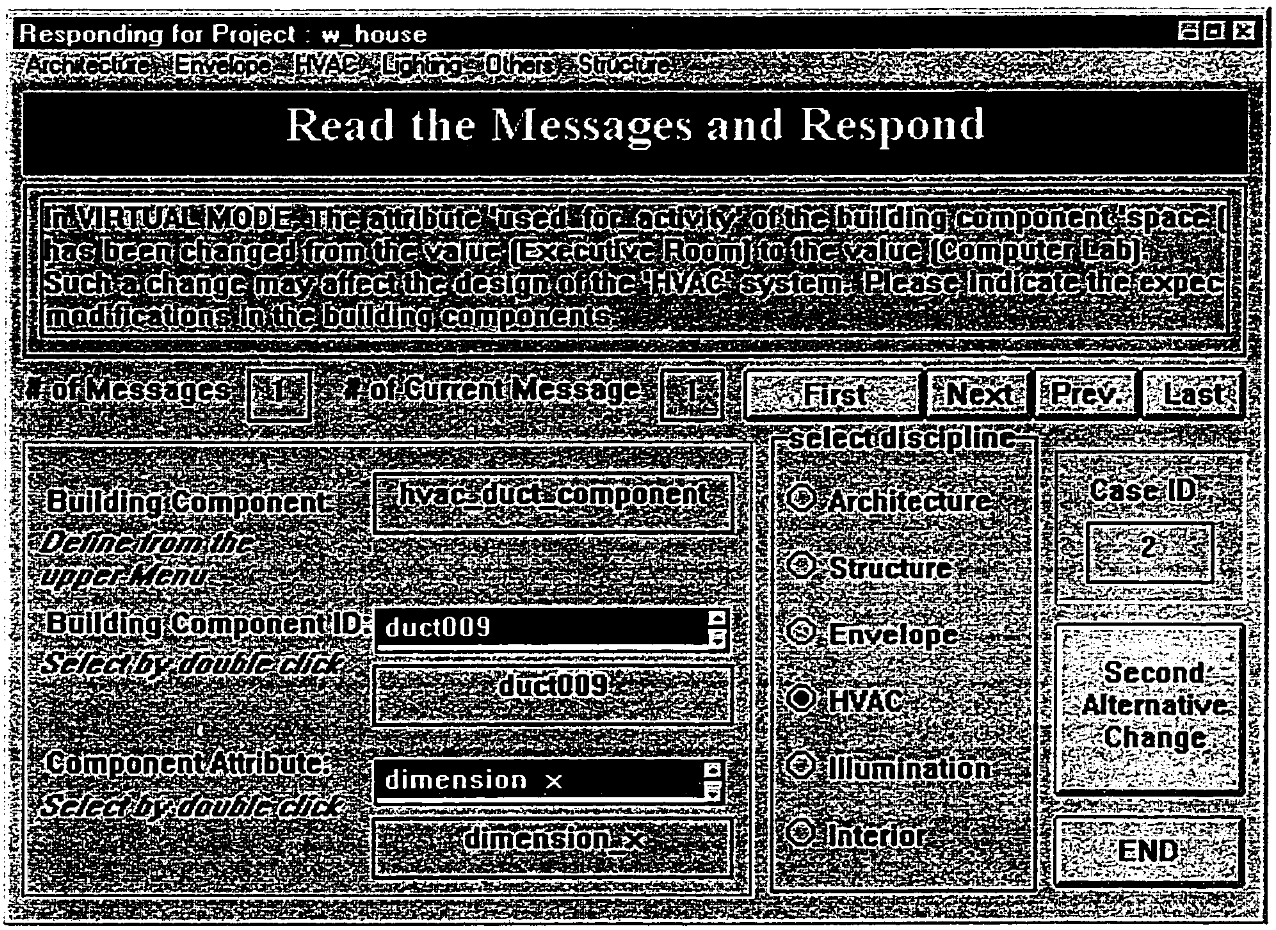


Figure 5-13 Response to virtual change message in virtual change module.

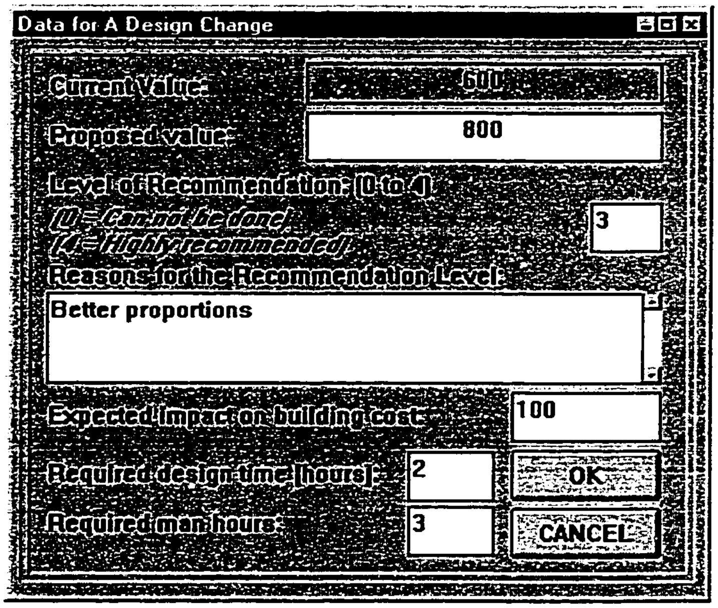


Figure 5-14 Data provided by designer for proposed design change.

Data-Table 5-6
MNG-VIRTUAL-CHANGE-SEQUENCE

ID_NUMBER
CASE_ID
DESIGN_CHANGE
SUCCESSOR
ALTERNATE_SUCCESSOR

id number	case id	design change	successor	alternate successor
116	2	NULL	A1	
117	2	A1	H1	H2
118	2	A1	L1	
119	2	A1	I1	
120	2	I1	L1	
121	2	H2	S3	
122	2	S3	A2	
123	2	H1	F5	
124	2	H1	S1	
125	2	A2	L1	
126	2	H2	S2	

Figure 5-15 Sample of data in Data-Table 5-6 that defines sequence of changes.

Additional data is also collected from designers during the process. As Figure 5-14 shows, when the HVAC designer specifies a change in the duct width, the system requires him/her to answer questions about the actual design time required to make the changes; the additional man-hours needed; the expected difference on building cost when the change is done; and the level of recommendation for that change. This data is saved in Data-Table 5-7 and a sample of the data is shown in Figure 5-16. The process continues till all related changes are addressed and their data are collected.

Data-Table 5-7 MNG-VIRTUAL-CHANGE
ID CASE_ID CHANGE BUILDING_COMPONENT BUILDING_COMPONENT_ID ATTRIBUTE REQUIRED_MAN_HOURS DIFFERENCE_IN_BUILD_COST RECOMMENDATION_LEVEL REASON_FOR_RECOMMENDATION DURATION OLD_VALUE NEW_VALUE

id	ca	chan	building_co	building_c	attribute	requ	differe	re	reason_for_r	du	old_value	new_valu
4	2	A1	space	space009	used_for_activity	1	0	4	As required	1	executive office	computer
5	2	H1	Hvac_duct_c	duct009	Dimension_x	3	100	3	Better propor	2	600	800

Figure 5-16 Sample of data in Data-Table 5-7 which is collected from designers through virtual change module.

5.4.2.2 Organize Changes

After data for the interrelated design changes is collected, two problems need to be addressed. **The first problem** is to define the number of possible change-paths as well as the actual design changes that compose each of them. A sub-routine is developed to provide the computer with the logic that can address this problem. The sub-routine, which is described in details in section B.1 (page 179), functions on the data stored in Data-Table 5-6 (page 111). It stores the initial design change as an item in the first change-path along with all its successor changes. When there are alternate successors ("OR" arrows in Figure 5-10), it considers first only one of them. For the first alternative, all interrelated design changes are defined and grouped together to constitute the first change-path.

Data-Table 5-8
MNG-VIRTUAL-CHANGE-ALTERNATIVES

ID
DESIGN_CHANGE
SUCCESSOR
ALTERNATIVE#
CASE_ID

id	design_change	successor	alternative#	case_id
4734	NULL	A1	ALTERNATIVE#1	2
4735	A1	H1	ALTERNATIVE#1	2
4736	A1	L1	ALTERNATIVE#1	2
4737	A1	I1	ALTERNATIVE#1	2
4738	H1	F5	ALTERNATIVE#1	2
4739	H1	S1	ALTERNATIVE#1	2
4740	I1	L1	ALTERNATIVE#1	2
4741	NULL	A1	ALTERNATIVE#2	2
4742	A1	H2	ALTERNATIVE#2	2
4743	A1	L1	ALTERNATIVE#2	2
4744	A1	I1	ALTERNATIVE#2	2
4745	H2	S3	ALTERNATIVE#2	2
4746	H2	S2	ALTERNATIVE#2	2
4747	I1	L1	ALTERNATIVE#2	2
4748	S3	A2	ALTERNATIVE#2	2
4749	A2	L1	ALTERNATIVE#2	2

Figure 5-17 Sample of data in Data-Table 5-8 that defines alternative change-paths.

The sub-routine then backtracks along the first change-path till an alternative change is encountered (sample is highlighted in Figure 5-15). A new change-path is then generated using the second design alternative (alternate_successor in Figure 5-15 on page 111) along with its successors. The process continues until all change-paths are generated. The result is stored in a specially structured data-table in the management-database (Data-Table 5-8). A sample of the result is illustrated in Figure 5-17 where two change paths (Alternative #1 and Alternative #2) are identified for the sample data in Figure 5-15.

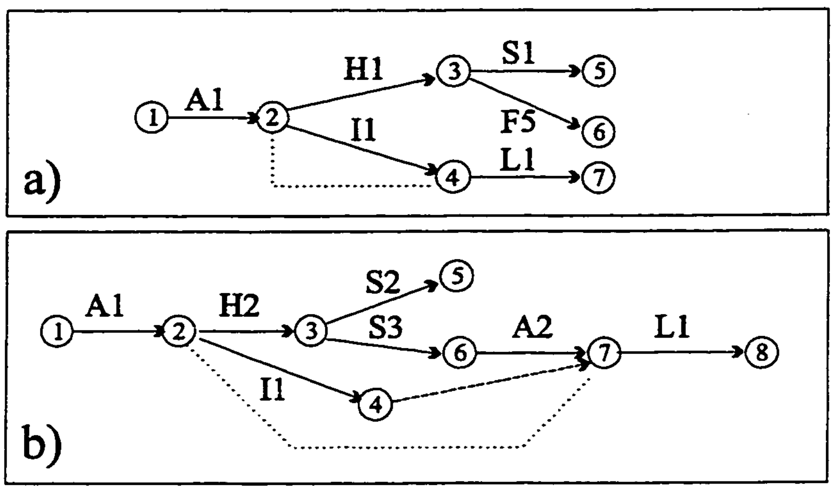


Figure 5-18 Alternate change-paths for scenario in Figure 5-10

The second problem is to define a logical sequence of the design changes in every change-path. As Figure 5-10 shows, some building components may need to be repeatedly redesigned because they are affected by changes in several other building components (for example, the type of luminaire). It is clearly inefficient to have the lighting designer change the type of luminaire each time a change occurs in a building component. It is therefore important to involve the lighting designer only after all these changes are done. Another sub-routine is therefore developed to determine the proper "location" of such changes so as to minimize redesigning. The sub-routine, which is described in details in section B.2 on page-182, functions on the data stored in Data-Table 5-8. It delays the positioning of the repeated design changes in a change-path till all preceding design changes have taken their own positions. The subroutine also prepares the design change data to be scheduled using a standard critical path algorithm.

Figure 5-18 shows (in conceptual form that is not actually used in the computer) the result of applying the two developed sub-routine to the scenario in Figure 5-10 where two alternate change-paths are generated. The lower portion of Figure 5-18 shows that the change "L1" is located in the flow diagram only in one position that comes after changes A1, I1, and H2-S3-A2.

5.4.2.3 Schedule Changes

Once the change-paths are identified and the sequence of changes is defined for each of them, a bar chart is generated for each path as in Figure 5-19 using the expected duration of individual design changes (collected in the first stage in section 5.4.2.1 on page 106 and stored in Data-Table 5-7 on page 112). Critical changes are also identified using a standard critical path method (CPM) algorithm (Paulson 1995). Figure 5-19 shows the critical design change activities in darker tone.

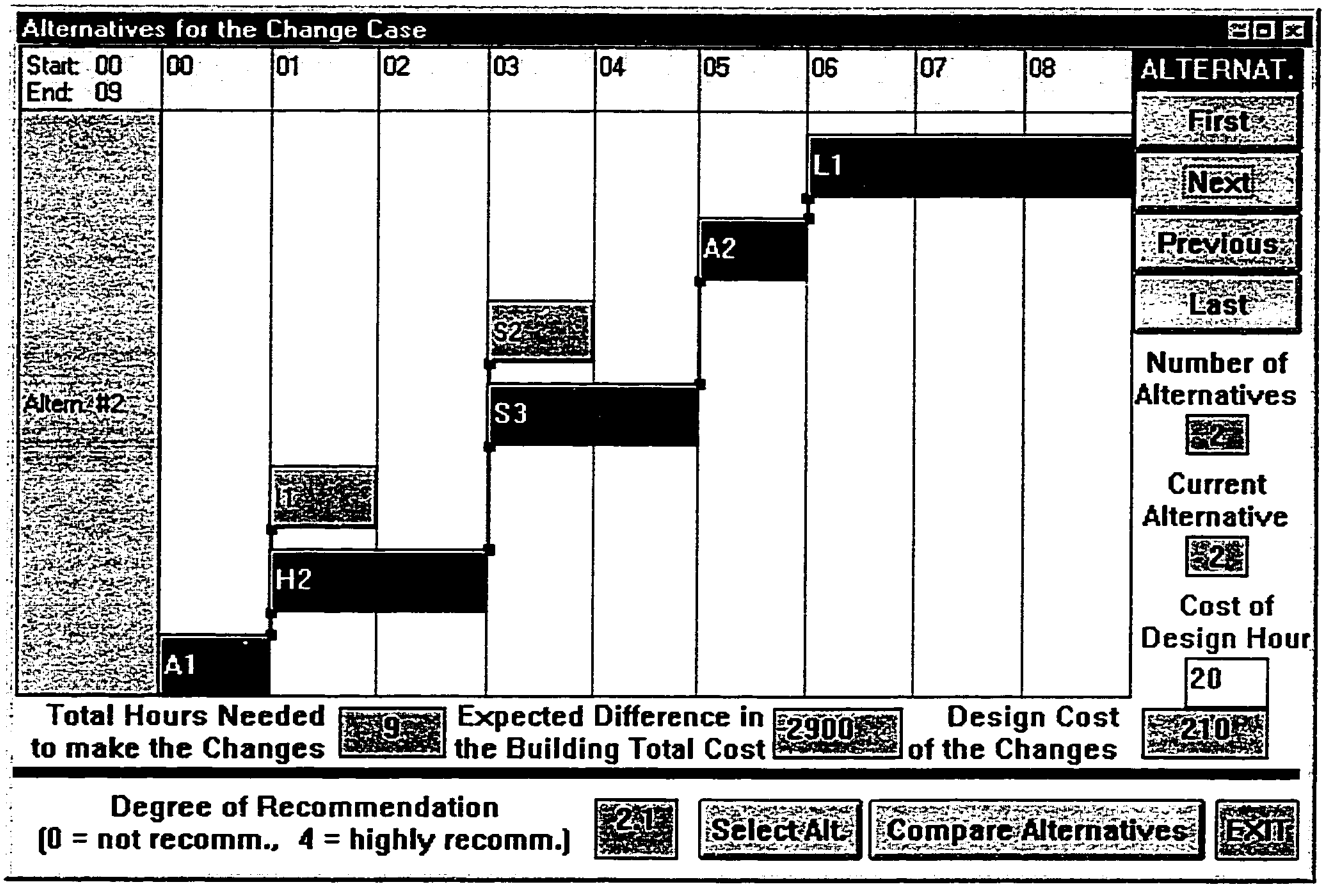


Figure 5-19 Bar chart for alternate change-path (b) in Figure 5-18

5.4.2.4 Calculate Costs and Durations

Using data collected in Data-Table 5-7 (page 112) and shown in Figure 5-20 (page 118), the expected impact on the building construction costs (C_T) is calculated for *each* change-path. It is the sum of the positive and negative effects of all design changes on the building cost. The following equation is used:

$C_T = \sum_{x=1}^{n} C_x$ where

n is the total number of design changes in a change path.

x is a design change.

C_x is the value of the attribute "DIFFERENCE_IN_BUILD_COST" in Data-Table 5-7.

For example, the change-path shown in Figure 5-18b on page 114 would result in building construction cost savings of $2900 as indicated in Figure 5-19. Also calculated is the level of recommendation for each change-path (R_T). It is the average of the recommendation levels assigned to all the changes in that path. If one of the recommendation level values of a design change path equals zero, it means that the designer of that change indicates that such a change is not possible to be done. Reasons can include violation of code. In such case, the whole change path is given the recommendation level of zero which tells the design manager that such an alternative can not be used. The recommendation level has a value of 2.1 in Figure 5-19. This information provides the design manager with the ability to choose the best change-path from the design point of view. The following equation is used:

$R_T = \left(\sum_{x=1}^{n} R_x\right)/n$ (if none of R_x equals zero) or $R_T = 0$ (if any of R_x equals zero)

where n is the total number of design changes in a change path.

x is a design change.

R_x is the value of the attribute "RECOMMENDATION_LEVEL" in Data-Table 5-7.

Other calculations are also performed for each change-path, such as the additional design time required to make the changes (T_T) (9 hours in Figure 5-19) using the equation:

$T_T = \sum_{x=1}^{n} T_x$ where

n is the total number of critical design changes in a change path.

x is a design change.

T_x is the value of the attribute "DURATION" in Data-Table 5-7.

and the corresponding design cost (D_T) ($210 in Figure 5-19) using the equation:

$$D_T = \left(\sum_{x=1}^{n} M_x\right) \cdot h \text{ where}$$

n is the total number of design changes in a change path.

h is the cost of man hour in the design firm.

x is a design change.

M_x is the value of the attribute "REQUIRED_MAN_HOURS" in Data-Table 5-7.

If the initial design change is requested by the owner, this information would substantiate the design manager request for extra design fees and time so as to accommodate the initial change. If the owner agrees, the initial design change can be accomplished through the best "design path" by switching from virtual to actual design mode. If the calculated impact of the initial design change is minimal, the design manager can proceed to actual change mode without delay.

change	required_man_hours	difference_in_build_cost	recommendation_level	duration
A1	1	0	4	1
A2	1	0	1	1
I1	1	-3000	2	1
H2	3	100	1	2
L1	0.5	-200	4	3
S2	2	0	2	1
S3	2	200	1	2

Figure 5-20 Partial data from Data-Table 5-7 that is used for calculating costs and durations.

5.4.3 USER INTERFACE

Two modules are used for the planning and scheduling of design changes. First is the virtual change module which interfaces with designers to collect the data. Second is the planning and scheduling module which shows the results to the design manager. The interface for the virtual change module (Figure 5-21 on page 121) starts by allowing the designer to choose among the projects that are currently under design. The designer has the option to start a new change case or to respond to a virtual change message (selection [S1] in Figure 5-21). In the event of starting a new change case, the designer selects the building component, the instance, and the attribute that s/he intends to change. A sample interface design is shown in Figure 5-11 on page 107. Because every project contains different building components, the interface has a customizable project menu that provides access to the various building components. The configuration module has the capability to make such customization in the project menu as shown in Figure 4-12 on page 77. Once the designer defines the changed building component, s/he is asked to provide the data about the design change. A sample interface design for collecting the data is shown in Figure 5-14 on page 111. To reduce the time needed to fill this data, the interface provides the designer with any historic data about the same design change. Figure 5-22 on page 122 shows a sample of the interface for such historical data. The designer can directly use these data or modify some of them.

In the event of responding to a virtual change message, the interface shows the total number of virtual messages that are sent to a specific discipline. The designer is able to browse through these messages, read each one and respond to it separately. To enable the designer to respond, s/he has access to any building component, any instance, and any attribute of the component. Figure 5-13 on page 110 shows a sample of that interface. Similar to the event of starting a new case, the designer is asked to provide data about the design change. The historical data is also shown to help the designer. The interface also allows the designer to provide a second design change alternative for the same message.

The interface for the planning and scheduling module starts by allowing the design manager to select one of the projects that are currently under design (Figure 5-23 on page 122). S/he selects among the available change cases in the specified project. The interface then shows the results of the change case. The total number of the alternate change paths is shown. The design manager can browse among the various change paths. The results of each change path is shown separately. Figure 5-19 on page 116 shows a sample interface of the results. The bar chart shows every design change in a coded format. The design manager is able to know the details of every design change. This is achieved by clicking on the relevant bar in the bar chart. The interface then shows all the data about the selected design change. Figure 5-24 on page 123 shows a sample of the interface to present the data about a design change. The interface allows the design manager to compare among the various alternatives by showing the results of all the alternatives in a table format (Figure 5-25 on page 123).

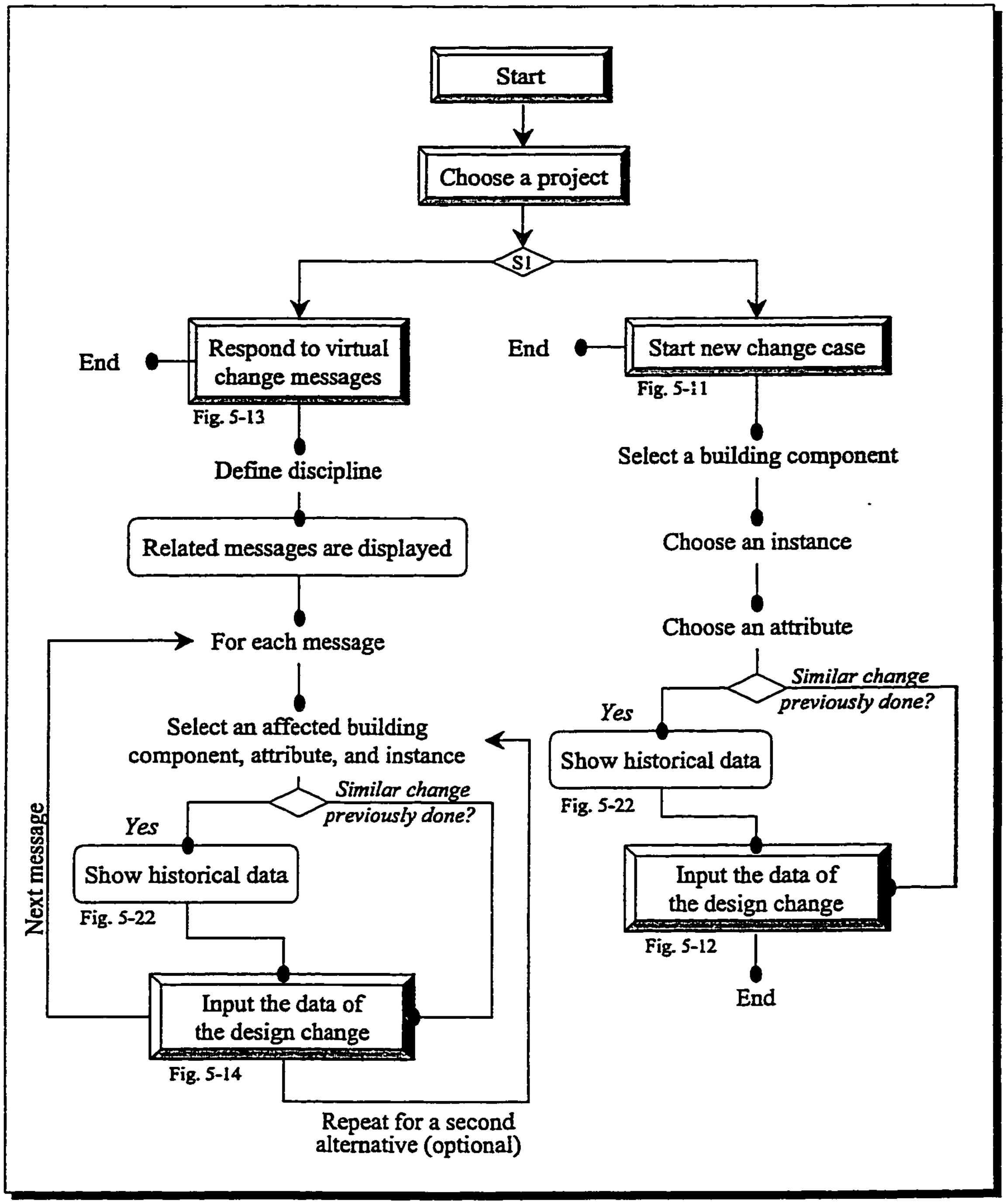


Figure 5-21 Diagram to illustrate user interface in virtual change module.

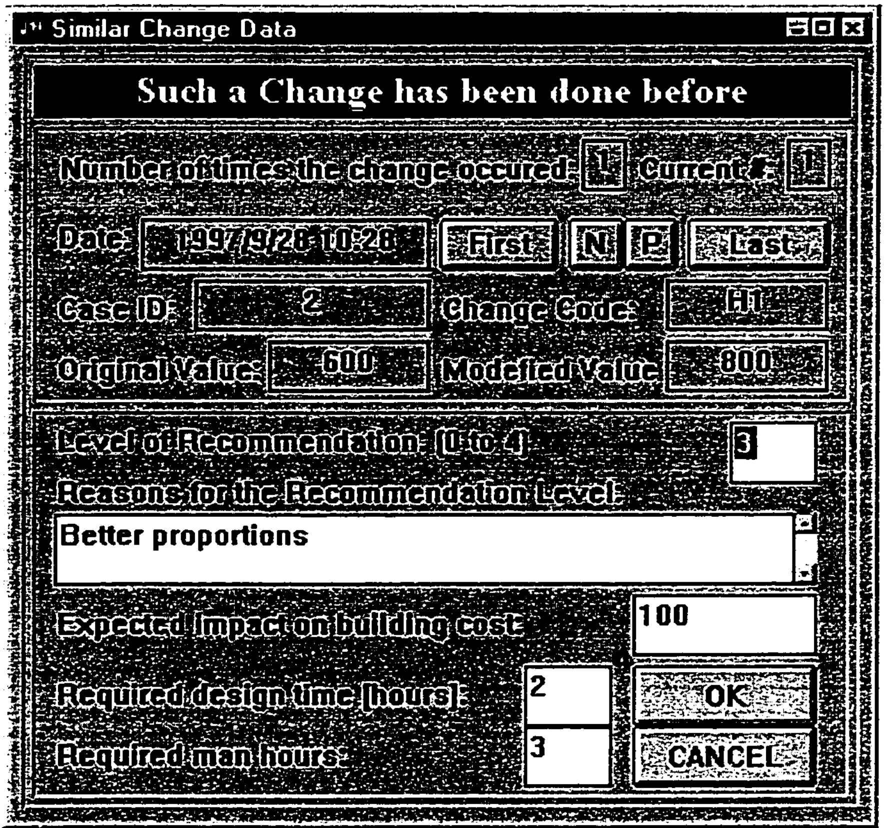


Figure 5-22 Interface to show historical data about certain design change.

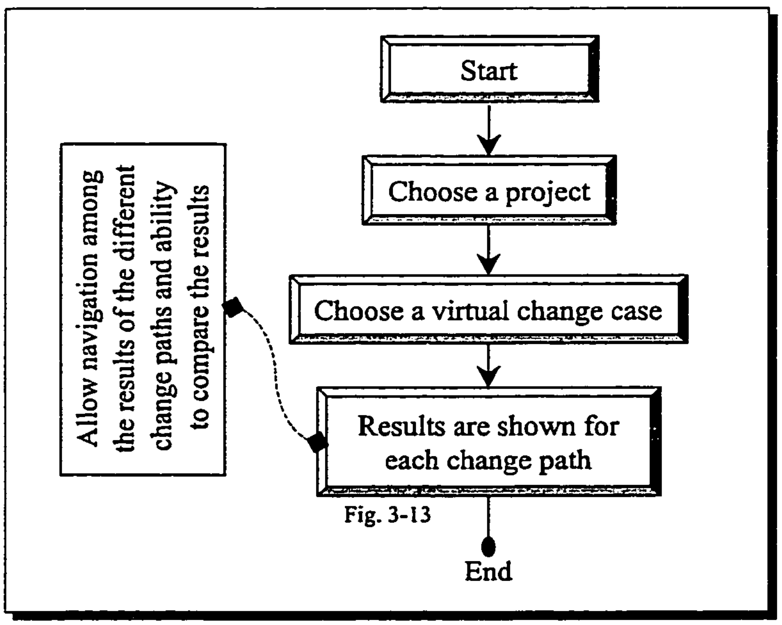


Figure 5-23 Diagram to illustrate user interface in planning and scheduling module.

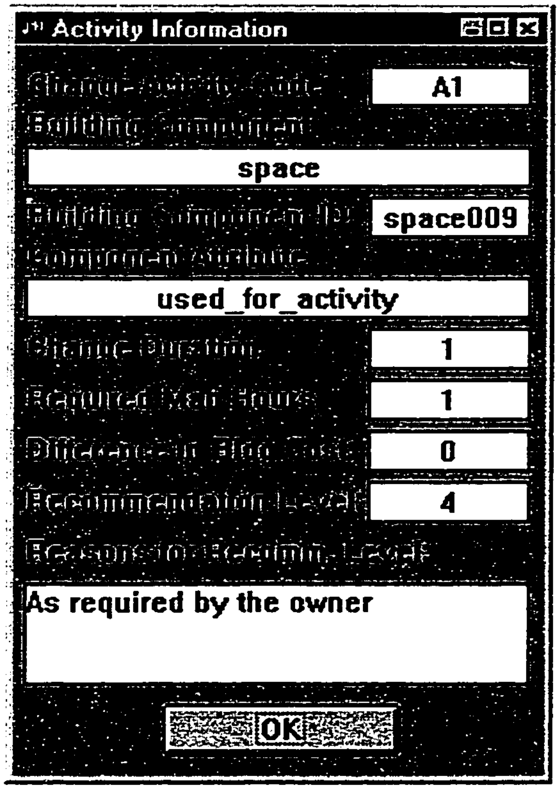


Figure 5-24 Interface to show detailed data of a design change.

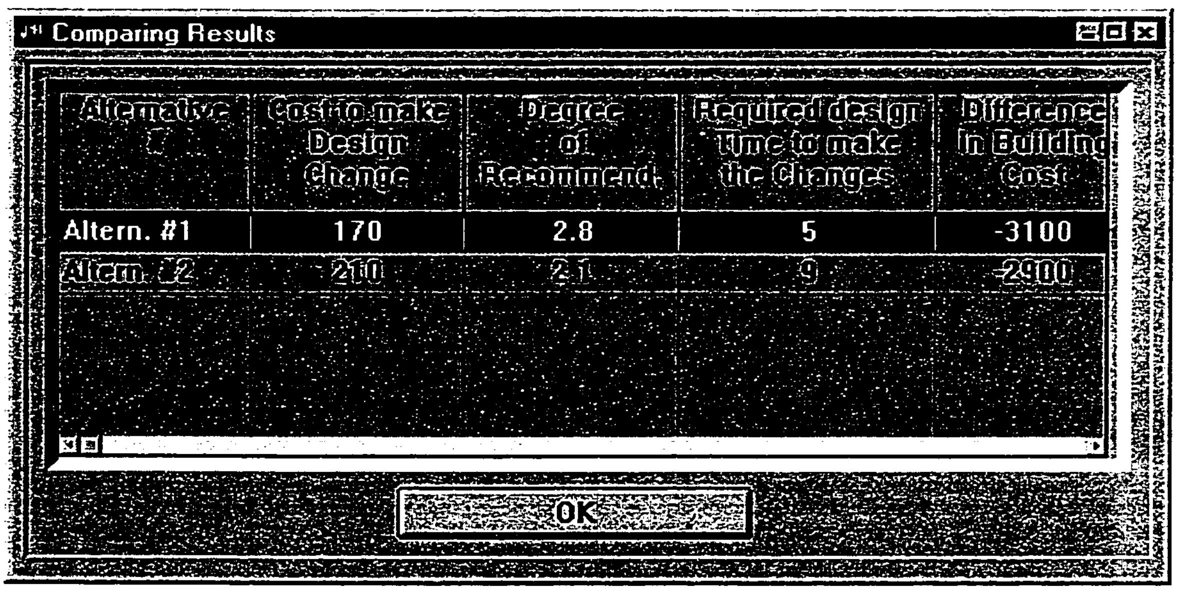


Figure 5-25 Interface to show results of all alternative change-paths so as to enable comparing them.

5.5 SUMMARY

The concept of active building components enables the model to manage design changes in terms of propagating current design changes, tracking past design changes, and planning and scheduling future ones. The building components are made active by providing them with the necessary linking knowledge. The acquisition of this knowledge becomes possible after reversing the knowledge acquisition process. The management-database plays a vital role in supporting the model ability to manage design changes. It sustains the linking knowledge in term of rules elements, records the data regarding every design change, carries the message sent by the building components, and maintains the data needed to plan and schedule future design changes. A methodology that included two specially developed subroutines is introduced to encounter the challenges of interrelated design changes. It makes use of the linking knowledge and the active building components to collect needed data from the designers. It then provides the design manager with clear idea on how such a design change can be done.

CHAPTER SIX
VALIDATION OF THE MODEL

6.1 INTRODUCTION

This chapter aims at demonstrating that the developed model, as described in previous chapters and implemented, can achieve its stated objectives. The first part of this chapter describes the environment in which the model is implemented in terms of software and hardware. The second part focuses on validating the model through three specific levels of validation.

6.2 COMPUTING ENVIRONMENT

The information model is implemented on a client/server network. NOVEL-NETWARE (1993) is used as the network management software while MS-WINDOWS-95 (1995) is used as the local operating system. The central project-database is implemented in MS-ACCESS (1994). It is installed on the server, hence accessible by all users. The modules in the designer system and the design manager system (see Figure 3-1 on page 36) are implemented in the software environment LEVEL5 OBJECT (1994). Depending on whether the user is a designer or a design manager, his/her own (client) computer contains the relevant modules. The modules - on the client computers - are connected with the central project-database on the server through the Object Database Connectivity (ODBC) component that is part of the MS-WINDOWS-95 system. This component enables the modules to use SQL in order to manipulate the project-database.

Hardware for the client computers consists of four INTEL™ based personal computers with 166 MHz Pentium processors and 16 MB of RAM. The server is also an INTEL™ based personal computer but with 200 MHz Pentium processors and 64 MB of RAM. These are common type of computers that are used by building design professionals. The computers are located in the same computer lab at the School for Building, Concordia University. Yet, their positions are selected so as none of the users can see the others. This is to emulate the actual design environment where designers of various disciplines are separated spatially.

6.3 VALIDATION

6.3.1 APPROACH

The nature of the developed model makes it unfeasible to compare its outputs with experimental data or data from literature. However, it is important to make sure that the model, as developed, functions properly and achieves its objectives. Therefore, the model is subjected to three levels of validation. The first level aims to show that the model is properly coded on the implementation software and in accordance with the model development. The second level demonstrates that the model provides the capabilities that are expected from its development. The third level establishes that the model improves the current practices of dealing with design changes and can solve their related problems.

6.3.2 FIRST LEVEL OF VALIDATION

This level of validation aims to ensure that the model components are coded according to the described development in chapters four and five. Among numerous tasks in this level, the validation includes making sure that the input data are used correctly, the program routines function accurately, the modules are properly connected to the database, and that the expected output data is presented. Several tools that exist within the development software (LEVEL5 OBJECT) are used in the process. The automated syntax validation ensures that any saved program code in syntactically correct even before compiling the code. The "session monitor" tool allows the developer to dynamically follow the program flow step by step and discover any logical error. The "history" tool is also used to print out all the program flow in a textual format (Figure 6-1), hence it can be reviewed for detecting any source of logical error. Several samples of data are used to validate each subroutine in order to make sure that the code is trouble-free.

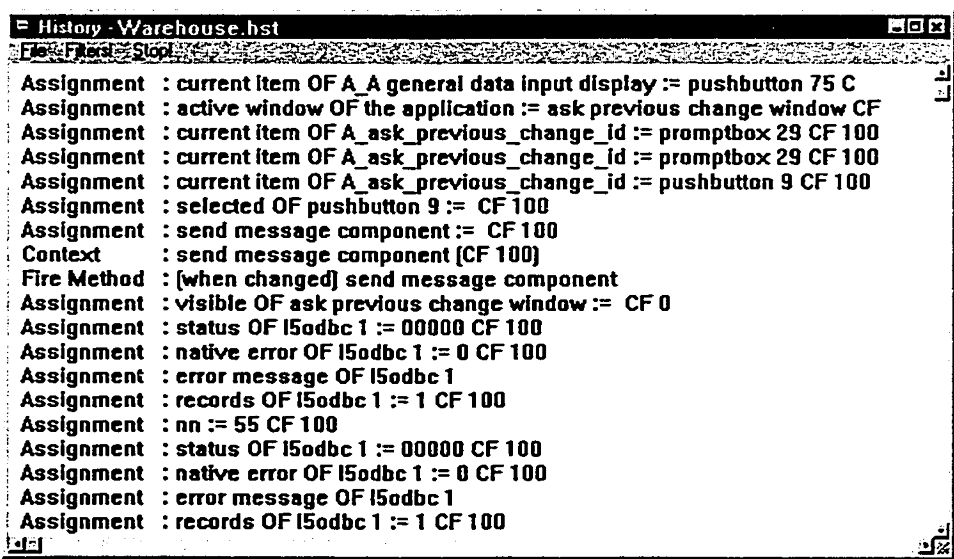


Figure 6-1 Sample of statements recorded by "history" tool in LEVEL5 OBJECT.

6.3.3 SECOND LEVEL OF VALIDATION

This level of validation aims to ensure that the components successfully function together and provide the user with the capabilities that are expected from the model. A setup that simulates a multi-disciplinary design environment is formed for this purpose. In this setup, graduate students who have professional experience represent four design disciplines. These disciplines are architecture, structure, HVAC, and envelope. A graduate student is assigned the role of the design manager. Data is extracted to populate the various parts of the model. The first part which needs to be populated with data is the general-database (see Figure 3-1 on page 36). Two references are used for this purpose "Architectural Graphic Standards" (Ramsey and Sleeper 1994) and "Building Construction Illustrated" (Ching 1991). From these references, a number of building components are extracted along with the attributes that describe each of them. Most of the extracted building components are grouped together to form building systems. Prebuilt rules are also added to many of the building components. With such data, the general-database is ready to be used in assembling the data-structure of the building-components-database for a variety of building types. The second part that needs to be populated with data is the central project-database. A warehouse project[1] (DeChiara 1980) is selected for this purpose. The warehouse is 50,292mm (165`) by 36,678mm (120` 4"). It consists of two main zones, a storage zone that is 6,198mm (20` 4") high and an administration zone that is 3,327mm (10` 11") high.

[1] Project: Sales office and Warehouse for W.W.Grainger, Troy, Mich. Architect: Gillett Associates, Inc.

The difference in height is used as room for mechanical equipment. The administrative zone consists of a general office area, entrance and a sales room, a lunchroom, and two rest rooms.

The structure of the warehouse consists of steel columns that support open web steel joists. The columns are located on non-equally spaced grid. The depth of the open web steel joists that support the building main roof is 457mm (18") while those supporting the floor above the administration zone – where the mechanical equipment are installed - is 356mm (14") in depth. The roof is 38mm (1.5") corrugated steel deck covered with 51mm (2") rigid insulation while the floor above the administrative zone is open web steel joists that carry 51mm (2") concrete on 38mm (1.5") corrugated steel deck. Acoustical ceiling is used in the administrative zone and is suspended from the joists. The external walls are mainly made of CMU_Backed_Brick_Veneer with 38mm (1.5") of rigid insulation. They are supported by reinforced concrete girders. The floor is 127mm (5") concrete slab over sand and gravel fill.

With the use of the data from the warehouse project, the following sections illustrate the validation of the various capabilities of the model. These capabilities are categorized in similar fashion as the model development which is presented in chapters four and five.

6.3.3.1 Assembly and Population of the Project-Database

The first step in using the model is to assemble the data-structure of the building-components-database so that it can accept the design data of the warehouse. The design manager performs this task using the configuration module and with the help of the general-database. He starts the process by creating a new project and uses the building systems option to assemble the data-structure (sample is in Figure 6-2). The majority of the building components are assembled through this option. The assembly process automatically adds the relevant prebuilt rules as stored in the general-database. The remaining building components are individually obtained from the general-database (sample is in Figure 6-3) or created from scratch. Each designer reviews the data-structure of the building components that are under his responsibility and may ask the design manager to modify some of these components by adding or editing attributes. For example, the concrete column component that is part of the structural system in the general-database (Figure 6-2) is removed and a steel column component is added (Figure 6-4). The design manager asks each designer about the elements of data which are used as input to the design of his system. Accordingly, the design manager adjusts the automatically added prebuilt rules and creates new ones (samples are in Figure 6-5 to Figure 6-8). After completing the model configuration, each designer uses his own data manipulation module to populate the building-components-database by creating instances of the building components under his responsibility. Occasionally, the designers through the use of the relation-acquiring sub-module create dynamically built rules (sample is in Figure 6-9).

The process proves that the model is capable of flexibly adapting to the data requirements of the project. The initial assembly process of the data-structure takes about one hour for the warehouse project while adjusting the prebuilt rules take about half an hour for each discipline. This is seen as a reasonable overhead time for using the model. The input of graphical data in form of textual data is difficult. The use of a CADD tool would be useful for this purpose but remains beyond the scope of this project, given time constraints.

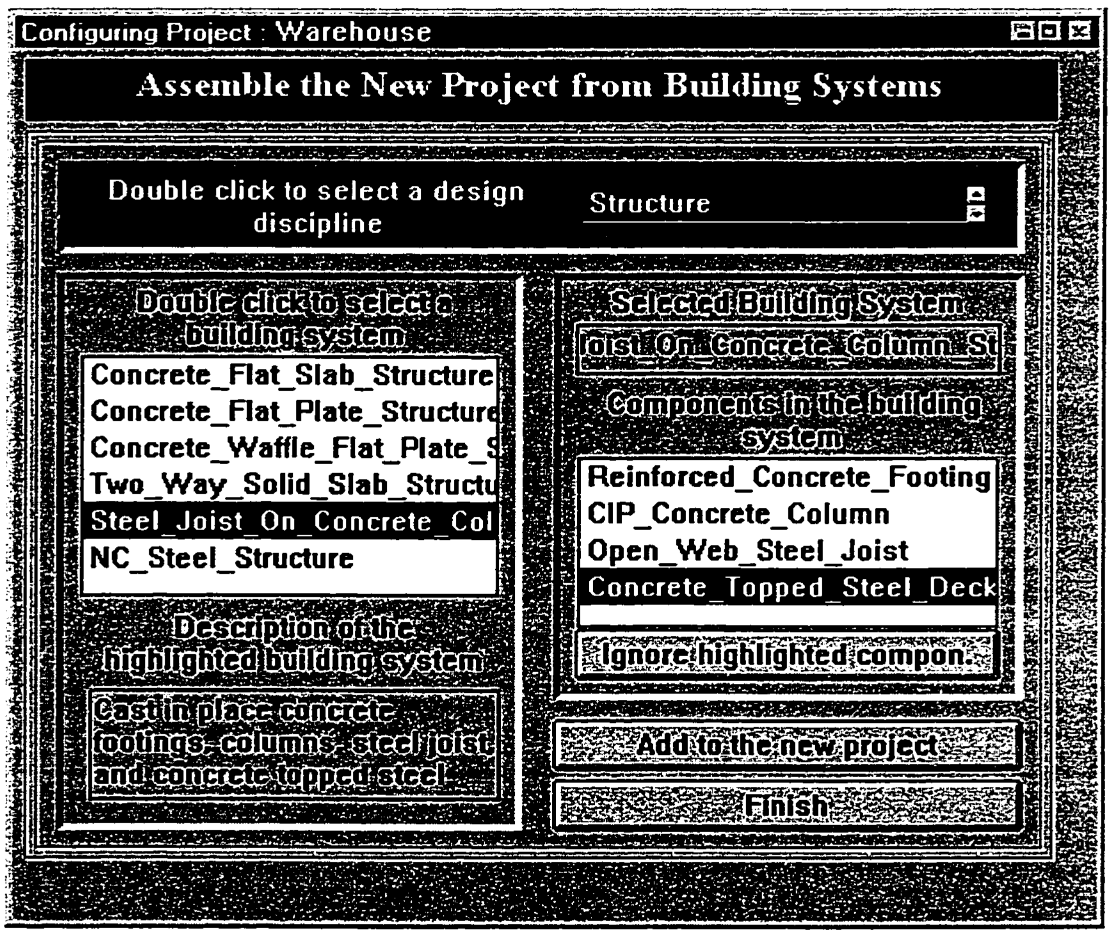


Figure 6-2 Assembly of building components in building-components-database from building systems available in general-database.

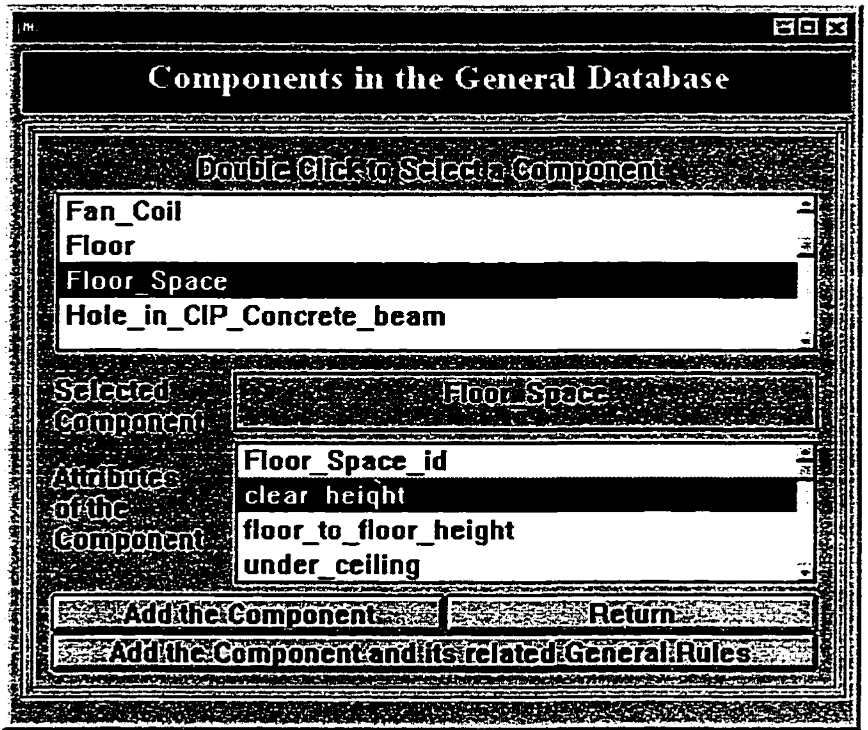


Figure 6-3 Adding building component from general-database to building-component-database.

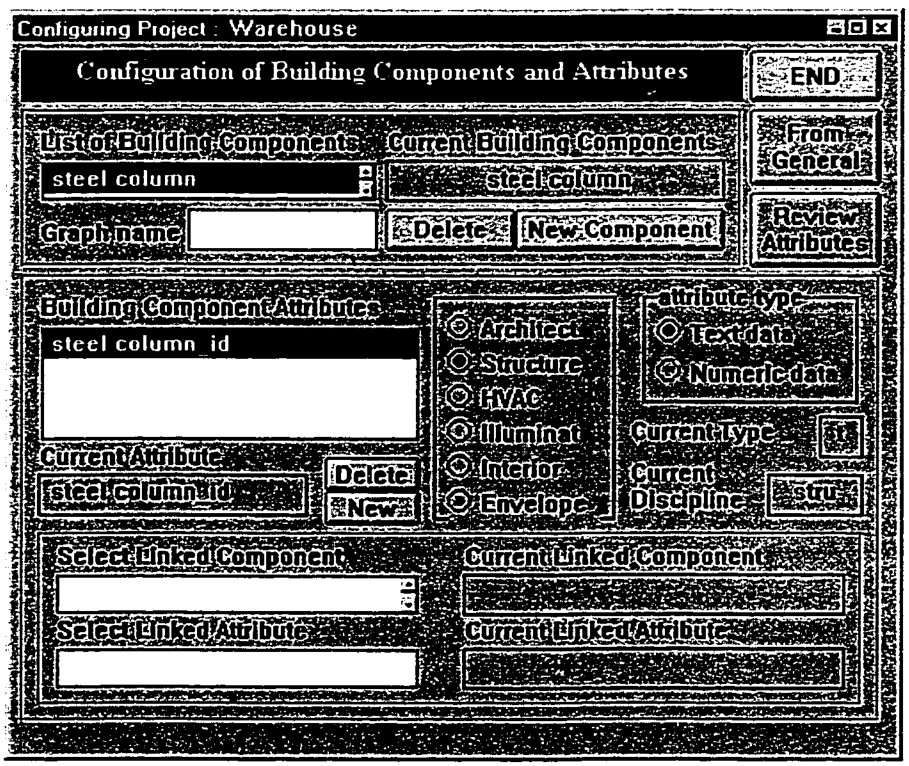


Figure 6-4 Configuration of a building component using configuration module.

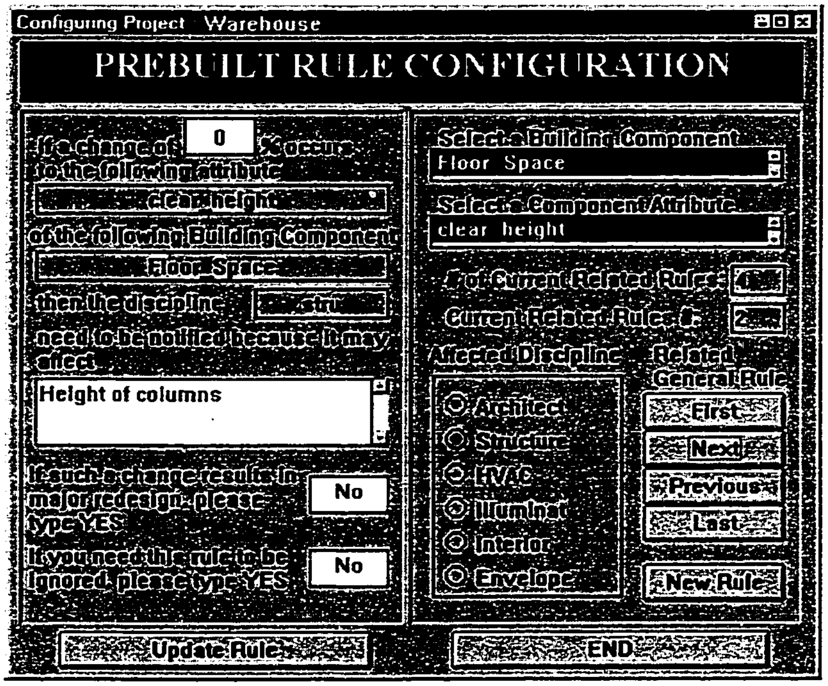


Figure 6-5 Input data to structural design translated to prebuilt rule.

(If any change occurs to clear height of floor space then the structural engineer needs to be notified because it can affect the height of columns).

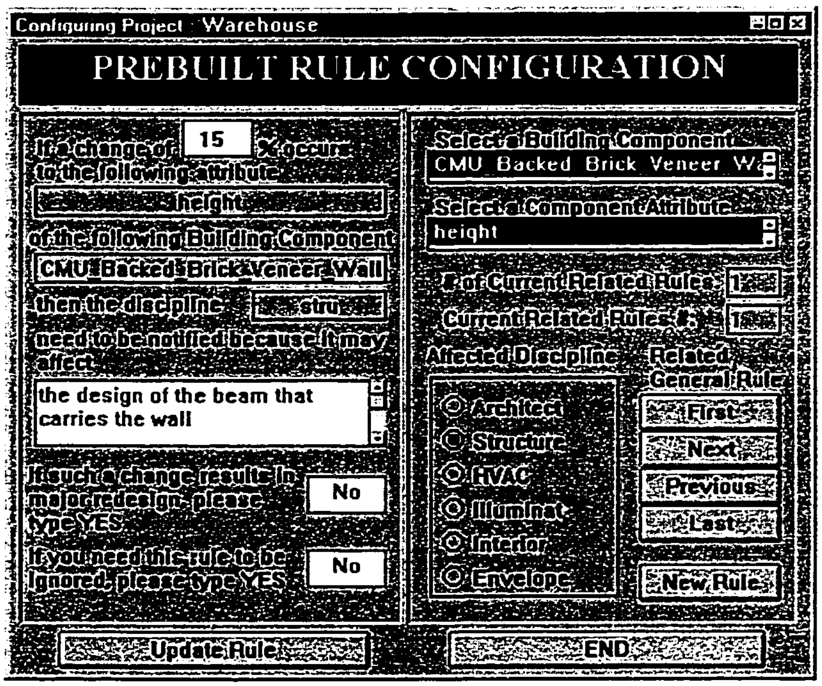


Figure 6-6 Input data to structural design translated to prebuilt rule.

(If a change more than or equal 15% occurs to height of CMU backed brick veneer wall then the structural engineer needs to be notified because it can affect the design of beam that carries the wall)

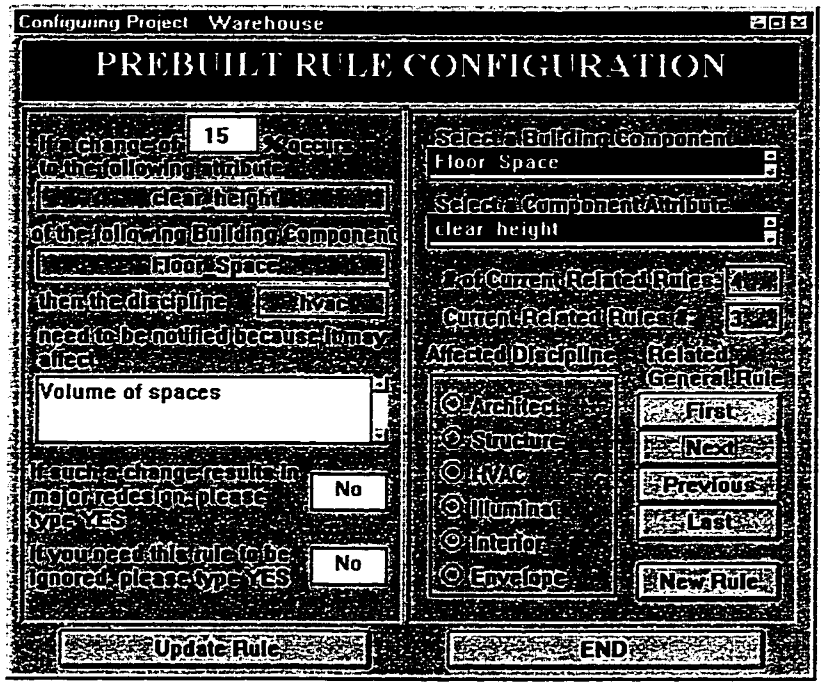


Figure 6-7 Input data to HVAC design translated to prebuilt rule.
(If a change more than or equal 15% occurs to clear height of the floor space then the HVAC engineer needs to be notified because it affect the volume of the conditioned space)

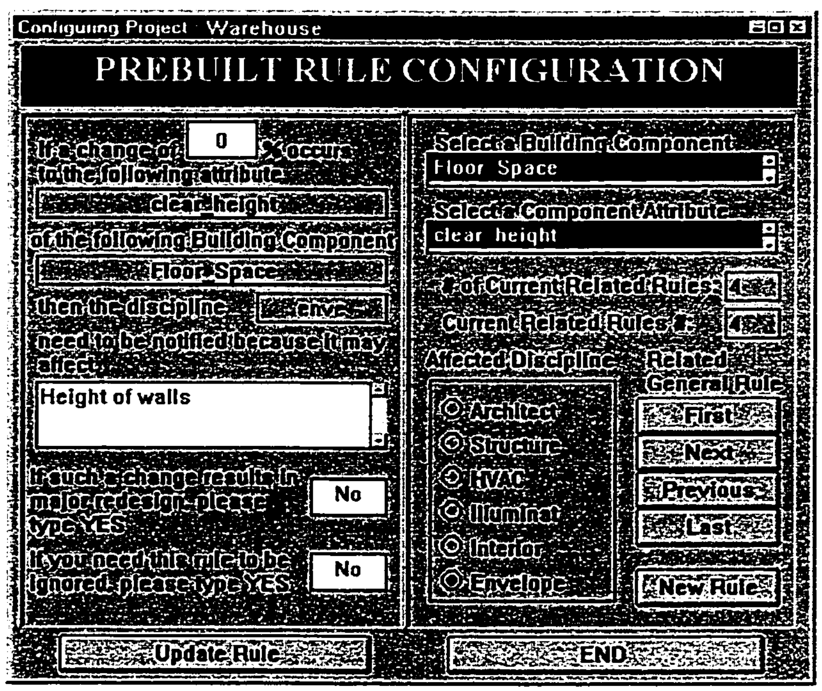


Figure 6-8 Input data to envelope design translated to prebuilt rule.
(If any change occurs to clear height of floor space then the envelope engineer needs to be notified because it affects the height of the wall)

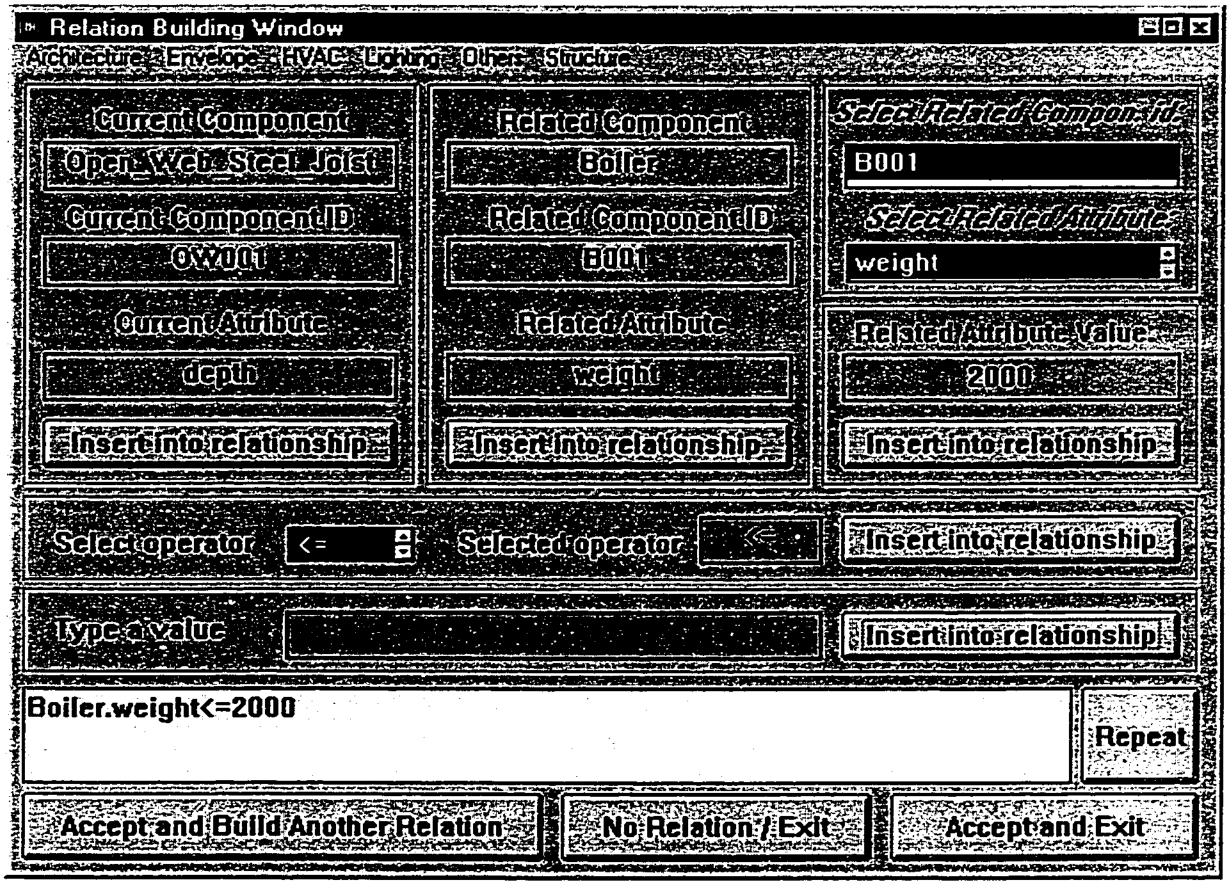


Figure 6-9 Dynamically built rule acquired from structural designer defining one of the conditions used to design depth of Open_Web_Steel_Joist.

(The depth of the open web steel joist Ow001 is determined based on the information that the weight of the boiler above it is less than or equal two tons)

6.3.3.2 Propagating Current Design Changes

To validate the model capability to propagate current design changes, one designer (the architect) introduces a random design change. The design change is to increase the height of the storage zone by 1.2m (4') to satisfy a modification in the owner requirements. Consequently, the changed component automatically sends messages to the affected designers. The structural engineer receives a message informing about the change in height and suggesting that columns design may be affected (Figure 6-10). Similarly, a message is sent to the HVAC designer stating that the HVAC system might be affected due to the change in the space volume (Figure 6-11). Another message is sent to the envelope designer indicating that the height of the walls is now incompatible with current height of the storage space (Figure 6-12). The structural engineer reads the message, evaluates the design change and only modifies the length of the columns. The HVAC designer reads the message, evaluates the capacity of the Boiler and specifies a larger type. He also resizes the HVAC ducts that supply the storage zone. The envelope designer reads the message and increases the height of the walls. Other automated messages are sent following these design changes. The structural engineer receives two messages. The first informs that the height of the walls has increased, which can affect the design of the beams that carry these walls (Figure 6-13). The second message informs that a heavier Boiler is used, which may affect the design of the floor that carries this equipment (Figure 6-14). The structural engineer re-evaluates the design of the beams that carry the walls and increases their dimensions. He also re-evaluates the design of the columns and the open web steel joists that carry the Boiler and finds these to be safe.

As this scenario illustrates, building components using the captured linking knowledge proves to be capable of adequately propagating design changes and only to the interested designers. The designers are able to perform necessary design modifications in the design information so as to ensure compatibility. The likelihood of errors is greatly reduced.

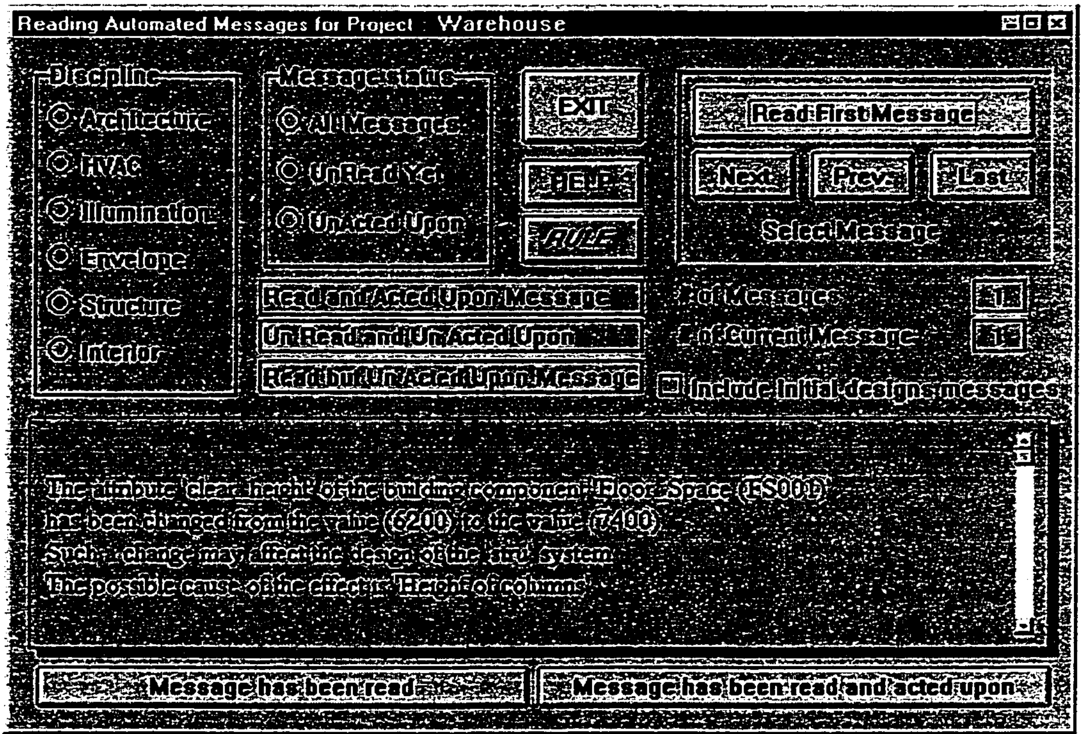


Figure 6-10 Message received by structural designer informing of design change made by architect.

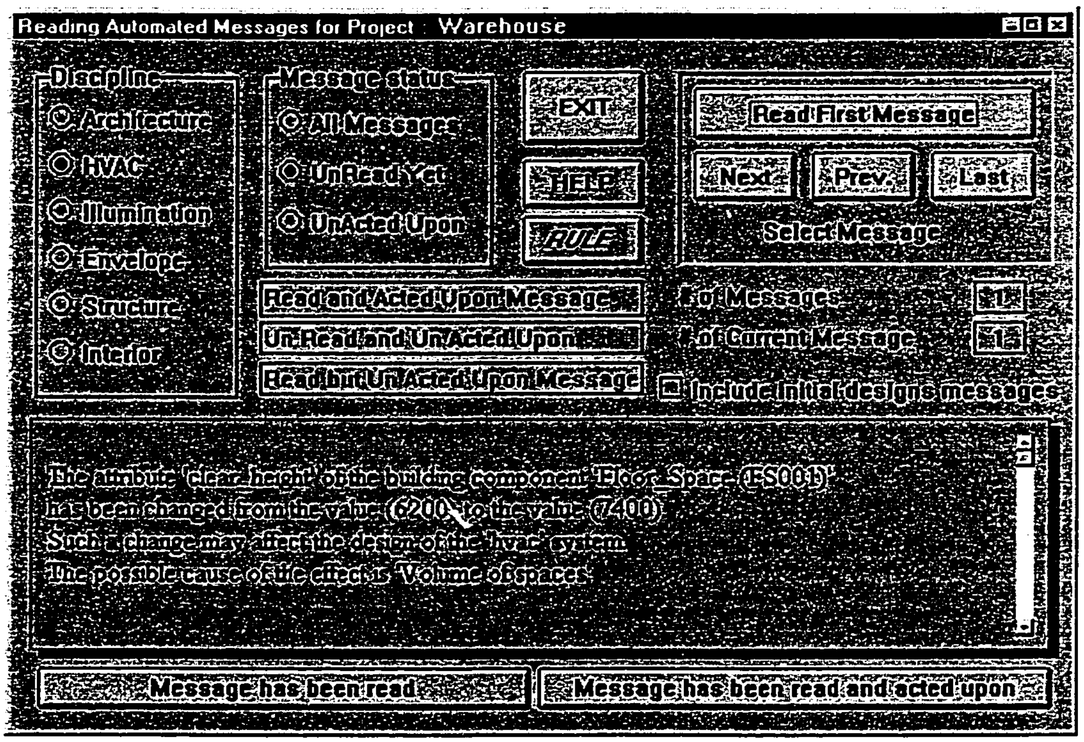


Figure 6-11 Message received by HVAC designer informing of design change made by architect.

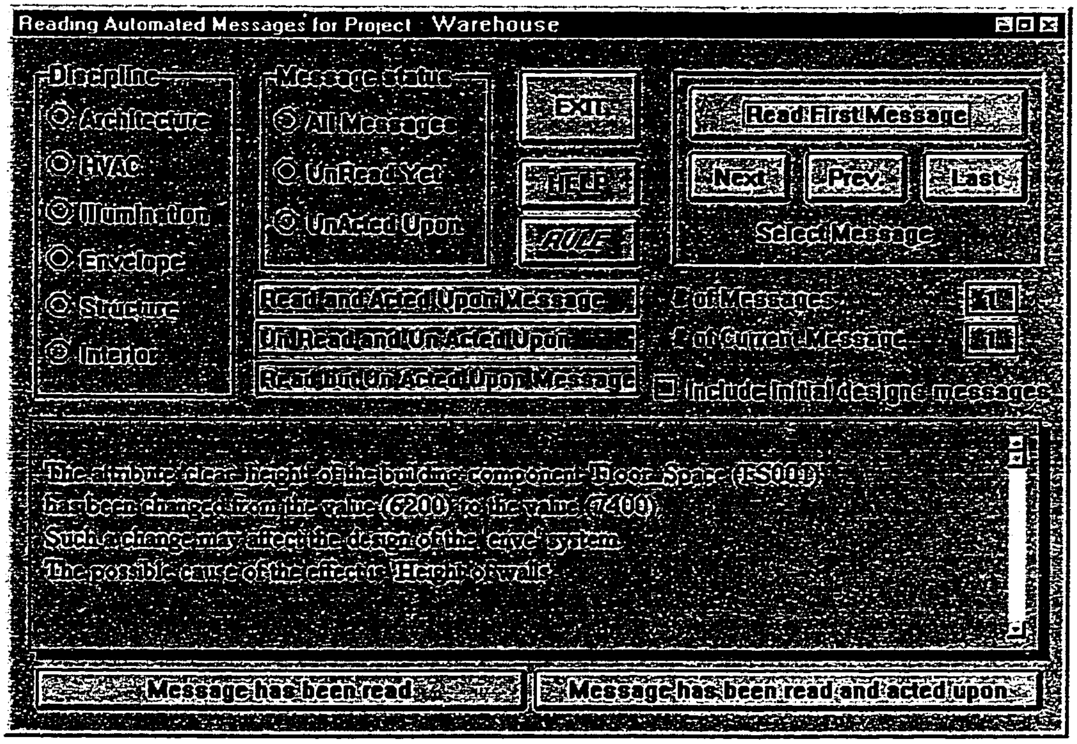


Figure 6-12 Message received by envelop designer informing of design change made by architect.

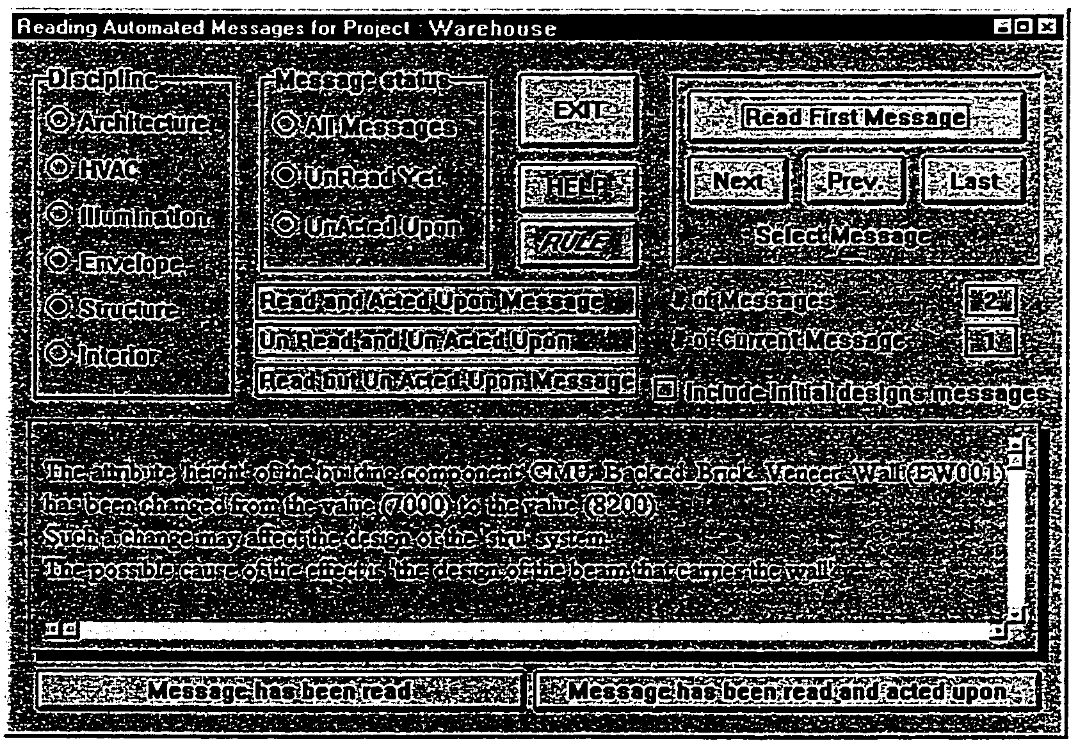


Figure 6-13 Message received by structural designer informing of design change made by envelope designer.

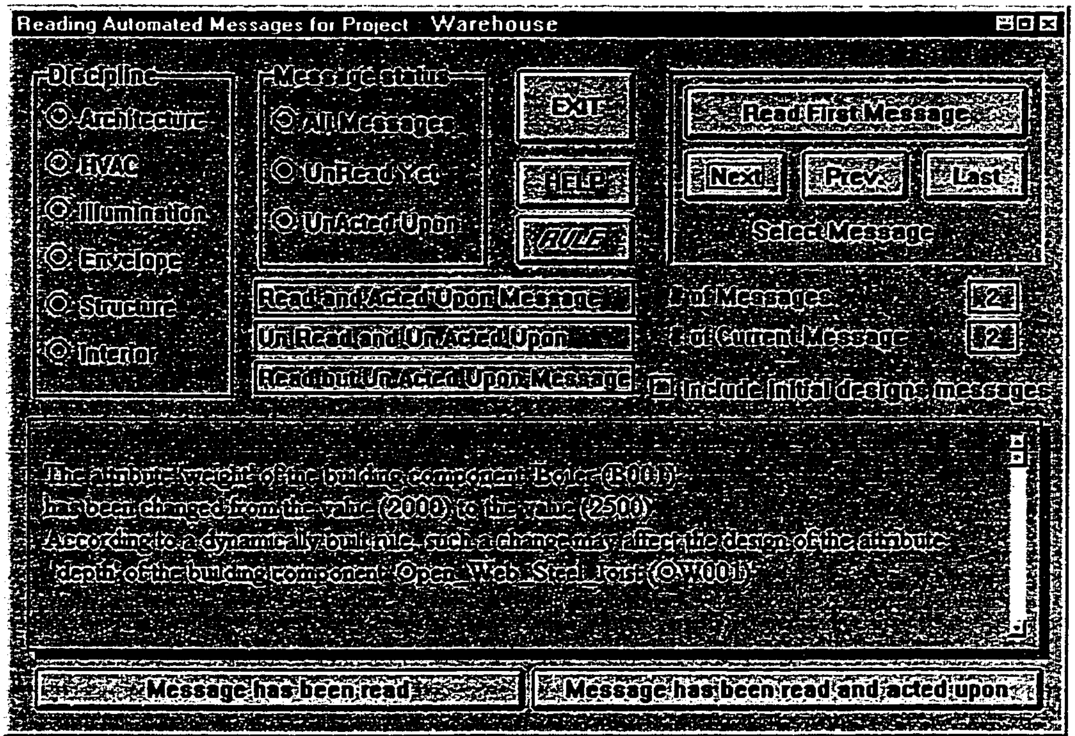


Figure 6-14 Message received by structural designer informing of design change made by HVAC designer.

6.3.3.3 Tracking Past Design Changes

To validate the model capability to track past design changes, the design manager inquires about some design changes which occurred during the scenario in section 6.3.3.2. A sample of these inquiries is about the design changes that occur to the weight of the building component "Boiler". As a result of this inquiry, the change in weight of the boiler appears to the design manager (Figure 6-15). As the design manager double clicks on the design change, the message that is automatically sent to the structural engineer due to this design change appears (Figure 6-16). From the performed inquiries, the model always performed correct tracking of past design changes and their related messages. Hence, its development provides the capability of tracking past design changes.

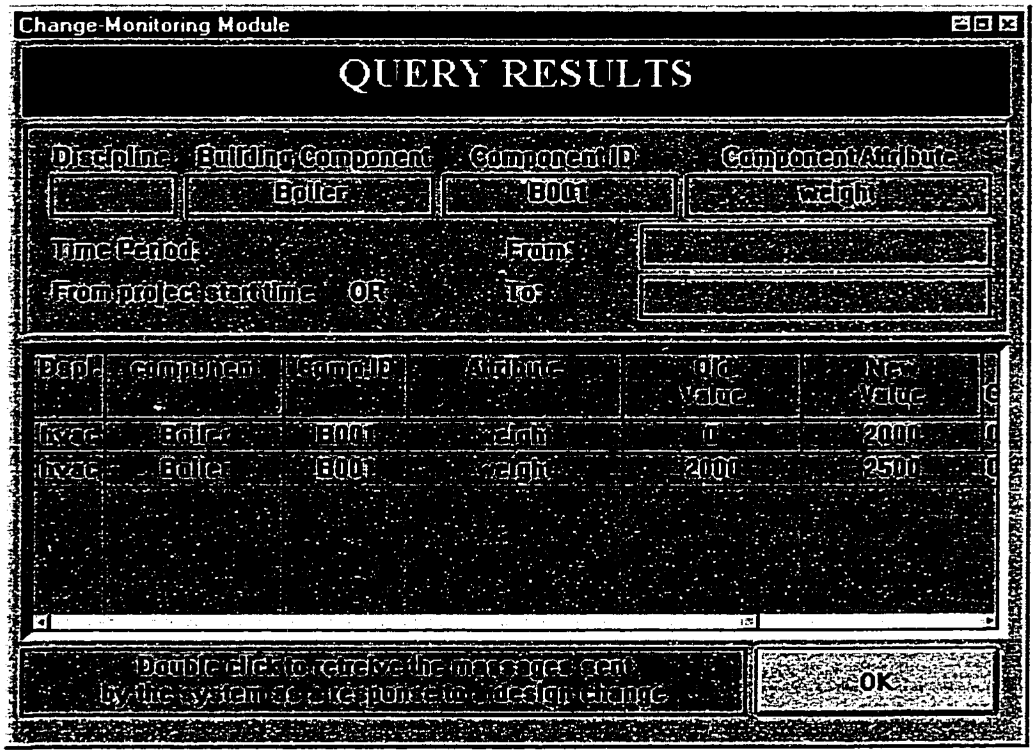


Figure 6-15 Results of request made by design manager to track design changes made to a building component.

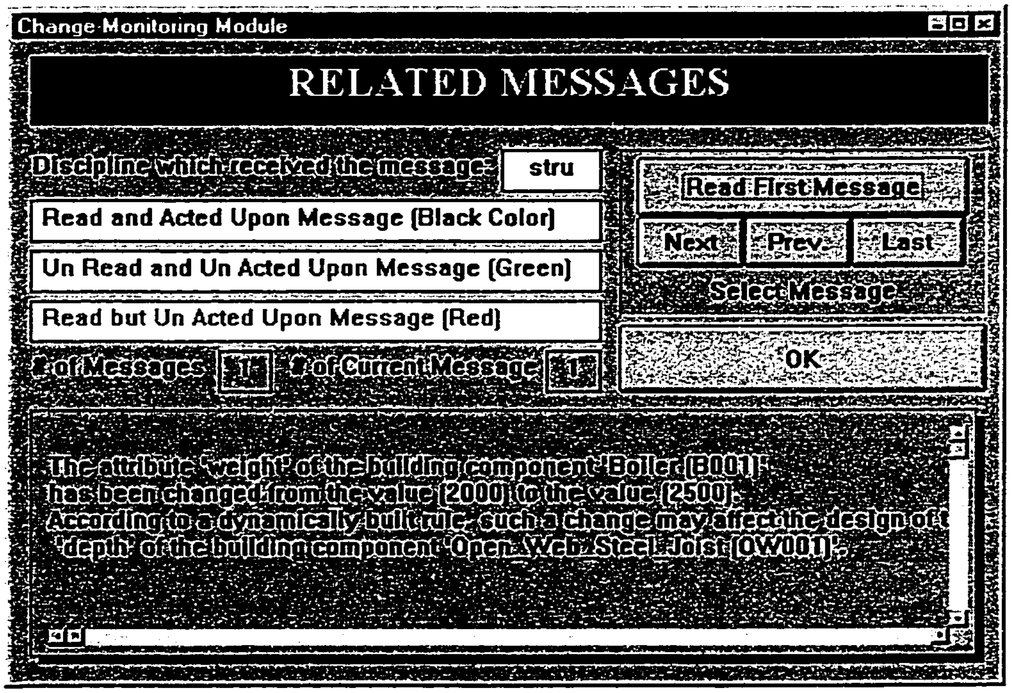


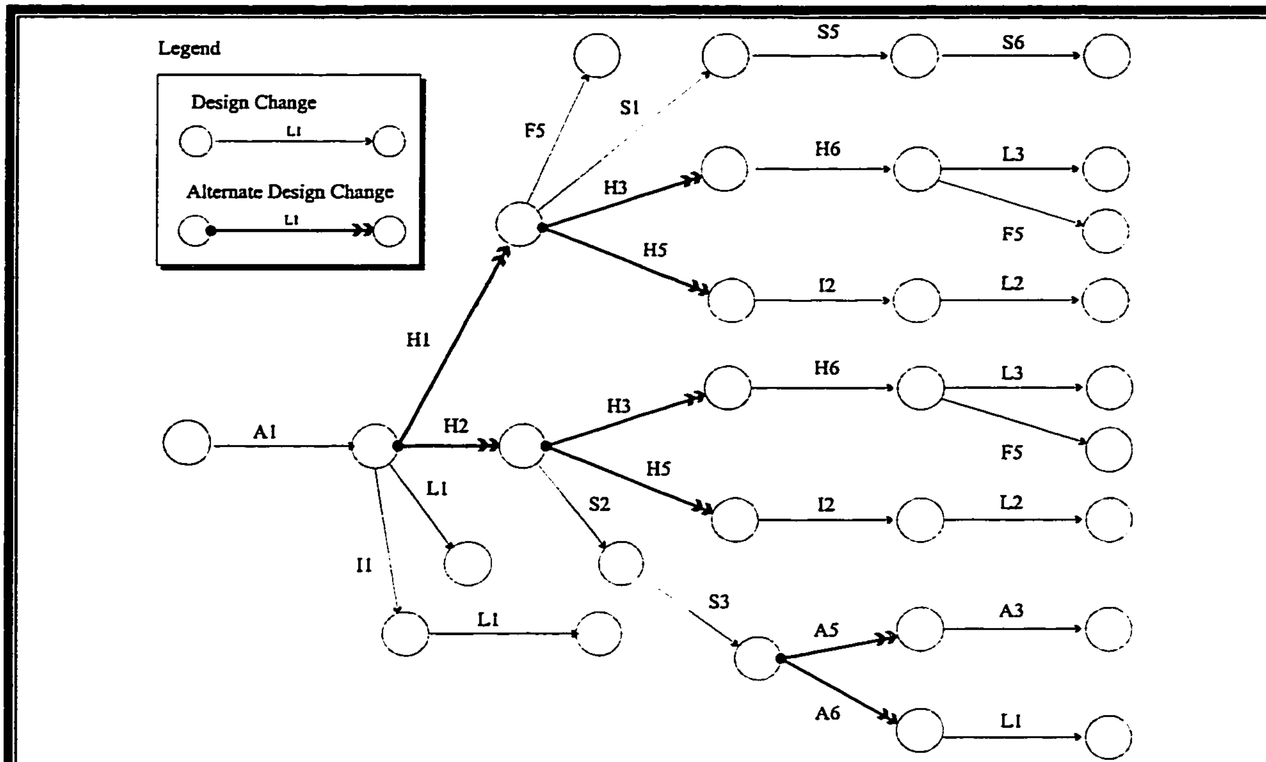
Figure 6-16 Results of request made by design manager to track automated messages that are sent because of certain design change.

6.3.3.4 Planning and Scheduling of Future Changes

The aim of this section is to validate the methodology which provides the model with its capability to plan and schedule future design changes. A hypothetical scenario for extended design changes is developed for this purpose (Figure 6-17). The scenario intends to include several design change alternatives that relate to each other differently. Some of these design change alternatives are dependent on the choice in a previous alternative. For example, design change alternative [(A5) or (A6)] is feasible only if the design change (H2) is chosen out of design change alternative [(H1) or (H2)]. On the other hand, design change alternative [(A5) or (A6)] is independent of design change alternative [(H3) or (H5)], yet they coexist in parallel. The scenario also includes repeated design change alternatives like [(H3) or (H5)]. The purpose for developing the scenario with these features is to make sure that the specially developed subroutines (section 5.4.2.2) function correctly in all possible scenarios.

The virtual change module is used to initiate a new case (similar to Figure 5-11 on page 107) and to collect the data about all the design changes in the developed scenario. The planning and scheduling module is then run to generate the various possible change-paths for the scenario. Figure 6-18 to Figure 6-23 present the result as produced by the planning and scheduling module. The model is able to recognize all the possible change-paths and to calculate the needed design time, design cost, impact on building cost and the level of recommendation for every change-path. In change-paths number three (Figure 6-20) and number five (Figure 6-22), the levels of recommendation are calculated with the result of the value zero. This indicates to the design manager that both of these change-paths can not be used. It is also shown that the reason is design change (A5), that is change in the slab to slab height. The architect assigns a level of recommendation of zero to this design change because, if it is pursued, will result in exceeding the maximum permissible building height according to the code.

The module also generates a comparison table among all the alternate change-paths as shown in Figure 6-24 to help the design manager in selecting the best change-path. All the generated bar charts and the calculations are identical to those performed manually for the scenario, only much faster. As such, the model proves to be capable of providing the expected planning and scheduling capability.



Change in:

A1. Space function (from executive office to computer lab).
A3. Height of façade panel.
A5. Slab to slab height.
A6. Reduce clear height.

L1. Luminaire type.
L2. Luminaire x dimension.
L3. Location of luminaires.

H1. HVAC duct width.
H2. HVAC duct depth.
H3. Add HVAC duct.
H5. Size of HVAC outlet.
H6. Location of HVAC outlets.

I1. Wall finishing. (from dark mahogany wood to white paint)
I2. Ceiling pattern x size.

S1. Width of hole in structural beam.
S2. Height of hole in structural beam.
S3. Depth of beam.
S5. Beam section type.
S6. Beam connection.

F5. Location of sprinkler outlets.

Figure 6-17 Scenario for extended design changes with several alternatives.

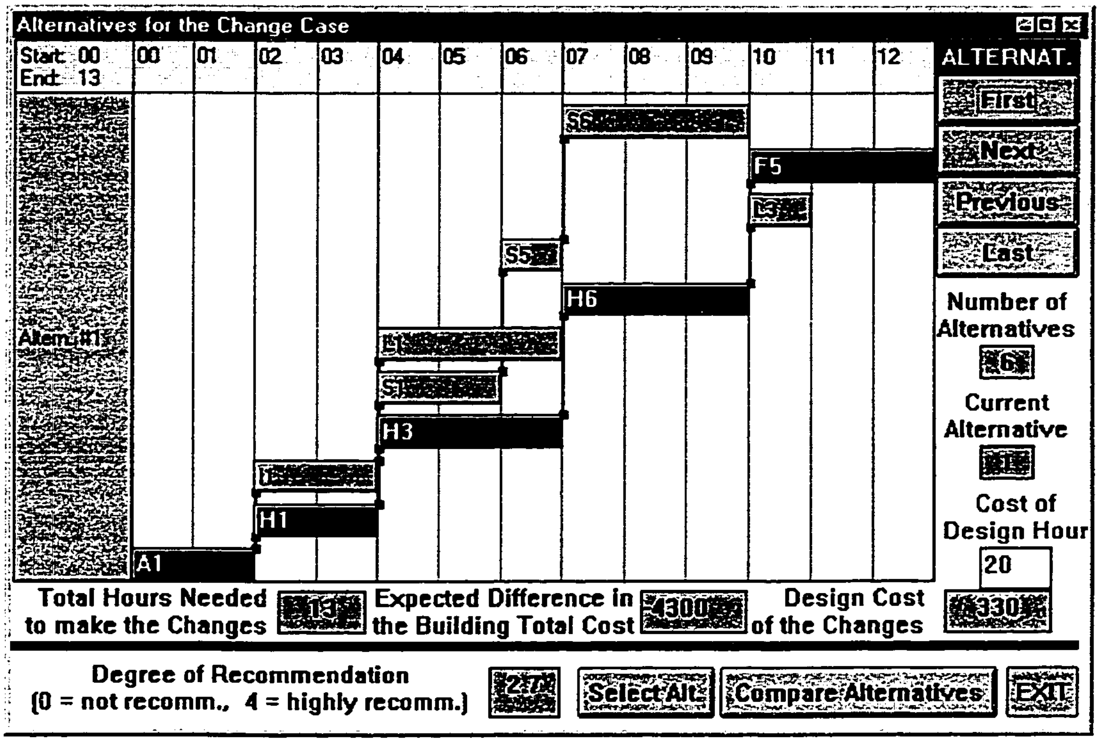


Figure 6-18 Bar chart and data for alternate change-path (1) for the scenario in Figure 6-17

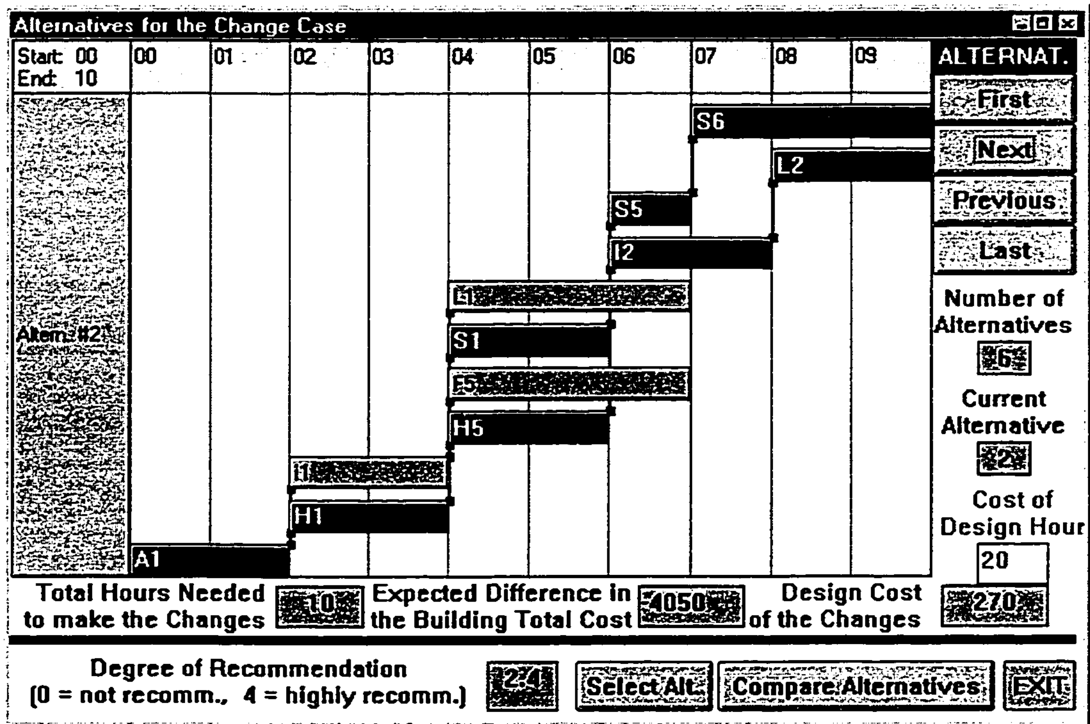


Figure 6-19 Bar chart and data for alternate change-path (2) for the scenario in Figure 6-17

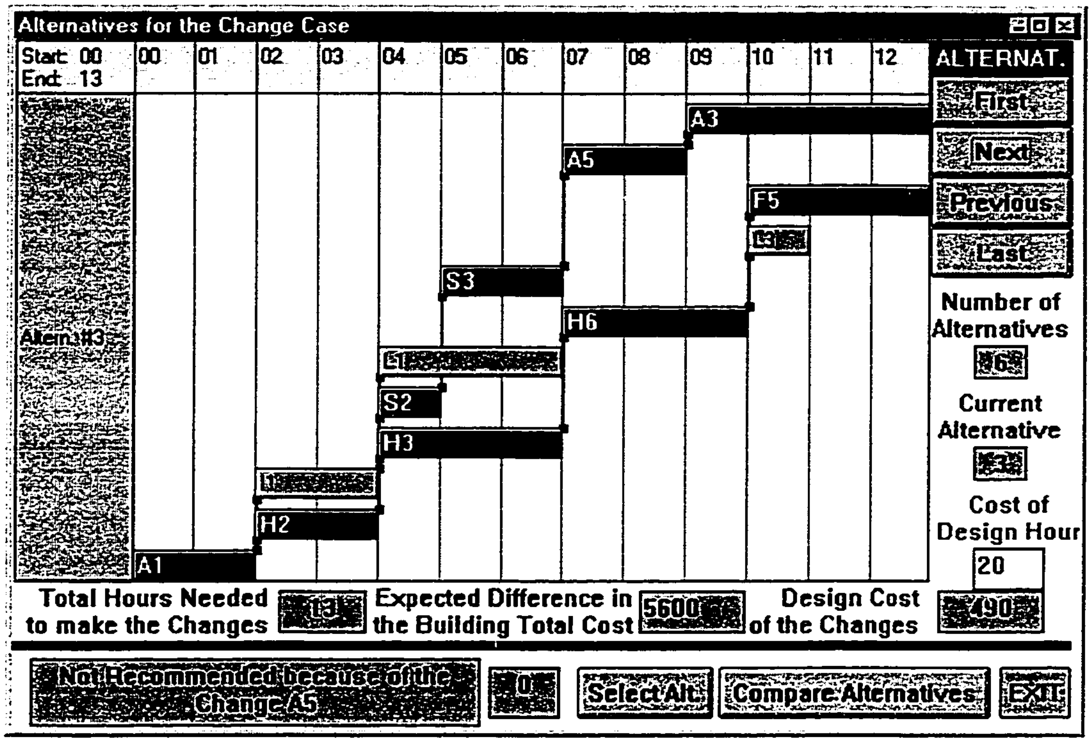


Figure 6-20 Bar chart and data for alternate change-path (3) for the scenario in Figure 6-17

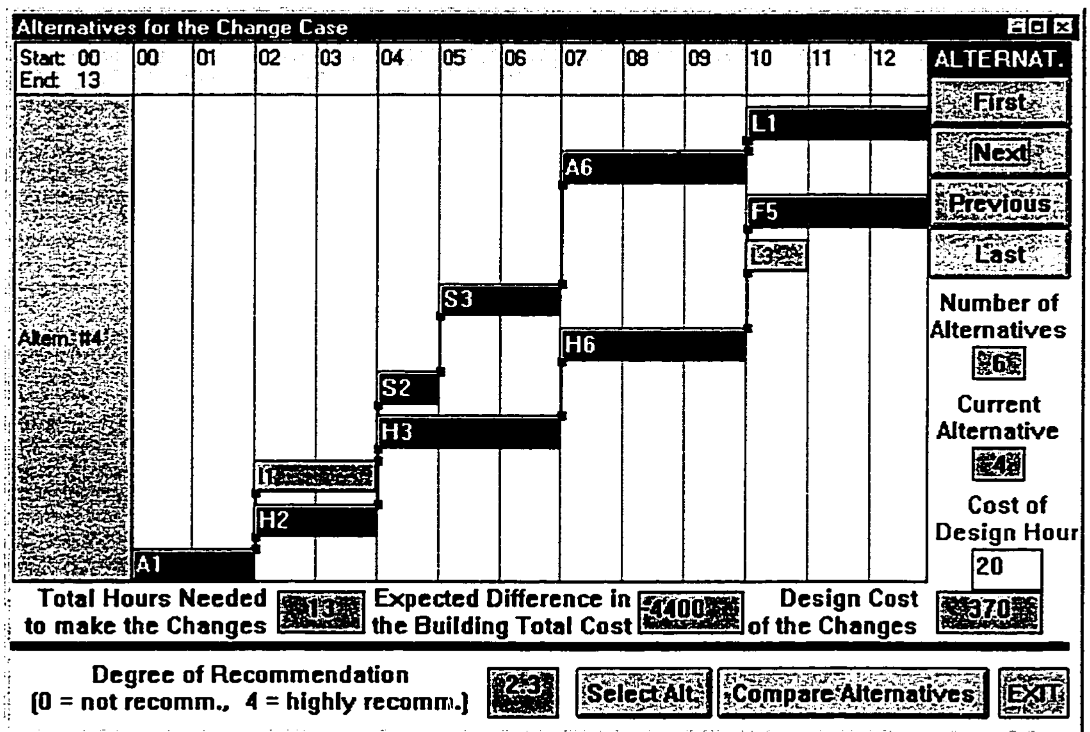


Figure 6-21 Bar chart and data for alternate change-path (4) for the scenario in Figure 6-17

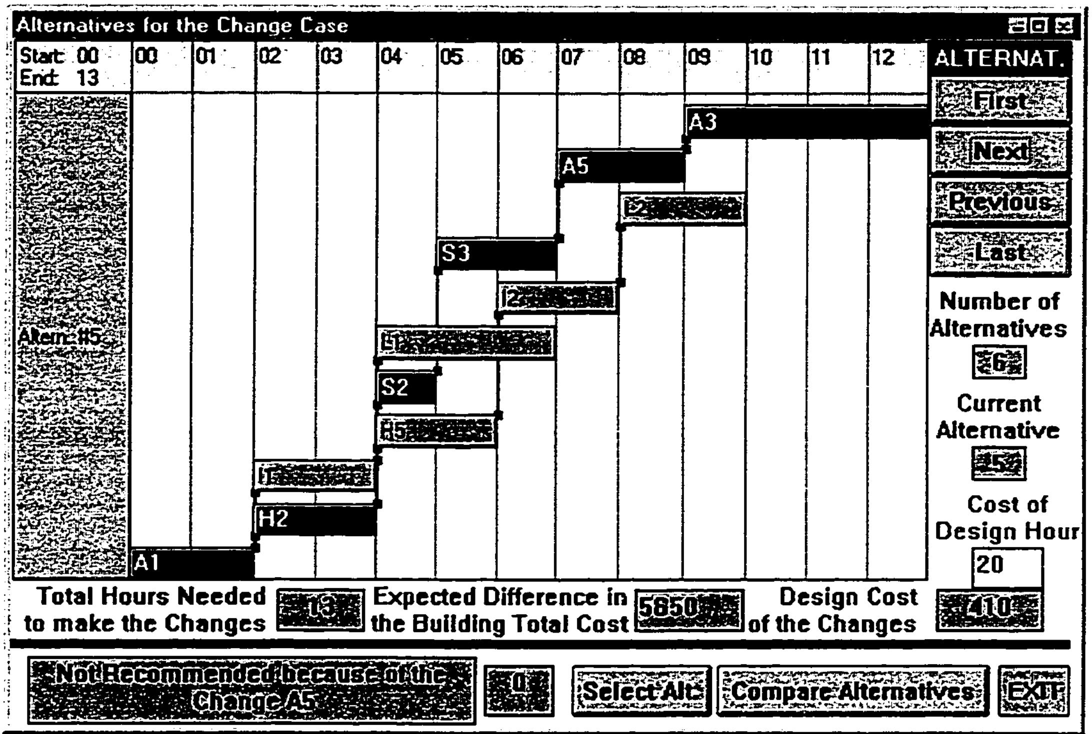


Figure 6-22 Bar chart and data for alternate change-path (5) for the scenario in Figure 6-17

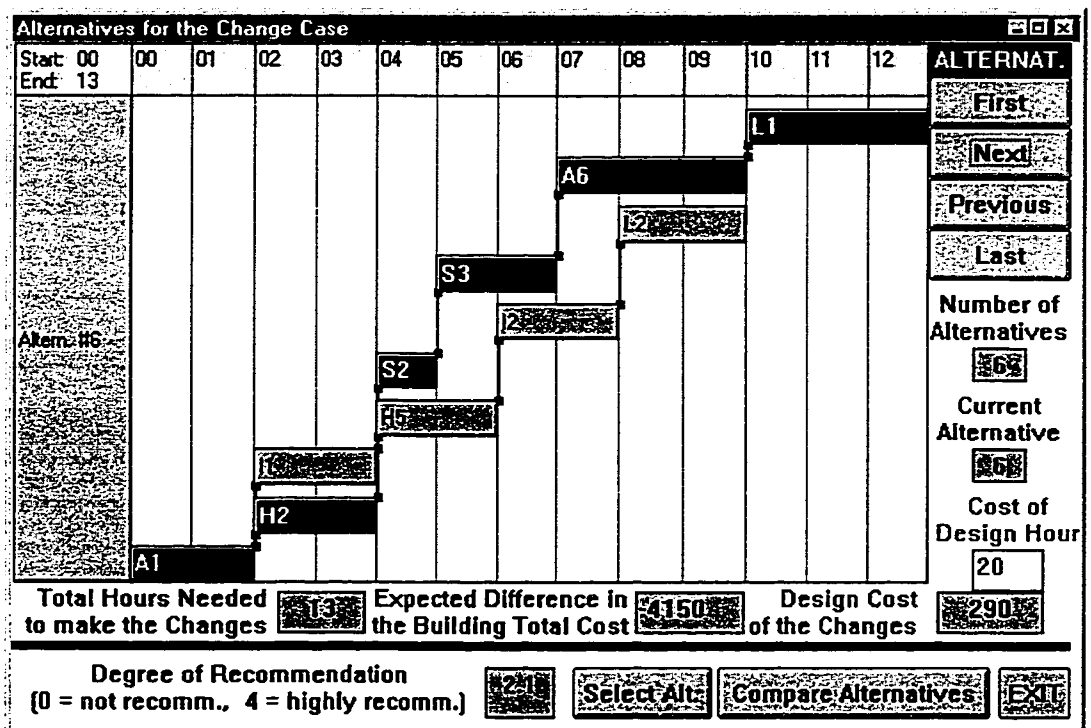


Figure 6-23 Bar chart and data for alternate change-path (6) for the scenario in Figure 6-17

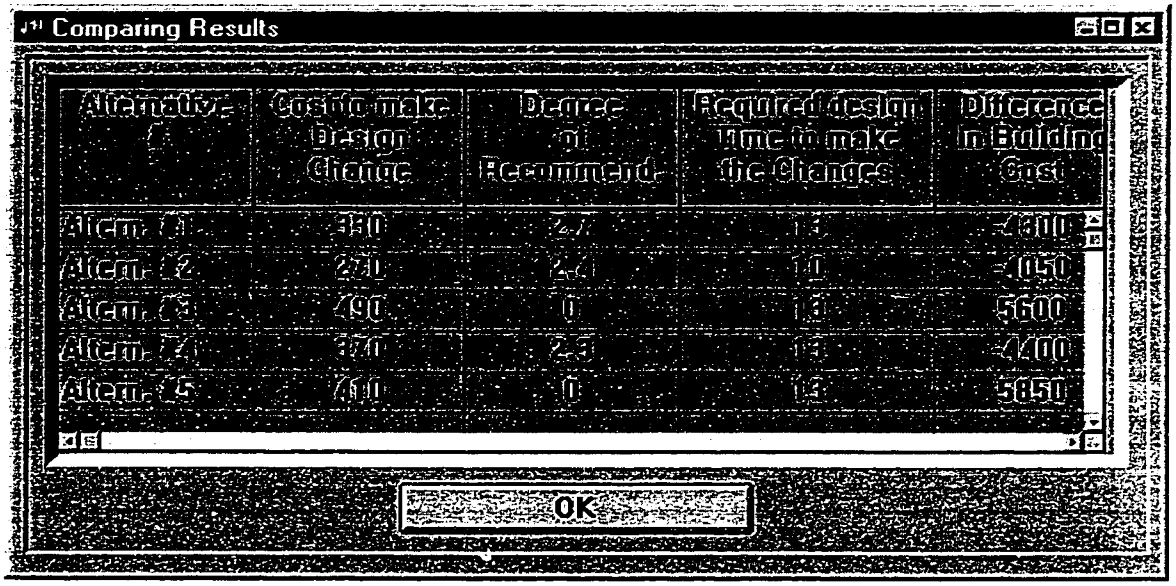


Figure 6-24 Comparison among various alternate change-paths for the scenario in Figure 6-17

6.3.4 THIRD LEVEL OF VALIDATION

The third level is to validate that the model provides a better tool over current practice and help in solving the problem of design changes in a multi-disciplinary team. The validation is performed through using a real case study that is selected from literature (Fazio 1990). The case study exhibits a real situation where incompatibility in design information led to unexpected cost overruns of 2 million dollars in a 122m (400') tall office building in a Canadian city. The building is designed using a column-and-beam steel structure system with reinforced concrete core and slabs. Figure 6-25 shows a plan view of a steel column with surrounding building components. The building envelope consists of metal air pans (component F in Figure 6-25) that are connected to the steel structure by metal clip angles (H). The function of the metal pans is to prevent airflow through the envelope. The external layer of the envelope consists of precast concrete panels (A) that are one story in height, spanning between the steel columns (B). The panels are supported on brackets that are connected to the steel beams. The windows (D) are supported by aluminum angles that are bolted to the concrete panels. Tracks that guide the window washing equipment are embedded on the exterior face of the precast panels and require *strict* vertical alignment of the precast panels. The columns are covered with sprayed-on fireproofing (C) and are encased by 13mm (1/2") gypsum board on metal studs (E). The induction units (G) of the HVAC system span between the gypsum board encasements of adjacent exterior columns.

Three independent design disciplines, architecture, structural, and mechanical engineering are involved in the design of the building components that appear in Figure 6-25. However, the design of these components is inter-dependent. The architect designs the precast concrete panels, the gypsum board encasement, the metal pan and clip angles. The design objective of the architect is to get maximum utilization of internal space and maximum window area. To do so, he runs the window up to the encasement and keeps the width of the encasement to a minimum. The vertical component of the precast concrete panel (A) is designed to have the same width as the gypsum board encasement (E) so that encasement does not overlap with the windows. Both of these widths, however, should cover the width of the column flange (B), the thickness of the fire proofing (C) and take into consideration the construction tolerance of the column. The spacing between the clip angles (H) needs to be as wide as possible to reduce the surface area of the metal pan (F) and consequently its cost. Yet, the design of this spacing should take into consideration the width of the column flange and the construction tolerance of the column. The width of the metal pan is defined so that the gypsum board encasement can be fixed to it. The following data is collected and used by the architect to design the building components under his responsibility:

- The width of the steel column flange is 356mm (14").
- The maximum construction tolerance for the steel column is 13mm (0.5").
- The thickness of the sprayed fireproofing is 13mm (0.5").

The structural engineer designs the steel column (B) and later specifies its construction tolerance according to the code. The local code allows a maximum of 127mm (5") for construction tolerance at the top of the building. This indicates a clear conflict with the same data element as used by the architect and may push the column outside the encasement. The error can be attributed to either oversight by the architect or poor communication. The structural engineer also specifies the type and the thickness of the fire proofing (C) for the column. A thickness of 13mm (0.5") is found to be inadequate and is later modified to 36mm (1 7/16"), consequently invalidating the value used by the architect for the same data element. The HVAC engineer designs the induction unit (G) to fit between two adjacent column encasements in accordance with the width of the encasement as given by the architect.

During construction, problems start to appear. The first problem is the connection between the welded clip angles (H) and the column flange. The strict vertical alignment of the angles conflicts with the construction tolerance of the columns. At high stories, one side of the angles would fall off the flange. The connection is redesigned and a change order is issued to use C-shape (component J in Figure 6-26) instead of the clip angles. The gypsum board encasement as designed does not cover the column and the sprayed fireproofing. A change order is issued to make the encasement wider. However, the metal pan is not wide enough for fixing the encasement. The issued change order requires the use of Z-clips (M) to support gypsum boards. The extra width of the encasement makes it impossible to fit the induction units in their place. Because these units are already delivered to site, a change order is issued to trim their length. These series of change orders also result in several construction delays. The contractors make a claim of $6 millions for cost overruns due to conflicts in design. The case is eventually settled out of court for $2 millions.

The proposed information model is used for this design case to examine the model ability to overcome such design incompatibility errors as described. The first step in using the model is to assemble the data-structure of the building components using the configuration module. The ability of the model to flexibly adapt to any design configuration makes it possible for the design manager to develop such an assembly. Prebuilt and dynamically built rules are then used to capture the linking knowledge among the involved disciplines. The following knowledge is captured using prebuilt rules:

- The architect uses construction tolerance of the column as an input data to design the connection of the envelope to the structure and to size the encasement of the column (Figure 6-27).

The following knowledge is captured using dynamically built rules:

- The architect sizes the width of the gypsum board column encasement (E) to be the same as the width of the precast concrete panel (A) and based on the following data:
    - A width of 356mm (14") for the flange of the steel column.
    - A thickness of 13mm (0.5") for the sprayed fireproof (Figure 6-28).

- The HVAC engineer sizes the length of the induction unit (G) based on the width of the gypsum board encasement and the column spacing.

The design changes that occurred in the case study are then performed in the model. The structural engineer increases the thickness of the fire proofing from a value of 13mm (0.5") to an adequate value of 36mm (1 7/16"). Consequently, two messages are automatically sent to the architect informing him about the change. The first message (Figure 6-29) shows that the change affects the width of the gypsum board encasement and the second message shows that the change affects the width of the precast concrete panel (A). Accordingly, the architect increases the width of these two components along with the width of the metal pan (F) to enable fixing of the gypsum board encasement. However, as soon as the architect changes the width of the gypsum board encasement, a message is sent automatically to the HVAC engineer informing about the change and indicating that the length of the induction unit (G) is affected. Similarly, when the structural engineer specifies the value of the construction tolerance for the steel columns, a message is automatically sent to the architect. The message shows the correct value of the tolerance, informing that this value affects the design of the connection between the envelope and the structure and also the width of the encasement. The architect then uses the correct tolerance value and redesigns the connection using C-shape instead of the clip angles. He also resizes the width of both the encasement and the metal pan to accommodate the expected construction tolerance. Another message is then sent to the HVAC engineer automatically informing him about the new width of the encasement and indicating that the length of the induction unit (G) is affected. The HVAC engineer then corrects the length of this unit.

This case study demonstrates how small elements of data can easily be missed in current design practice. These result in incompatibilities in design information and lead to change orders and unnecessary increase in the building cost and project duration. Using the model, design changes are accommodated before starting building construction. The success of the model largely depends on the linking knowledge that is captured from designers. However, the model provides the design team with the ability to record and make use of this knowledge. In current practice, such knowledge is scattered around, unused and/or completely wasted throughout the design process. The case study proves that the use of the model provides a better tool for designers in multi-disciplinary design environment to accommodate design changes. Consequently, the related problems that appear during construction are avoided.

6.4 SUMMARY AND CONCLUSIONS

The model is validated through three levels of validation. Hypothetical design scenarios ensured that the model as it is developed and implemented can provide the expected capabilities in managing design changes. A real case study proved that the model can improve the current design practices and help building design professionals eliminate problems related to incompatibility in design information.

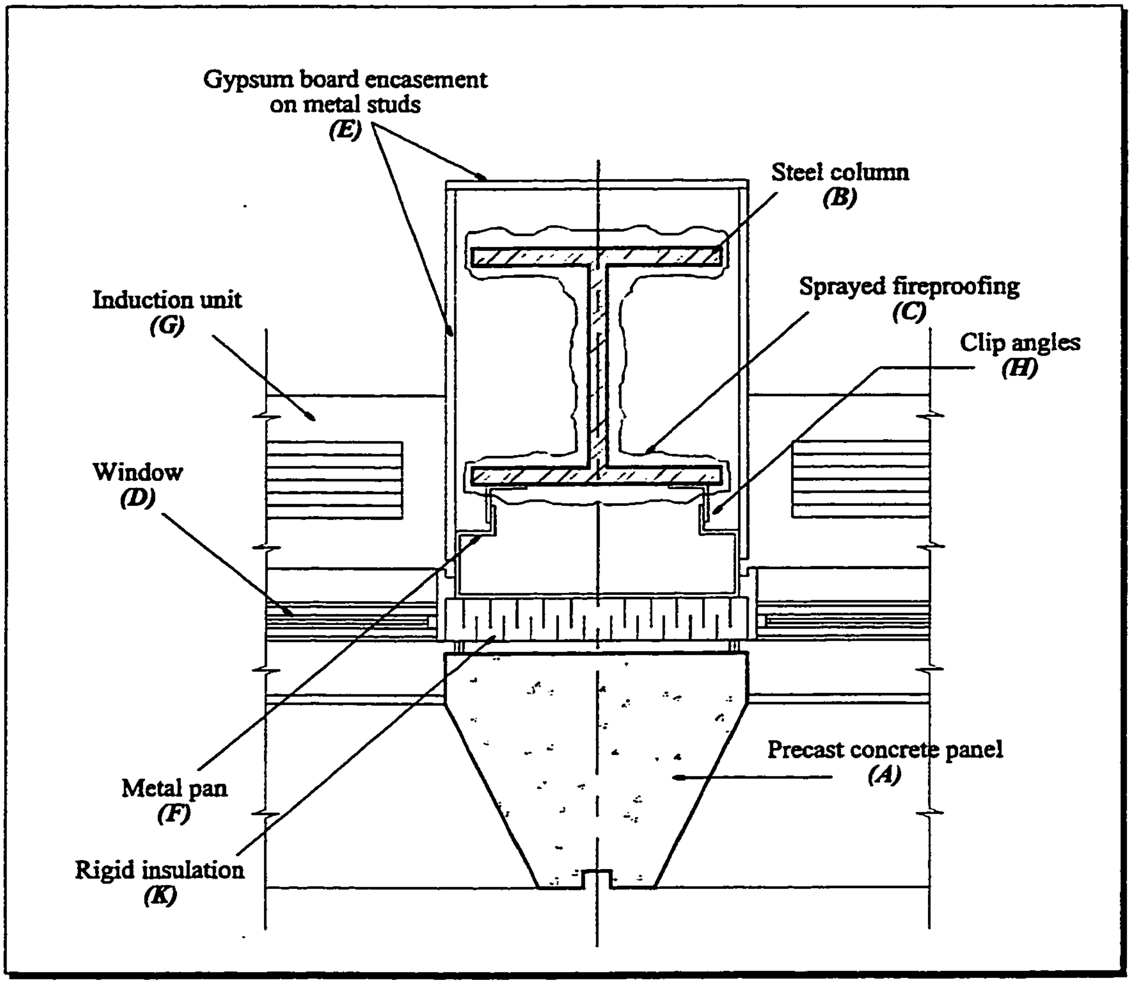


Figure 6-25 Plan view of an exterior column and the surrounding components as designed (Fazio 1990 reproduced)

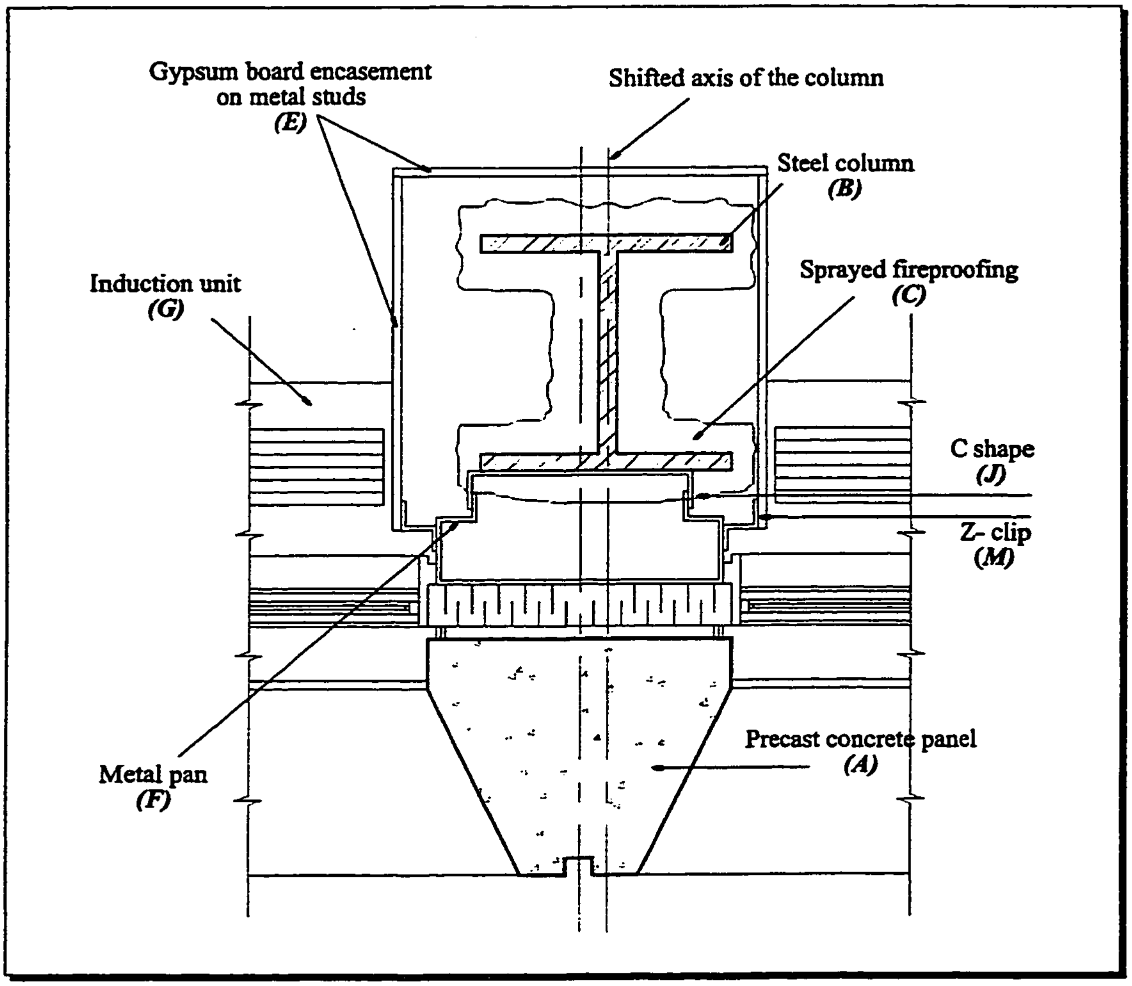


Figure 6-26 Plan view of the exterior column and the surrounding components as constructed (Fazio 1990 reproduced)

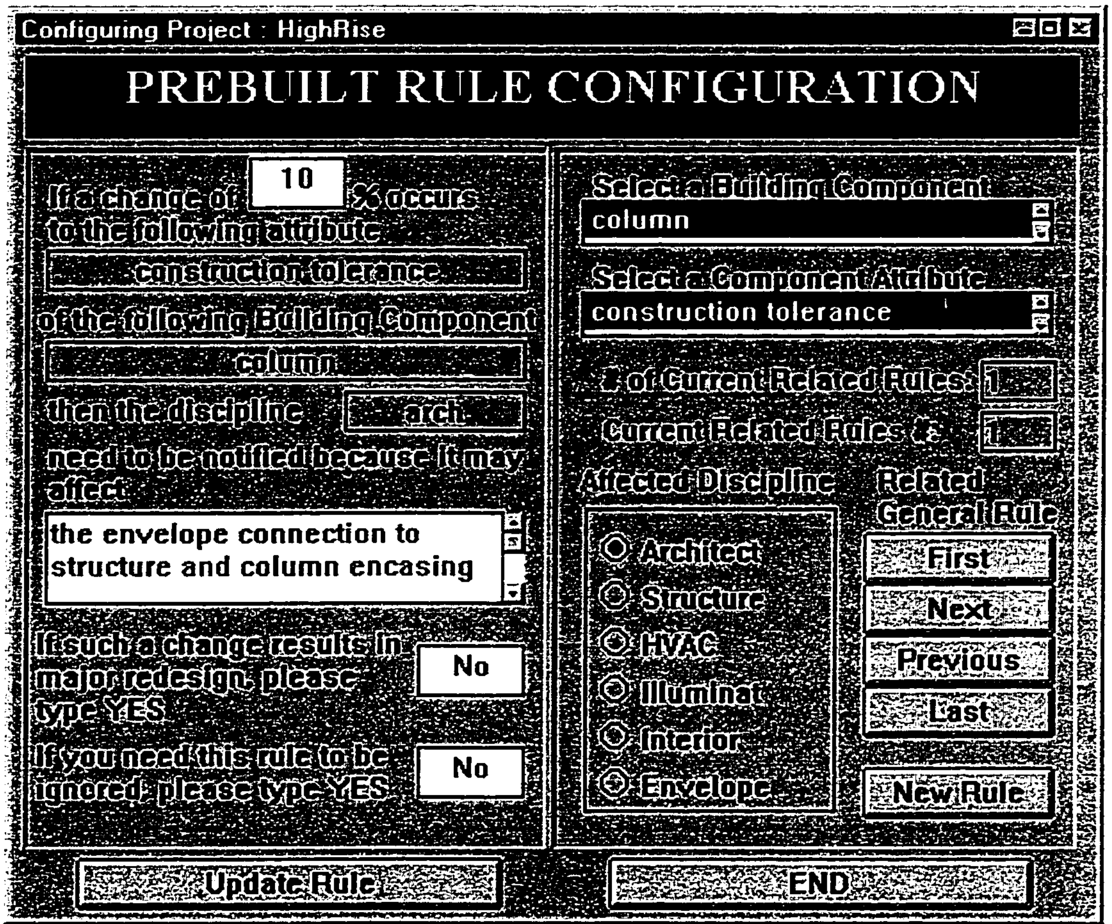


Figure 6-27 Prebuilt rule to capture link between construction tolerance and design of envelope and encasement.

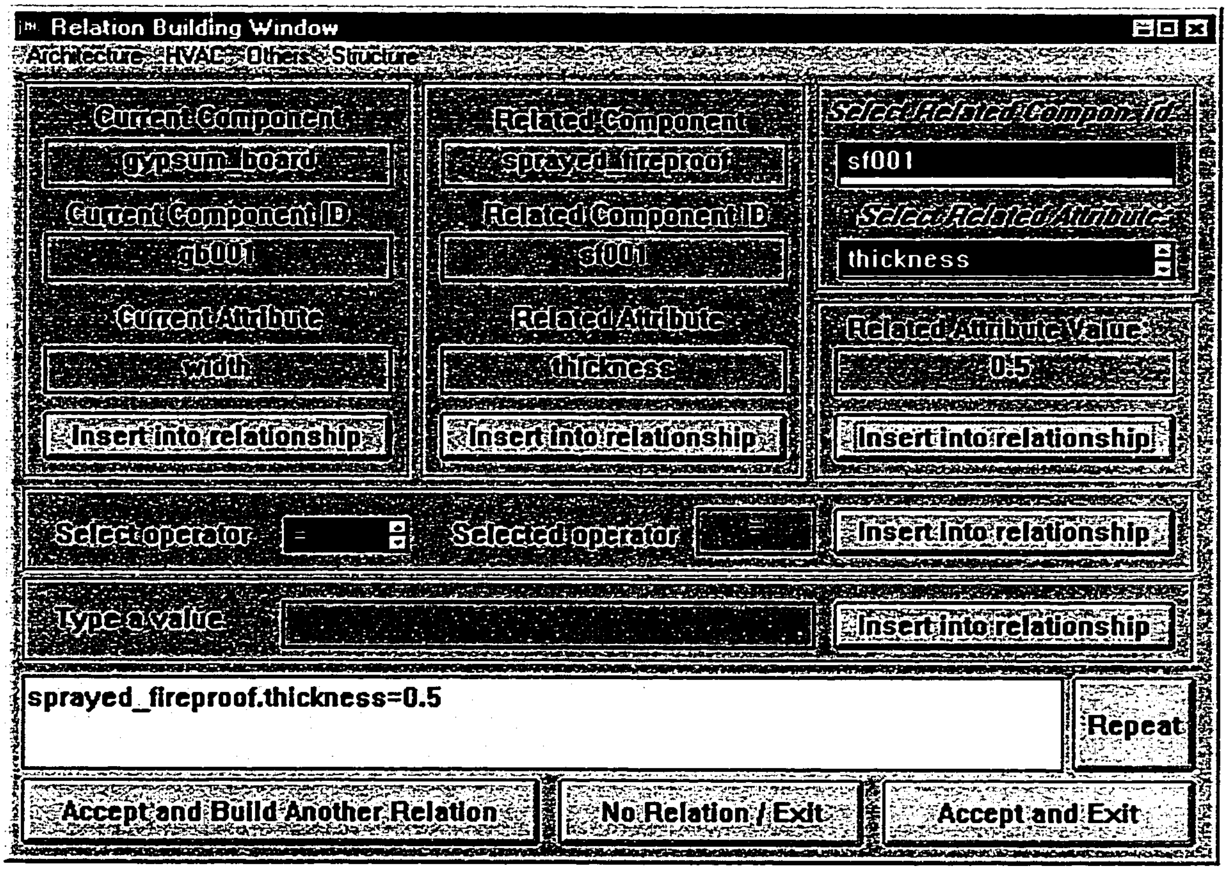


Figure 6-28 Dynamically built rule to capture link between width of the gypsum board encasement and fireproofing thickness[1].

[1] Units in Figure 6-28 and Figure 6-29 are in Inches.

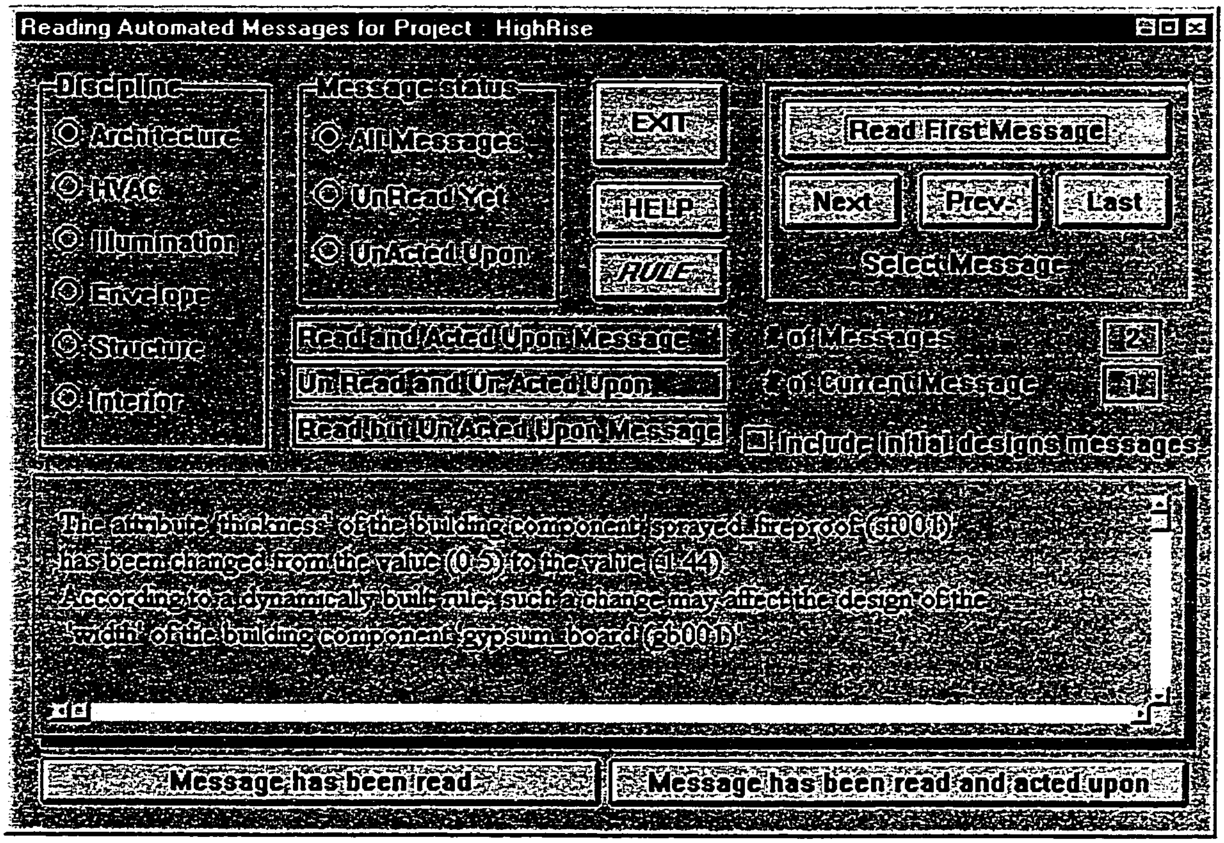


Figure 6-29 Automated message to inform architect about change in thickness of fireproofing.

CHAPTER SEVEN

SUMMARY, CONTRIBUTIONS, AND RECOMMENDATIONS

7.1 SUMMARY

Incompatibilities in construction technical documents represent a major problem for the construction industry. An analysis of the production process of these documents during the detailed design stage reveals that managing design changes is a main cause for incompatibilities. More specifically, propagation of design changes is a principal source of problems. The large amount of data that is generated within a multi-disciplinary design environment makes this task very complex, especially when considering the fact that the involved design disciplines are, in most cases, separated both spatially and educationally.

This thesis presents the development of a model that uses information technology to address the problem. The core concept of the model is a central database that functions as a repository of active building components. Each building component in this database not only carries its design data, but is also capable of recognizing the design disciplines that are affected by any change in these data and automatically send them messages. As such, the complex task of propagating design changes is assigned to the building components themselves. The components efficiently perform the task regardless of the amount of data or the number of disciplines involved in a project. Notification messages are automatically sent by any building component to only affected design disciplines as soon as a design change is made to any attribute of the building components. The messages clearly describe the design changes and advise each design discipline on how the change may influence its building system. An appropriate reaction is left to the designer who is now well informed. The active building components are able to perform this task because they are equipped with the necessary linking knowledge. The linking knowledge is acquired from the designers and is implemented in the form of rules.

The central database is composed of two parts. The first is the building-components-database which carries the active building components data. The second part is the management-database which carries data that is necessary for the various functions of the model. The concept of management-database allows the building-components-database to adapt easily to any building configuration, an essential requirement because buildings are unique products. The utilization of combined Object-Oriented and Relational Database technologies enables the model to achieve this flexibility.

The developed information model is also equipped with the capability to track past design changes. It can answer the requests of design managers to track past design changes in a variety of ways. It can also show the automated messages that are sent by a building component to each affected discipline as a reaction to a design change. The response of the informed discipline to each of these messages can also be tracked.

The model is also developed to facilitate the planning and scheduling of future design changes. A methodology is incorporated within the model and uses its active components to collect future design change data. This data is organized using especially developed sub-routines, then scheduled and manipulated with some calculations that provide the design manager with a clear view on how to conduct a future design change.

The information model is successfully implemented in a client/server setup. It is subjected to three levels of validation. The validation process ensured not only that the model provides the capabilities that are expected from its development but also that the model is a better tool over current practices for managing design changes in a collaborative multi-disciplinary design environment.

7.2 CONTRIBUTIONS

Aiming to improve the quality of buildings, the contributions of this research towards eliminating the serious problems associated with incompatibility errors in construction technical documents can be summarized as follows:

- A thorough analysis of the production process of construction technical documents with an emphasis on the techniques for coordinating design information so as to accommodate design changes. The analysis diagnoses the main problems that cause incompatibilities in design information. These problems are the management of design changes, the media used to communicate design information, and the source of final documents.

- Review of research work in the area of using computer technology in collaborative design. The review includes an analysis of approaches used in these researches so as to evaluate their capabilities and limitations to eliminate incompatibilities in design information.

- Development of an information model that establishes the theoretical basis for a computer-aided collaborative multi-disciplinary design environment that facilitates the management of design changes. The model provides remedy for problems with current production processes of construction technical documents and helps ensure the compatibility of design information scattered among these documents. The model, being the first of its kind, not only helps accommodating design changes but also tracks past design changes and helps planning and scheduling of future ones as well. In addition, the model has the flexibility to include any configuration of different building components along with the knowledge that connect them. Hence, it is able to function with any type of building. The model, however, does not cover all the information needed for the design of a building such as codes and design constraints. The model is also intended for sequential type of project delivery systems. It is not intended for other types of delivery systems such as fast track system. Designers who will use the model are expected to collaborate using client-server networks and therefore they should be located in the same building or nearby buildings. Other types of networks such as wide area networks, intranets, or internet are beyond the scope of this model.

- Development and implementation of the concept of active building components. Such a concept enables the management of design changes by assigning the task of propagating design changes to the building components that are subject to change rather than the designers who perform these changes. The building components are made active by capturing the necessary linking knowledge from the designers. A process is developed and implemented to capture this knowledge in terms of prebuilt and dynamically built rules. The active components, however, do not use a knowledge-based system and therefore no induction is performed by the components.

- Development and implementation of the concept of management database. Such database manages the data-structure of the building-components-database, which carries the design data, and allows it to be customizable to fit any type of building. The management database also keeps track of all design changes as well as the messages that are automatically sent to the designers due to these changes. In addition, it carries the data necessary to plan and schedule future design changes.

- Development and implementation of the concept of planning and scheduling future design changes. To realize this concept, a methodology has been outlined to utilize the capabilities of active building components in collecting design change data from designers so as to enable the planning of extended design changes. Subroutines have been created to translate the collected data into organized design change paths that show the design manager all the possible paths to perform a design change. It also shows the time needed, the design cost, the impact on building cost, and the recommendation level for each of these change paths.

- Validation of the developed model not only through hypothetical scenario but also with a real design case. The hypothetical scenario proves that the model provides the capabilities that are expected from its development while the real design case shows that the model improves the current design practices, which is the ultimate objective of developing the model.

7.3 RECOMMENDATIONS FOR FUTURE WORK

Due to the fast technological development in this field of research, many new avenues can be explored to apply and evolve the concepts that are presented in this thesis. At the time of writing these recommendations, we can see potential developments as follows:

- Explore the use of the internet as the carrier of the central project-database and as the medium for automated messages propagation.
- Develop multimedia messages that provide clearer contents with more information.
- Apply the standards of IFCs (IAI·1996) and STEP (Froese 1996) for the structure of the building-components-database.

Some complementary components of the information model have not been developed in this research due to resource limitations. Other researchers can work on these developments as:

- The construction technical documents generation module. This module is responsible for generating, from the project-database, the documents that are used by the contractors to construct the building. The module needs to have the following features:

1. Document formats and classifications need not to be based on disciplines any longer e.g., architectural drawings and structural drawings. Some documents could be prepared on the basis of the requirements of the contractors and the subcontractors so as to make their job easier and with fewer errors (see Mokhtar and Bédard 1994).
2. The output medium for construction technical documents needs not to be paper anymore; it can be a laptop connected through a wireless modem to the central database that lies on the internet.

- A drafting interface that facilitates the manipulation of graphical data.
- A mechanism to control the access to the project-database by various users.

More development for some of the model main components is also recommended. The following is advocated:

- More sophisticated relation-acquisition capability that can acquire and incorporate design rationale.
- Automated control of the design changes after an alternative is chosen through the planning and scheduling capability of the model.
- Connect the results of the planning and scheduling to a project management software such as Primavera (1996).

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APPENDIX A
DATABASE STRUCTURE IN MS ACCESS

A.1 MANAGEMENT-DATABASE

A.1.1 CONCEPTUAL DATA-STRUCTURE

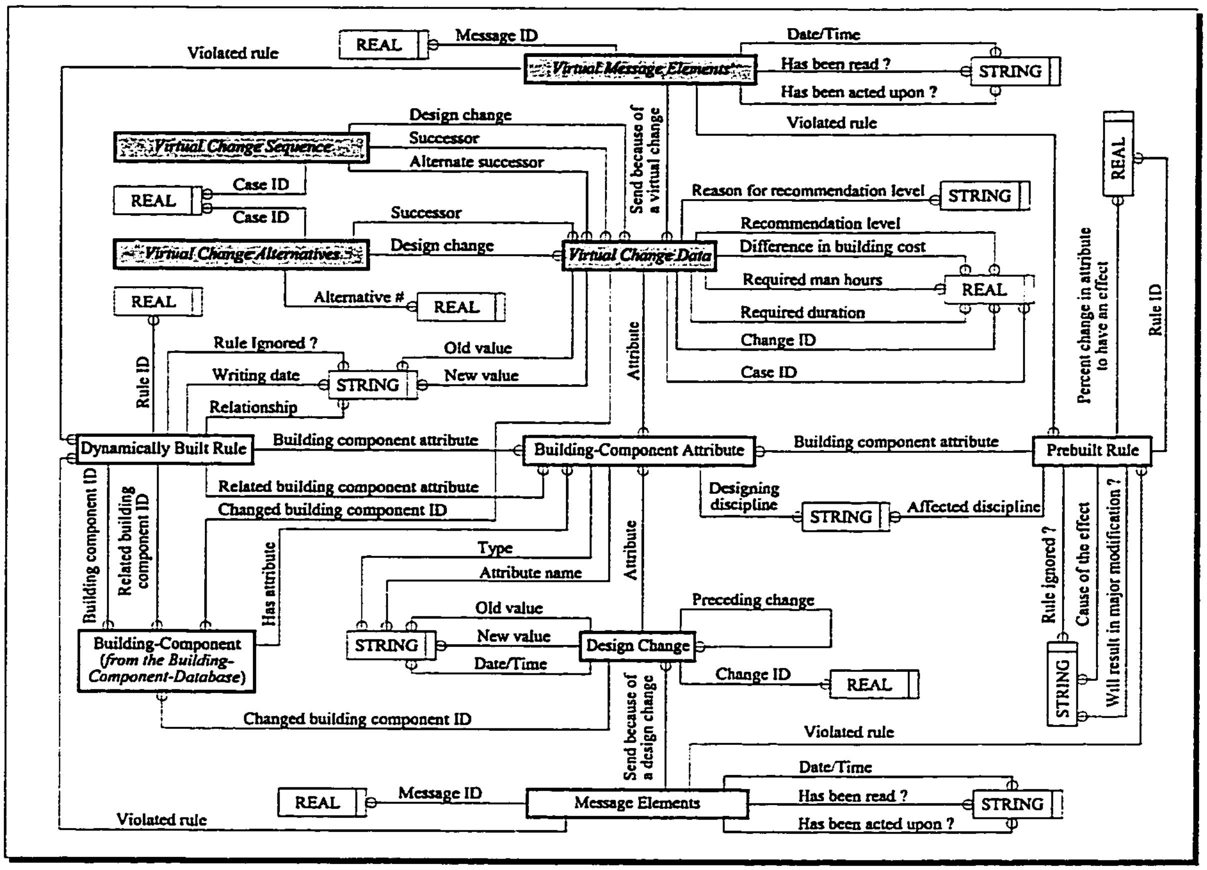

Figure A-1 Conceptual data-structure for management-database presented in EXPRESS-G.

A.1.2 STRUCTURE OF DATA-TABLES

Data-Table A-1 MNG-BUILDING-COMPONENTS-ATTRIBUTES
ID
BUILDING_COMPONENT
ATTRIBUTE_OF_BUILDING_COMPONENT
ATTRIBUTE_TYPE
DESIGNING_DISCIPLINE
LINKED_BUILDING_COMPONENT
LINKED_ATTRIBUTE_OF_BUILDING_COMPONENT
GRAPH_NAME

Data-Table A-2 MNG-MENU-CONFIGURATION
ID
LABEL
MAIN_MENU_LABEL

Data-Table A-3 MNG-PREBUILT-RULES
PREBUILT_RULE_ID
BUILDING_COMPONENT
ATTRIBUTE_OF_BUILDING_COMPONENT
AFFECTED_DISCIPLINE
PERCENT_CHANGE_TO_HAVE_AN_EFFECT
RESULT_IN_MAJOR_MODIFICATION_?
RULE_IGNORED_?
CAUSE_OF_THE_EFFECT

Data-Table A-4 MNG-DYNAMICALLY-BUILT-RULES
DYNAMICALLY_BUILT_RULES_ID
BUILDING_COMPONENT
BUILDING_COMPONENT_ID
ATTRIBUTE_OF_BUILDING_COMPONENT
RELATED_BUILDING_COMPONENT
RELATED_BUILDING_COMPONENT_ID
RELATED_ATTRIBUTE
RELATIONSHIP
WRITING_DATE
RULE_IGNORED_?

Data Table A-5 MNG-DESIGN-CHANGES
CHANGE_ID
DATE_TIME
DISCIPLINE
BUILDING_COMPONENT
BUILDING_COMPONENT_ID
ATTRIBUTE
OLD_VALUE
NEW_VALUE
PRECEEDING_CHANGE_ID

Data Table A-6 MNG-VIRTUAL-CHANGE
ID
CASE_ID
CHANGE
BUILDING_COMPONENT
BUILDING_COMPONENT_ID
ATTRIBUTE
REQUIRED_MAN_HOURS
DIFFERENCE_IN_BUILD_COST
RECOMMENDATION_LEVEL
REASON_FOR_RECOMMENDATION
DURATION
OLD_VALUE
NEW_VALUE

Data Table A-7 MNG-MESSAGE-ELEMENTS
ID
CHANGED_ATTRIBUTE
CHANGED_BUILDING_COMPONENT
CHANGED_BUILDING_COMPONENT_ID
OLD_VALUE
NEW_VALUE
AFFECTED_ATTRIBUTE
AFFECTED_BUILDING_COMPONENT
AFFECTED_BUILDING_COMPONENT_ID
RELATIONSHIP
WRITING_DATE
BEEN_READ_?
BEEN_ACTED_UPON_?
DISCIPLINE_TO
DISCIPLINE_FROM
SENT_BECAUSE_CHANGE_ID
PREBUILT_OR_DYNAMICALLY_?
RULE_WRITING_DATE
VIOLATED_RULE_ID
RULE_IGNORED_?
CAUSE_OF_THE_EFFECT

Data Table A-8 MNG-VIRTUAL-MESSAGE-ELEMENTS
ID
CHANGED_ATTRIBUTE
CHANGED_BUILDING_COMPONENT
CHANGED_BUILDING_COMPONENT_ID
OLD_VALUE
NEW_VALUE
AFFECTED_ATTRIBUTE
AFFECTED_BUILDING_COMPONENT
AFFECTED_BUILDING_COMPONENT_ID
RELATIONSHIP
WRITING_DATE
BEEN_READ_?
BEEN_ACTED_UPON_?
DISCIPLINE_TO
DISCIPLINE_FROM
SENT_BECAUSE_CHANGE_ID
PREBUILT_OR_DYNAMICALLY_?
RULE_WRITING_DATE
VIOLATED_RULE_ID
CASE_ID
CAUSE_OF_THE_EFFECT

Data-Table A-9 MNG-VIRTUAL-CHANGE-SEQUENCE
ID_NUMBER
CASE_ID
DESIGN_CHANGE
SUCCESSOR
ALTERNATE_SUCCESSOR

Data-Table A-10 MNG-VIRTUAL-CHANGE-ALTERNATIVES
ID
DESIGN_CHANGE
SUCCESSOR
ALTERNATIVE#
CASE_ID

A.2 GENERAL-DATABASE

A.2.1 CONCEPTUAL DATA-STRUCTURE

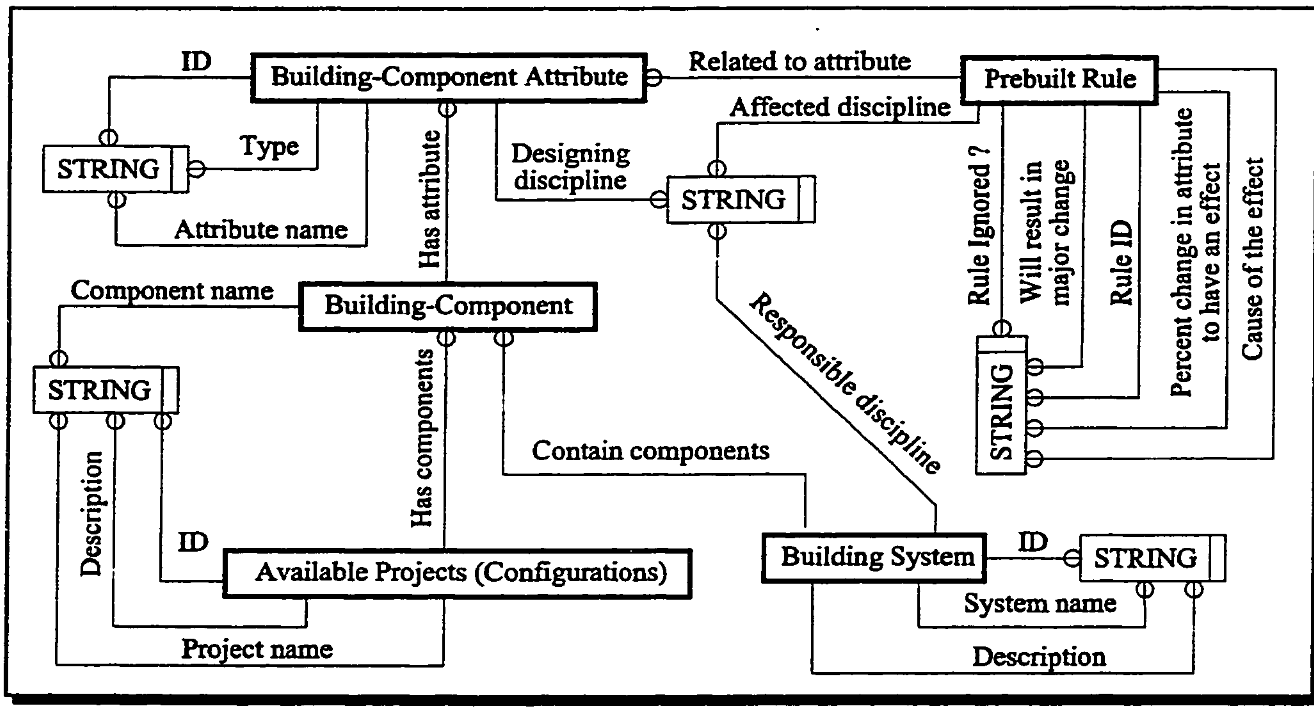

Figure A-2 Conceptual data-structure for general-database presented in EXPRESS-G.

A.2.2 STRUCTURE OF DATA-TABLES

Data-Table A-11 GNL-BUILDING-COMPONENTS-ATTRIBUTES.
ID
BUILDING_COMPONENT
ATTRIBUTE_OF_BUILDING_COMPONENT
ATTRIBUTE_TYPE
DESIGNING_DISCIPLINE
LINKED_BUILDING_COMPONENT
LINKED_ATTRIBUTE_OF_BUILDING_COMPONENT
GRAPH_NAME

Data-Table A-12 GNL-PREBUILT-RULES.
PREBUILT_RULE_ID
BUILDING_COMPONENT
ATTRIBUTE_OF_BUILDING_COMPONENT
AFFECTED_DISCIPLINE
PERCENT_CHANGE_TO_HAVE_AN_EFFECT
RESULT_IN_MAJOR_MODIFICATION_?
RULE_IGNORED_?
CAUSE_OF_THE_EFFECT

Data-Table A-13 GNL-BUILDING-SYSTEMS.
ID
BUILDING_SYSTEM
DESCRIPTION
DISCIPLINE

Data-Table A-14 GNL-COMPONENTS-OF-BUILDING-SYSTEM.
ID
BUILDING_SYSTEM
BUILDING_COMPONENT

Data-Table A-15 GNL-CURRENT-PROJECTS.
ID
PROJECT_NAME
DESCRIPTION

APPENDIX B
SUBROUTINES FOR PLANNING AND SCHEDULING DESIGN CHANGES

B.1 SUBROUTINE TO GENERATE THE VARIOUS CHANGE-PATHS.

B.1.1 INITIALIZATIONS

Sub1-A. Connect to Data-Table 5-6 (page 111) and Data-Table 5-8 (page 113) of the related project-database.

Sub1-B. Limit the reading of the data from Data-Table 5-6 to the rows that have the specified value for the attribute "CASE_ID" (i.e. CASE_ID = 2).

Sub1-C. Create two lists for "Processed design changes" and "Under processing design changes".

B.1.2 GENERATE THE FIRST CHANGE-PATH

Sub1-D. Query Data-Table 5-6 (page 111) for the data row that have the value "NULL" in the attribute "DESIGN_CHANGE" and read the value of the attribute "SUCCESSOR" in the found row. This value is the initial design change that has been defined when a designer starts a new case (i.e. A1 in Figure 5-15 on page 111). Add this design change (i.e. A1) to both the list of "Processed design changes" and the list of "Under processing design changes".

Sub1-E. Save this data in Data-Table 5-8 (page 113) with the attribute "ALTERNATIVE#" given the value "ALTERNATIVE#1". The value for the attribute "ID" is automatically generated in the database. Sample for the saved data is in the row with ID = 4734 in Figure 5-17 (page 113).

For each design change in the list of "Under processing design changes", perform steps Sub1-F to Sub1-H:

Sub1-F. Query from Data-Table 5-6 (page 111) all the data rows which have the value of the attribute "DESIGN_CHANGE" equals the under processing design change (i.e. A1). Read the corresponding values in the attribute "SUCCESSOR" (i.e. H1, L1, I1 in Figure 5-15 on page 111).

Sub1-G. Save the data in Data-Table 5-8 (page 113) for each read successor similar to the saving process in step Sub1-E. Samples are rows with ID = 4735, 4736, 4737 in Figure 5-17 on page 113.

Sub1-H. For each read successor in Sub1-F, check if the successor exists in the list of "Processed design changes".

- If it exists then ignore it.
- If it does not exist then add it to the list of "Processed design changes" and the list of "Under processing design changes". Figure B-1 shows the result of applying steps Sub1-D till Sub1-H on the example given in Figure 5-10 on page 105.

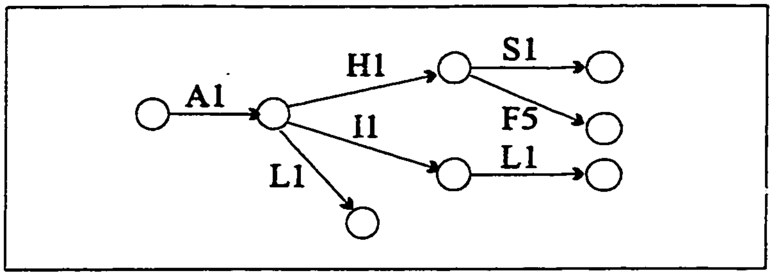

Figure B-1 Result of applying steps Sub1-D till Sub1-H on example given in Figure 5-10.

B.1.3 GENERATE THE OTHER CHANGE-PATHS

Sub1-I. Read sequentially the design changes in the last generated change-path starting from the end design changes (i.e. F5, S1, or L1 in Figure B-1) to the first design change.

Sub1-J. For each design change that is read, check using Data-Table 5-6 (page 111) if the design change has an alternate successor.

- If it does not have an alternate successor (i.e. S1) then ignore this design change.
- If it has one but the last generated change-path uses the value of the alternate successor then ignore this design change
- If it has an alternate successor (i.e. A1) and the last generated change-path uses the value of the successor, then repeat steps Sub1-D to Sub1-H to generate the next change-path with the use of the "ALTERNATE_ SUCCESSOR" for this change (i.e. H2 in Figure 5-15 on page 111) instead of the "SUCCESSOR".

In case that the second option is the valid one, the value of the

"SUCCESSOR" - not the "ALTERNATE_SUCCESSOR" - is used the next time this design change passes through steps Sub1-D to Sub1-H. Figure B-2 shows the result of applying steps Sub1-I and Sub1-J on the example given in Figure 5-10 on page 105.

Repeat step Sub1-I and Sub1-J till all the possible change-paths are generated as shown in Figure 5-17 (page 113). Figure B-4 shows a flowchart for the subroutine.

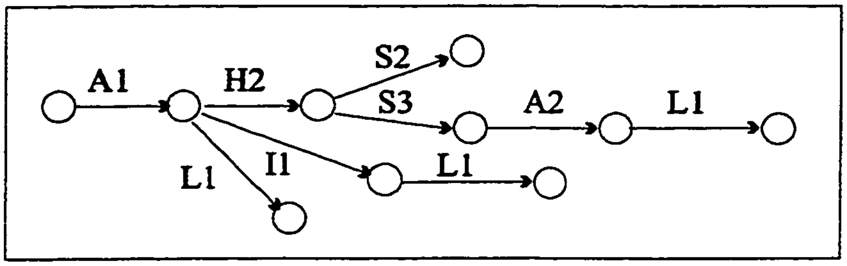

Figure B-2 Result of applying steps Sub1-I and Sub1-J on example given in Figure 5-10.

B.2 SUBROUTINE TO GENERATE THE LOGICAL SEQUENCE OF DESIGN CHANGES.

The logic for developing this subroutine is based on providing a start node value and an end node value for each of the design changes in a certain change-path (Figure 5-18 on page 114). This is to satisfy the requirement for using a CPM algorithm that can schedule the design changes. The following rules apply when defining the values for the start node and the end node:

- The value of the start node of a design change is always less than the value of its end node.
- The value of the start node of a successor to a design change is the same value of the

end node of the design change.

- More than one design change can share the same value for the start node (i.e. H2 and I1 in Figure 5-18b on page 114).
- The value of the end node is always unique. This rule is not required for using the CPM algorithm, rather to support the logic of the subroutine.
- Dummy design changes are used (shown as dotted lines with arrow heads in Figure 5-18) to reflect the case where two design changes share the same successor (i.e. I1 and A2 in Figure 5-18b).

Figure B-3 represents a matrix that is used to represent the logic for the developed subroutine and reflects the previous rules. The vertical values of the matrix indicate the start nodes of design changes while the horizontal values indicate the end nodes. Figure B-3 reflects the change-path in Figure 5-18b.

Values of start nodes

Values of end nodes	1	2	3	4	5	6	7
2	A1						
3		H2					
4		I1					
5			S2				
6			S3				
7						A2	
8							L1

Figure B-3 Matrix to represent start nodes and end nodes for change-path in Figure 5-18b.

B.2.1 Initializations

Sub2-A Connect to Data-Table 5-8 (page 113) of the related project-database.

Sub2-B Limit the reading of the data from Data-Table 5-8 to the rows that have the specified value for the attribute "CASE_ID" (i.e. CASE_ID = 2).

Sub2-C Create two lists for "Processed design changes" and "Under processing design changes". Each element in these lists has attributes for the value of the start node and the value of the end node.

Repeat the following steps for each group of design changes in Data-Table 5-8 that has the same "ALTERNATIVE#" (i.e. Alternative#1).

B.2.2 Process the initial design change

Sub2-D Query Data-Table 5-8 (page 113) for the data row that have the value "NULL" in the attribute "DESIGN_CHANGE" and read the value of the attribute "SUCCESSOR" in the found row. This value is the initial design change that has been defined when a designer starts a new case (i.e. A1 in Figure 5-17 on page 113). Add this design change to the list of "Processed design changes" and the list of "Under processing design changes".

Sub2-E Make the value of the start node = 1 for the initial design change and make a unique consecutive value (i.e. 2) for the end node.

B.2.3 Process the rest of the design changes in the change-path.

For each design change in the list of "Under processing design changes" perform the steps Sub2-F to Sub2-I:

Sub2-F Read the value of the end node for this design change (i.e. 2 for the design change A1). Assign this value to the variable (e).

Sub2-G Get from Data-Table 5-8 on page 113 all the successors of the design change (i.e. H1, L1, I1 in Figure 5-17 on page 113).

For each successor, perform steps Sub1-H to Sub1-I:

Sub2-H Read from Data-Table 5-8 (page 113) all the design changes that have this successor. (i.e. design changes A1 and I1 for the successor L1).

Sub2-I Check if all the found design changes in Sub2-H (i.e. A1 and I1) exit in the list of "Processed design changes".

- If any of the found design changes does not exist then ignore this successor. (i.e. L1)
- If all of the found design changes exit then add this successor to the list of "Processed design changes" and the list of "Under processing design changes". Make the value of the start node for this successor equals the value of the end node of the under processing design change. (i.e. the value of the variable (e) which is defined in step Sub2-F) and use a unique consecutive value for the end node of this successor. Using unique consecutive value for the end nodes makes use of all the rows in the matrix of Figure B-3 and ensures that only one design change exists in every row hence reflecting the stated rules at the beginning of section B.2 on page 182.

B.2.4 GENERATE THE DUMMY DESIGN CHANGES

Sub2-J For the value of a variable (i) that starts from the value (1) to the highest value used as a start node in the processed design change (i.e. 1 to 7 in Figure B-3 on page 183), check if the value is used as a start node in any of the processed design change. This is similar to searching for the empty columns in the matrix in Figure B-3.

- If the value of (i) is used (e.g. 1), then check the next value.
- If the value of (i) is not used (e.g. 4), then continue the following steps.

Sub2-K Find the design change in the list of processed design changes that have the same value of (i) for its end node (e.g. I1). This should be a single design change as the end node is a unique value for every design change. This is demonstrated in the matrix in Figure B-3 by having only one design change in any row. The matrix also shows that there are no empty rows.

Sub2-L Query Data-Table 5-8 (page 113) for all the successors of the found design (e.g. I1) change and determine - from the list of processed design changes - the successor that has the lowest start node value (i.e. L1). Assign this value (i.e. 7) to the variable (ii).

Sub2-M Create a dummy design change that has a start node value equals the value of (i) (i.e. 4) and an end node value equals the value of (ii) (i.e. 7). Add the dummy design change to the list of processed design changes.

After generating all the dummy design changes Figure 5-18 on page 114, arrange all the design changes in the processed design change list according to their start node value. The design change of this change-path is ready to be scheduled using a standard CPM algorithm. Figure B-5 shows a flowchart for the described subroutine.

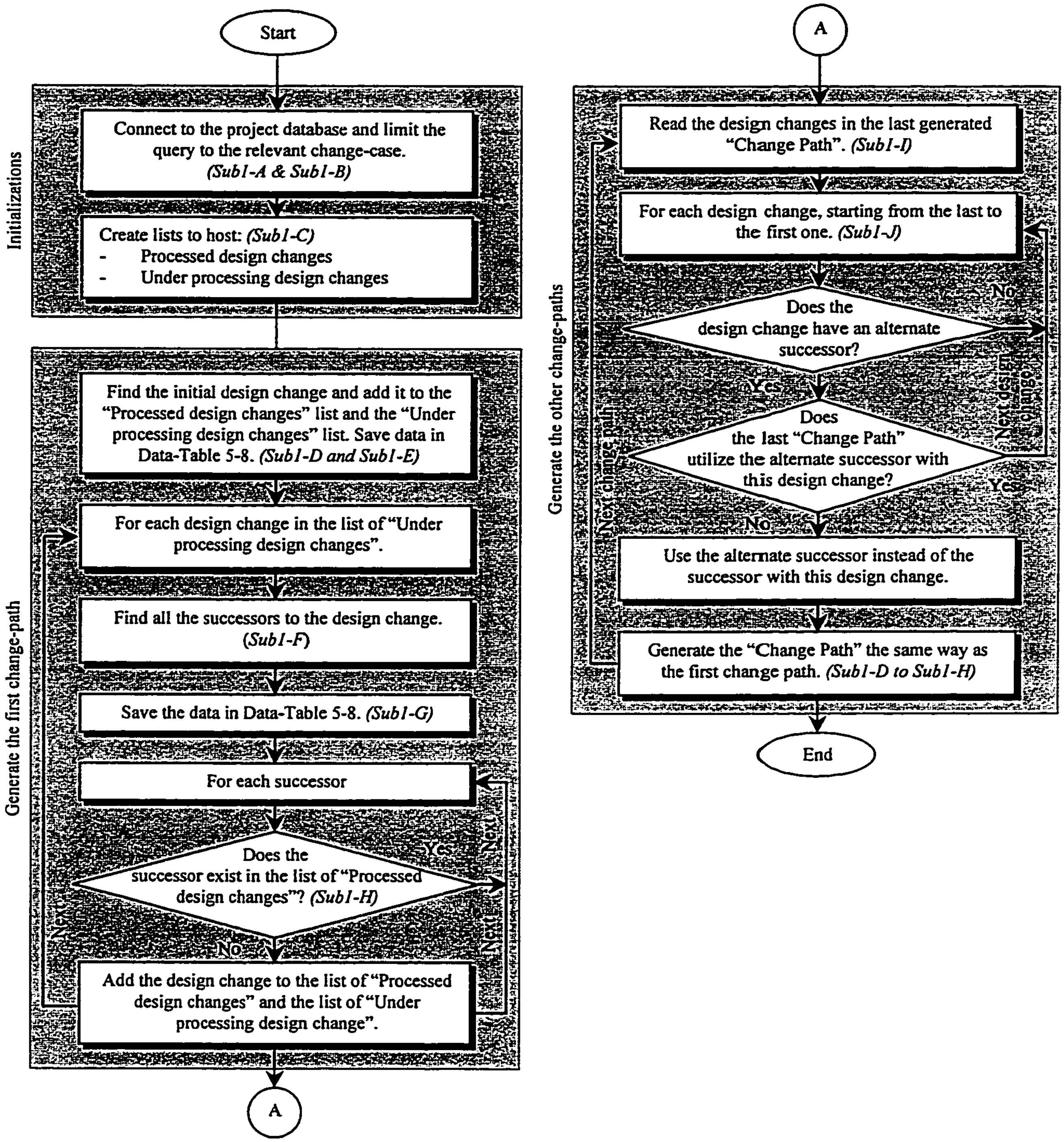

Figure B-4 Flowchart for sub-routine developed to generate various change-paths.

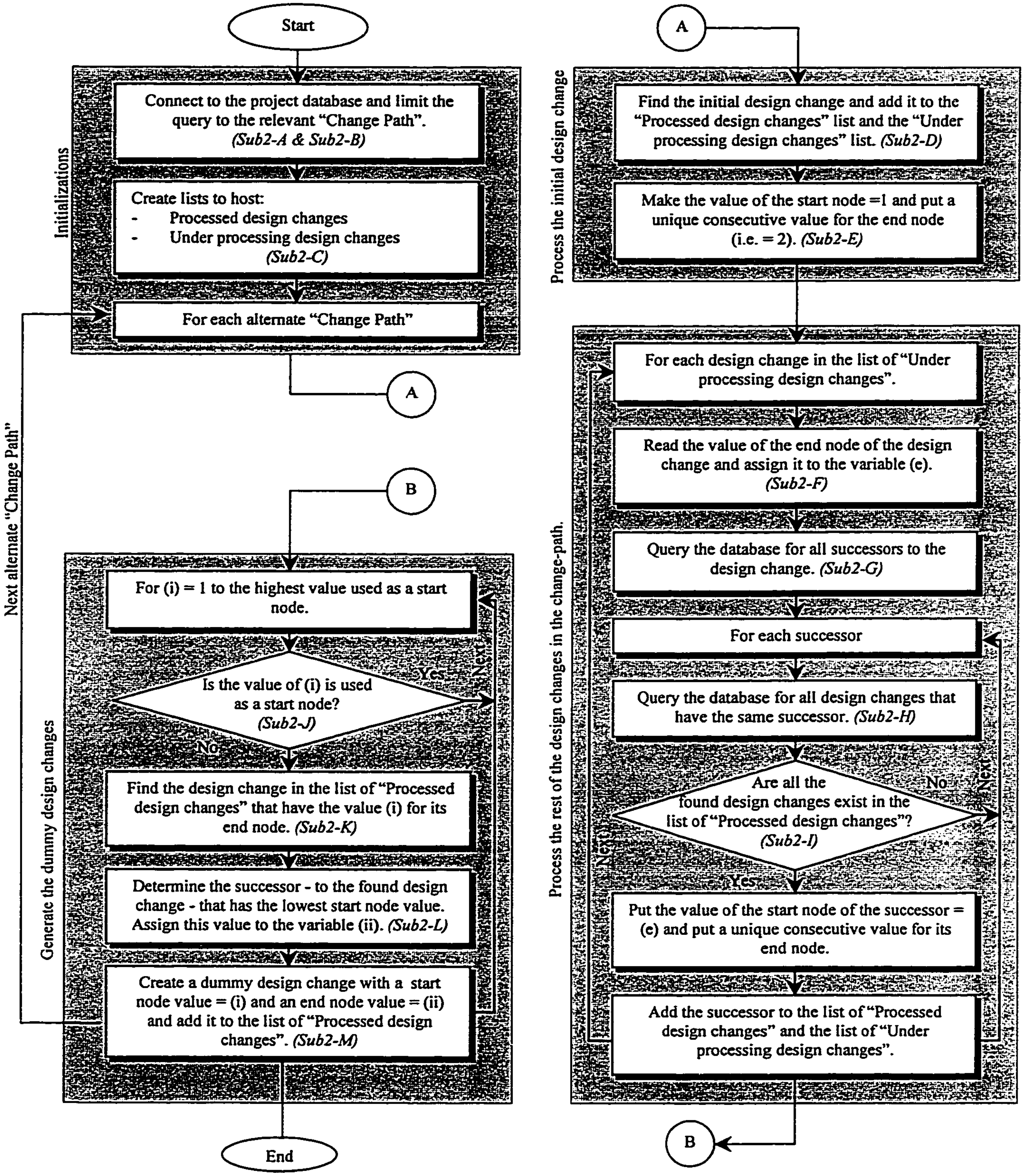

Figure B-5 Flow chart for sub-routine developed to define sequence of performing design changes so as to eliminate redundancy.

APPENDIX C
LISTINGS OF LEVEL5 OBJECT MODULES

C.1. CONFIGURATION MODULE

```
$VERSION35
$LOCATIONS ARE PIXELS

CLASS AB_general_rules
 WITH AB_general_rules_ID NUMERIC
 WITH building_element STRING
 WITH attribute_of_building_element STRING
 WITH affected_discipline STRING
 WITH percent_change NUMERIC
 WITH result_in_major_modification STRING
 WITH cause_of_the_effect STRING
 WITH rule_ignored STRING

CLASS border INHERITS add on, display item
 WITH style COMPOUND
  picture frame,
  edit control,
  group,
  shadow
  INIT picture frame
 WITH perspective COMPOUND
  in,
  out
  INIT in
 WITH border width NUMERIC
  INIT 1
 WITH background color COLOR
  INIT 192,192,192
 WITH fill color COLOR
  INIT 192,192,192
 WITH highlight color COLOR
  INIT 255,255,255
 WITH shadow color COLOR
  INIT 128,128,128

CLASS Building element
 WITH building_element STRING
 WITH graph_name STRING
  WHEN CHANGED
   BEGIN
    graph_name OF current_data := graph_name OF
Building element
   END

CLASS building_element_attribute
 WITH attribute_of_building_element STRING
 WITH attribute_type STRING
 WITH designing_discipline STRING
 WITH linked_building_element STRING
 WITH linked_attribute_of_building_element STRING

CLASS current_data
 WITH building_element STRING
  WHEN CHANGED
   BEGIN
    EXEC l5odbc 1 SQL SELECT *  from [AB-
attribute-designer] where building_element =
:current_data.building_element
                END SQL INTO
building_element_attribute
!
    FOR  (i :=  1 TO  number instances OF navigate
1)
     BEGIN
      instance number OF navigate 1 := i
      IF ( CONF(linked_building_element OF
building_element_attribute) >= 0) THEN
       BEGIN
        EXEC l5odbc 1 SQL SELECT
linked_attribute_of_building_element  from [AB-
attribute-designer] where building_element =
:current_data.building_element AND
linked_building_element =
:building_element_attribute.linked_building_element
                END SQL INTO domain (tt)
          linked_attribute_of_building_element OF
building_element_attribute := tt
        END
      END
!
     FORGET  attribute type OF input data
     FORGET  discipline OF input data
!
   END
 WITH attribute_of_building_element STRING
  WHEN CHANGED
   BEGIN
    IF ( CONF(attribute_of_building_element OF
current_data) >= 0) THEN
      BEGIN
       attribute_type OF current_data := attribute_type
OF building_element_attribute
       designing_discipline OF current_data :=
designing_discipline OF building_element_attribute
       linked_building_element OF current_data :=
linked_building_element OF
building_element_attribute
       linked_attribute_of_building_element OF
current_data := linked_attribute_of_building_element
OF building_element_attribute
       FORGET  attribute type OF input data
       FORGET  discipline OF input data
      END
   END
 WITH attribute_type STRING
 WITH designing_discipline STRING
 WITH linked_building_element STRING
  WHEN CHANGED
   BEGIN
    IF ( CONF(linked_building_element OF
current_data) >= 0) THEN
      BEGIN
       EXEC l5odbc 1 SQL SELECT *  from [AB-
attribute-designer] where building_element =
:current_data.linked_building_element
                END SQL INTO Linked element
attribute
!
       FIND Linked building element
        WHERE  building_element OF Linked
building element = linked_building_element OF
current_data
        FIND END
!
       linked_building_element OF
building_element_attribute := linked_building_element
OF current_data
      END
!
   END
 WITH linked_attribute_of_building_element STRING
  WHEN CHANGED
   BEGIN
    IF ( CONF(linked_attribute_of_building_element
OF current_data) >= 0) THEN
      BEGIN
       linked_attribute_of_building_element OF
building_element_attribute := linked_building_element
OF current_data
      END
   END
 WITH graph_name STRING

CLASS Current_projects
 WITH project_name STRING

CLASS Current_rule_data
 WITH building_element STRING
  WHEN CHANGED
   BEGIN
    EXEC l5odbc 1 SQL SELECT *  from [AB-
attribute-designer] where building_element =
:Current_rule_data.building_element
                END SQL INTO
building_element_attribute
   END
 WITH attribute_of_building_element STRING
  WHEN CHANGED
   BEGIN
    EXEC l5odbc 1 SQL SELECT *  from [AB-
general-rules] where building_element =
:Current_rule_data.building_element AND
attribute_of_building_element =
:Current_rule_data.attribute_of_building_element
                END SQL INTO AB_general_rules
   END
 WITH affected_discipline STRING
 WITH result_in_major_modification STRING
 WITH cause_of_the_effect STRING
 WITH percent_change NUMERIC
 WITH rule_ignored STRING

CLASS edit table INHERITS add on, display item
 WITH attachment CLASS REFERENCE
 WITH columns INSTANCE REFERENCE
  COLLECTION
 WITH heading SIMPLE
  INIT TRUE
 WITH heading height NUMERIC
 WITH row height NUMERIC
 WITH fill color COLOR
 WITH row separator SIMPLE
  INIT TRUE
 WITH column separator SIMPLE
  INIT TRUE
 WITH max rows NUMERIC
 WITH total rows NUMERIC
 WITH current cell NUMERIC
  ARRAY SIZE 2
  INIT [1 ] 1
  INIT [2 ] 1
 WITH current cell data STRING
 WITH highlight text color COLOR
 WITH highlight fill color COLOR
 WITH display only SIMPLE
 WITH selected SIMPLE
 WITH double clicked SIMPLE

CLASS edit table column
 WITH attachment ATTRIBUTE REFERENCE
 WITH heading label STRING
 WITH heading style INSTANCE REFERENCE
 WITH column style INSTANCE REFERENCE
 WITH width NUMERIC
 WITH max characters NUMERIC
 WITH format STRING
 WITH justify COMPOUND
  left,
  center,
  right
  INIT left
 WITH pen color COLOR
  COLLECTION
 WITH fill color COLOR
  COLLECTION

CLASS GENERAL_Building_element
 WITH building_element STRING
 WITH graph_name STRING

CLASS GENERAL_building_element_attribute
 WITH attribute_of_building_element STRING
 WITH attribute_type STRING
 WITH designing_discipline STRING
 WITH linked_building_element STRING
```

```
WITH linked_attribute_of_building_element STRING

CLASS input data
 WITH discipline COMPOUND
  Architect,
  Structure,
  HVAC,
  Illuminat,
  Interior,
  Envelope
  WHEN CHANGED
   BEGIN
!
    IF ( CONF(discipline OF input data) >= 0) THEN
     BEGIN
!
      IF discipline OF input data IS Architect THEN
       BEGIN
        designing_discipline OF
building_element_attribute := "arch"
        designing_discipline OF current_data :=
"arch"
        affected_discipline OF AB_general_rules :=
"arch"
       END
!
      IF discipline OF input data IS Structure THEN
       BEGIN
        designing_discipline OF
building_element_attribute := "stru"
        designing_discipline OF current_data :=
"stru"
        affected_discipline OF AB_general_rules :=
"stru"
       END
!
      IF discipline OF input data IS HVAC THEN
       BEGIN
        designing_discipline OF
building_element_attribute := "hvac"
        designing_discipline OF current_data :=
"hvac"
        affected_discipline OF AB_general_rules :=
"hvac"
       END
!
      IF discipline OF input data IS Illuminat THEN
       BEGIN
        designing_discipline OF
building_element_attribute := "illu"
        designing_discipline OF current_data :=
"illu"
        affected_discipline OF AB_general_rules :=
"illu"
       END
!
      IF discipline OF input data IS Interior THEN
       BEGIN
        designing_discipline OF
building_element_attribute := "inte"
        designing_discipline OF current_data :=
"inte"
        affected_discipline OF AB_general_rules :=
"inte"
       END
!
      IF discipline OF input data IS Envelope THEN
       BEGIN
        designing_discipline OF
building_element_attribute := "enve"
        designing_discipline OF current_data :=
"enve"
        affected_discipline OF AB_general_rules :=
"enve"
       END
!
     END
!
   END
 WITH attribute type COMPOUND
  Text data,
  Numeric data
  WHEN CHANGED
   BEGIN
!
    IF ( CONF(attribute type OF input data) >= 0)
THEN
     BEGIN
!
      IF attribute type OF input data IS Text data
THEN
       BEGIN
        attribute_type OF current_data := "t"
        attribute_type OF building_element_attribute
:= "t"
       END
!
      IF attribute type OF input data IS Numeric data
THEN
       BEGIN
        attribute_type OF current_data := "n"
        attribute_type OF building_element_attribute
:= "n"
       END
!
     END
!
   END

CLASS l5odbc INHERITS add on
 WITH data source STRING
 WITH userid STRING
 WITH password STRING
 WITH connection string STRING
 WITH connection prompting SIMPLE
  INIT FALSE
 WITH auto commit SIMPLE
  INIT TRUE
 WITH action COMPOUND
  connect,
  disconnect
 WITH records NUMERIC
 WITH transaction COMPOUND
  commit,
  rollback
 WITH append SIMPLE
  INIT FALSE
 WITH status STRING
 WITH show error SIMPLE
 WITH default error handling SIMPLE
  INIT TRUE
 WITH error message STRING
 WITH native error NUMERIC
 WITH trace file STRING

CLASS Linked building element
 WITH building_element STRING

CLASS Linked element attribute
 WITH attribute_of_building_element STRING

CLASS Menus_classified_B_comp
 WITH label STRING

CLASS Menus_group
 WITH label STRING

CLASS Menus_group_items
 WITH label STRING

CLASS Menus_manipulation_data
 WITH current_menu_group STRING
  WHEN CHANGED
   BEGIN
!
    IF CONF(current_menu_group OF
Menus_manipulation_data) > 0 THEN
     BEGIN
      EXEC l5odbc 1 SQL SELECT label from [AB-
menu_item] WHERE main_menu_label =
:Menus_manipulation_data.current_menu_group
           END SQL INTO
Menus_group_items
!
      FORGET current_menu_B_comp OF
Menus_manipulation_data
!
     END
!
! *** end of method
   END
 WITH current_menu_B_comp STRING
 WITH add build comp SIMPLE
  WHEN CHANGED
   BEGIN
!
    IF CONF(current_menu_B_comp OF
Menus_manipulation_data) > 0 AND CONF(
current_menu_group OF Menus_manipulation_data) >
0 THEN
     BEGIN
!
      EXEC l5odbc 1 SQL INSERT into [AB-
menu_item] (label, main_menu_label) values
      (
:Menus_manipulation_data.current_menu_B_comp,
:Menus_manipulation_data.current_menu_group)
           END SQL
!
      EXEC l5odbc 1 SQL SELECT label from [AB-
menu_item] WHERE main_menu_label =
:Menus_manipulation_data.current_menu_group
           END SQL INTO
Menus_group_items
!
      FIND Menus_unclassified_B_comp
       WHERE label OF
Menus_unclassified_B_comp = current_menu_B_comp
OF Menus_manipulation_data
       WHEN FOUND
        FORGET CURRENT
Menus_unclassified_B_comp
      FIND END
!
      FORGET current_menu_B_comp OF
Menus_manipulation_data
!
! *** end of IF
     END
    ELSE
     BEGIN
      text OF message box 2 := "A selected Menu
Group or Building Component is missing"
      put up OF message box 2 := TRUE
     END
!
!
! *** end of method
   END
 WITH delete build comp SIMPLE
  WHEN CHANGED
   BEGIN
!
    IF CONF(current_menu_B_comp OF
Menus_manipulation_data) > 0 AND CONF(
current_menu_group OF Menus_manipulation_data) >
0 THEN
     BEGIN
!
      EXEC l5odbc 1 SQL DELETE from [AB-
menu_item] WHERE label =
:Menus_manipulation_data.current_menu_B_comp
           END SQL
!
      EXEC l5odbc 1 SQL SELECT label from [AB-
menu_item] WHERE main_menu_label =
:Menus_manipulation_data.current_menu_group
           END SQL INTO
Menus_group_items
!
      MAKE Menus_unclassified_B_comp
       WITH label := current_menu_B_comp OF
Menus_manipulation_data
!
      FORGET current_menu_B_comp OF
Menus_manipulation_data
!
! *** end of IF
     END
    ELSE
     BEGIN
      text OF message box 2 := "A selected Menu
Group or Building Component is missing"
      put up OF message box 2 := TRUE
     END
!
! *** end of method
   END
 WITH add menu group SIMPLE
  WHEN CHANGED
   BEGIN
!
    IF CONF(current_menu_B_comp OF
Menus_manipulation_data) > 0 AND CONF(
new_name_of_menu_group OF
Menus_manipulation_data) > 0 THEN
     BEGIN
!
      EXEC l5odbc 1 SQL INSERT into [AB-
menu_item] (label, main_menu_label) values
      (
:Menus_manipulation_data.current_menu_B_comp,
:Menus_manipulation_data.new_name_of_menu_group
```

```
)
                END SQL
!
        EXEC lSodbc 1 SQL SELECT label from [AB-
menu_item] WHERE main_menu_label =
:Menus_manipulation_data.new_name_of_menu_group
                END SQL INTO
Menus_group_items
!
        FIND Menus_unclassified_B_comp
         WHERE label OF
Menus_unclassified_B_comp = current_menu_B_comp
OF Menus_manipulation_data
         WHEN FOUND
          FORGET CURRENT
Menus_unclassified_B_comp
        FIND END
!
        MAKE Menus_group
         WITH label := new_name_of_menu_group
OF Menus_manipulation_data
!
        FORGET current_menu_B_comp OF
Menus_manipulation_data
        FORGET current_menu_group OF
Menus_manipulation_data
        FORGET new_name_of_menu_group OF
Menus_manipulation_data
!
! *** end of IF
     END
    ELSE
     BEGIN
      text OF message box 2 := "Type a New Menu
Group and select a Building Component"
      put up OF message box 2 := TRUE
     END
!
!
! *** end of method
   END
  WITH delete menu group SIMPLE
   WHEN CHANGED
    BEGIN
!
    IF CONF(current_menu_group OF
Menus_manipulation_data) > 0 THEN
     BEGIN
!
      EXEC lSodbc 1 SQL DELETE from [AB-
menu_item] WHERE main_menu_label =
:Menus_manipulation_data.current_menu_group
                END SQL
!
      FORGET current_menu_B_comp OF
Menus_manipulation_data
      FORGET current_menu_group OF
Menus_manipulation_data
      FORGET Menus_group_items
!
      EXEC lSodbc 1 SQL SELECT distinct
(main_menu_label) from [AB-menu_item]
                END SQL INTO Menus_group
(label)
!
      EXEC lSodbc 1 SQL SELECT label from [AB-
menu_item]
                END SQL INTO
Menus_classified_B_comp
!
      FOR (i := 1 TO number instances OF navigate
Building element)
       BEGIN
        instance number OF navigate Building
element := i
        FIND Menus_classified_B_comp
         WHERE label OF
Menus_classified_B_comp = building_element OF
Building element
         WHEN NONE FOUND
          MAKE Menus_unclassified_B_comp
           WITH label := building_element OF
Building element
        FIND END
       END
!
! *** end of IF
     END
    ELSE
     BEGIN
      text OF message box 2 := "A selected Menu
Group is missing"
        put up OF message box 2 := TRUE
       END
!
! *** end of method
    END
  WITH rename menu group SIMPLE
   WHEN CHANGED
    BEGIN
!
     IF CONF(new_name_of_menu_group OF
Menus_manipulation_data) > 0 AND CONF(
current_menu_group OF Menus_manipulation_data) >
0 THEN
      BEGIN
!
       FOR (i := 1 TO number instances OF navigate
menu_group_items)
        BEGIN
         instance number OF navigate
menu_group_items := i
         EXEC lSodbc 1 SQL update [AB-
menu_item] set
           main_menu_label =
:Menus_manipulation_data.new_name_of_menu_group
           WHERE label =
:Menus_group_items.label
          END SQL
        END
!
       FIND Menus_group
        WHERE label OF Menus_group =
current_menu_group OF Menus_manipulation_data
        WHEN FOUND
         label OF Menus_group :=
new_name_of_menu_group OF
Menus_manipulation_data
       FIND END
!
       current_menu_group OF
Menus_manipulation_data :=
new_name_of_menu_group OF
Menus_manipulation_data
       FORGET new_name_of_menu_group OF
Menus_manipulation_data
! *** end of IF
      END
     ELSE
      BEGIN
       text OF message box 2 := "A selected Menu
Group or a New name for the Menu Group is missing"
       put up OF message box 2 := TRUE
      END
!
! *** end of method
    END
  WITH new_name_of_menu_group STRING

CLASS Menus_unclassified_B_comp
  WITH label STRING

CLASS message box INHERITS add on
  WITH title STRING
  WITH text STRING
  WITH variable text STRING
  WITH modal style COMPOUND
   app modal,
   sys modal,
   not modal
   INIT app modal
  WITH icon COMPOUND
   exclamation,
   information,
   question,
   stop sign
   INIT exclamation
  WITH button COMPOUND
   abort retry ignore,
   ok,
   ok cancel,
   retry cancel,
   yes no,
   yes no cancel
   INIT ok
  WITH default button COMPOUND
   one,
   two,
   three
   INIT one
  WITH button selected COMPOUND
   abort,
   cancel,
   ignore,
   no,
   ok,
   retry,
   yes
  WITH put up SIMPLE

CLASS navigate INHERITS add on
  WITH class attachment CLASS REFERENCE
  WITH action COMPOUND
   first,
   previous,
   next,
   last
  WITH instance number NUMERIC
  WITH number instances NUMERIC

CLASS NEW_building_systems
  WITH building_system STRING
  WITH description STRING
  WITH discipline STRING

CLASS NEW_design_disciplines
  WITH discipline STRING

CLASS NEW_other_project_components
  WITH building_element STRING

CLASS NEW_to_make_a_new_project
  WITH from another project SIMPLE
  WITH from systems SIMPLE
   WHEN CHANGED
    BEGIN
     EXEC lSodbc 2 SQL select distinct (discipline)
from [building_systems]
          END SQL INTO NEW_design_disciplines
!
     action OF lSodbc 1 IS connect := TRUE
!
     visible OF main window := FALSE
     visible OF configuration window := TRUE
     output OF configuration window := NEW from
systems display
    END
  WITH from components SIMPLE
   WHEN CHANGED
    BEGIN
     EXEC lSodbc 2 SQL select distinct
(building_element) from [General-AB-attribute-
designer]
          END SQL INTO Building element
!
     action OF lSodbc 1 IS connect := TRUE
!
     visible OF main window := FALSE
     visible OF configuration window := TRUE
     output OF configuration window := NEW from
components display
    END
  WITH another_project_name STRING
   WHEN CHANGED
    BEGIN
!
! **** this part will do the following
! **** 1) make connection to the other project database
! **** 2) read the components from the table AB-
attribute-designer form the database of the
! ****     other project
! **** 3) create tables in the new project database
! **** 4) insert the tables data into the table AB-
attribute-designer of the new table
! **** 5) read the general rules and menus from the old
project database and put them
! ****     in the database of the new project database
!
! ------ connect to the new project database
     action OF lSodbc 1 IS connect := TRUE
!
! ---------- make connection with the database of the
other project
     data source OF lSodbc 3 := another_project_name
OF NEW_to_make_a_new_project
     action OF lSodbc 3 IS connect := TRUE
!
! ---------- read the components from the other project
     EXEC lSodbc 3 SQL SELECT distinct
(building_element), graph_name from [AB-attribute-
designer]
          END SQL INTO Building element
     FOR (i := 1 TO number instances OF navigate
```

```
Building element)
        BEGIN
          instance number OF navigate Building element
:= i
       ! **** create the database table with its id attribute
          general statement of sql := CONCAT(
"CREATE TABLE [", building_element OF Building
element, "] ([", building_element OF Building element,
"_id] TEXT(50));")
          EXEC l5odbc 1 SQL WITH general statement
of sql END SQL
        END
!
! ---------- read the attributes of the components from
the other project
      FOR (i := 1 TO number instances OF navigate
Building element)
        BEGIN
          instance number OF navigate Building element
:= i
      ! **** the next step is to overcome the name
"Building element" which can not be linked to Access
          tt := building_element OF Building element
          EXEC l5odbc 3 SQL SELECT * from [AB-
attribute-designer] where building_element =
:domain.tt
                  END SQL INTO
building_element_attribute
          FOR (ii := 1 TO number instances OF
navigate building element attributes)
            BEGIN
              instance number OF navigate building
element attributes := ii
          ! **** ignore the attribute that has the _id of the
table
              IF SEARCHSTR("_id",
attribute_of_building_element OF
building_element_attribute) = 0 THEN
                BEGIN
          ! **** put the attributes in the database
                  general statement of sql := CONCAT(
"alter table [", building_element OF Building element,
"] add [", attribute_of_building_element OF
building_element_attribute, "] ")
                IF attribute_type OF
building_element_attribute = "t" THEN
                  general statement of sql := CONCAT(
general statement of sql, "TEXT (50);")
                IF attribute_type OF
building_element_attribute = "n" THEN
                  general statement of sql := CONCAT(
general statement of sql, "Number;")
                EXEC l5odbc 1 SQL WITH general
statement of sql END SQL
                END
!
            END
        END
!
! -------- insert the tables data into the table AB-
attribute-designer of the new table
      FOR (i := 1 TO number instances OF navigate
Building element)
        BEGIN
          instance number OF navigate Building element
:= i
      ! **** the next step is to overcome the name
"Building element" which can not be linked to Access
          tt := building_element OF Building element
!
          EXEC l5odbc 3 SQL SELECT * from [AB-
attribute-designer] where building_element =
:domain.tt
                  END SQL INTO
building_element_attribute
!
          FOR (ii := 1 TO number instances OF
navigate building element attributes)
            BEGIN
              instance number OF navigate building
element attributes := ii
              IF CONF(linked_building_element OF
building_element_attribute) = 100 THEN
                BEGIN
!
!           ****** the following step is necessary as data
can not be got directly from access to this attribute
                EXEC l5odbc 3 SQL SELECT
(linked_attribute_of_building_element) from [AB-
attribute-designer]
                  where building_element = :domain.tt and
attribute_of_building_element =
:building_element_attribute.attribute_of_building_elem
ent
                  END SQL INTO domain (ttt)
                linked_attribute_of_building_element OF
building_element_attribute := ttt
!
                EXEC l5odbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline, linked_building_element,
linked_attribute_of_building_element) values
                  ( :domain.tt,
:building_element_attribute.attribute_of_building_elem
ent, :building_element_attribute.attribute_type,
:building_element_attribute.designing_discipline,:build
ing_element_attribute.linked_building_element,:buildin
g_element_attribute.linked_attribute_of_building_elem
ent )


                                                  END
SQL
                END
              ELSE
                BEGIN
                  EXEC l5odbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline) values
                  ( :domain.tt,
:building_element_attribute.attribute_of_building_elem
ent, :building_element_attribute.attribute_type,
:building_element_attribute.designing_discipline)


                                                  END
SQL
                END
            END
        END
!
!
! ---------- get the general rules from the old database
and save them in the new one (ignore the id attribute)
      EXEC l5odbc 3 SQL SELECT * from [AB-
general-rules]
                  END SQL INTO AB_general_rules
!
      FOR (i := 1 TO number instances OF rules
navigate 2)
        BEGIN
          instance number OF rules navigate 2 := i
          EXEC l5odbc 1 SQL INSERT INTO [AB-
general-rules] (building_element,
attribute_of_building_element, affected_discipline,
percent_change, result_in_major_modification,
cause_of_the_effect) values
              ( :AB_general_rules.building_element,
:AB_general_rules.attribute_of_building_element,
:AB_general_rules.affected_discipline,
:AB_general_rules.percent_change,
:AB_general_rules.result_in_major_modification,
:AB_general_rules.cause_of_the_effect)


                                                  END
SQL
        END
!
!
!
! ---------- to activate the push bottons
      attribute attachment OF pushbutton 42 := Building
Components
      attribute attachment OF pushbutton 43 := Menus
      attribute attachment OF pushbutton 44 := General
Rules
!
! **** end of method
    END
  WITH building_element STRING
    WHEN CHANGED
      BEGIN
        EXEC l5odbc 2 SQL SELECT * from [General-
AB-attribute-designer] where building_element =
:NEW_to_make_a_new_project.building_element
                END SQL INTO
building_element_attribute
      END
  WITH add component to the new project SIMPLE
    WHEN CHANGED
      BEGIN
        i := 0
        CONF(tt) := -2
!
! **** check that there is an inserted name and that this
name does not exist
        IF ( CONF(building_element OF
NEW_to_make_a_new_project) >= 0) THEN
          BEGIN
!
            EXEC l5odbc 1 SQL select distinct
building_element from [AB-attribute-designer]
                where building_element =
:NEW_to_make_a_new_project.building_element
                END SQL INTO domain (tt)
!
          END
!
!
!
        IF CONF(tt) = 100 THEN
          i := 1
        ELSE
          i := 2
!
!
!
        IF i = 1 THEN
          BEGIN
            text OF message box 2 := "There is already a
building component with that name"
            put up OF message box 2 := TRUE
          END
!
!
!
! ****** If the name was not used before
!
        IF i = 2 THEN
          BEGIN
!
! **** create the database table with its id attribute
            general statement of sql := CONCAT(
"CREATE TABLE [", building_element OF
NEW_to_make_a_new_project, "] ([",
building_element OF NEW_to_make_a_new_project,
"_id] TEXT(50));")
            EXEC l5odbc 1 SQL WITH general statement
of sql END SQL
!
! ***** add the rest of attributes to the created table
            FOR (ii := 1 TO number instances OF
navigate building element attributes)
              BEGIN
                instance number OF navigate building
element attributes := ii
              ! **** ignore the attribute that has the _id of the
table
                IF SEARCHSTR("_id",
attribute_of_building_element OF
building_element_attribute) = 0 THEN
                  BEGIN
              ! **** put the attributes in the database
                    general statement of sql := CONCAT(
"alter table [", building_element OF Building element,
"] add [", attribute_of_building_element OF
building_element_attribute, "] ")
                  IF attribute_type OF
building_element_attribute = "t" THEN
                    general statement of sql := CONCAT(
general statement of sql, "TEXT (50);")
                  IF attribute_type OF
building_element_attribute = "n" THEN
                    general statement of sql := CONCAT(
general statement of sql, "Number;")
                  EXEC l5odbc 1 SQL WITH general
statement of sql END SQL
                  END
              END
!
! **** add the attributes to the table [AB-attribute-
designer] in the new project
            FOR (ii := 1 TO number instances OF
navigate building element attributes)
              BEGIN
                instance number OF navigate building
element attributes := ii
                IF CONF(linked_building_element OF
building_element_attribute) = 100 THEN
                  BEGIN
```

```
!
!          ****** the following step is necessary as data can not be got directly from access to this attribute
                 EXEC l5odbc 2 SQL SELECT (linked_attribute_of_building_element) from [GENERAL-AB-attribute-designer]
                 where building_element = :NEW_to_make_a_new_project.building_element and attribute_of_building_element = :building_element_attribute.attribute_of_building_element
                      END SQL INTO domain (ttt)
                 linked_attribute_of_building_element OF building_element_attribute := ttt
!
                 EXEC l5odbc 1 SQL INSERT INTO [AB-attribute-designer] (building_element, attribute_of_building_element, attribute_type, designing_discipline, linked_building_element, linked_attribute_of_building_element) values
                      (
:NEW_to_make_a_new_project.building_element, :building_element_attribute.attribute_of_building_element, :building_element_attribute.attribute_type, :building_element_attribute.designing_discipline, :building_element_attribute.linked_building_element, :building_element_attribute.linked_attribute_of_building_element )

                                                        END
SQL
            END
           ELSE
            BEGIN
              EXEC l5odbc 1 SQL INSERT INTO [AB-attribute-designer] (building_element, attribute_of_building_element, attribute_type, designing_discipline) values
                 (
:NEW_to_make_a_new_project.building_element, :building_element_attribute.attribute_of_building_element, :building_element_attribute.attribute_type, :building_element_attribute.designing_discipline)

                                                        END
SQL
            END
          END
        END
!
! **** end of method
   END
 WITH finish components of the new project SIMPLE
  WHEN CHANGED
   BEGIN
!
! **** this method aims to add the general rules of the chosen components to the new project database
!
! **** get the names of the components from the new project database
    EXEC l5odbc 1 SQL select distinct (building_element) from [AB-attribute-designer]
    END SQL INTO Building element
  !
    FOR (i := 1 TO number instances OF navigate Building element)
      BEGIN
       instance number OF navigate Building element := i
       tt := building_element OF Building element
       EXEC l5odbc 2 SQL select * from [GENERAL-AB-general-rules] where building_element = :domain.tt
       END SQL INTO AB_general_rules
!
! ***** add the rules to the new project database
!
      FOR (ii := 1 TO number instances OF rules navigate 2)
         BEGIN
          instance number OF rules navigate 2 := ii
          EXEC l5odbc 1 SQL INSERT INTO [AB-general-rules] (building_element, attribute_of_building_element, affected_discipline, percent_change, result_in_major_modification, cause_of_the_effect) values
                 ( :AB_general_rules.building_element, :AB_general_rules.attribute_of_building_element, :AB_general_rules.affected_discipline, :AB_general_rules.percent_change, :AB_general_rules.result_in_major_modification, :AB_general_rules.cause_of_the_effect)

                                                        END
SQL
        END
!
     END
!
! **** move to the CURRENT_project_selection_display to allow more configuration
     visible OF configuration window := FALSE
     visible OF main window := TRUE
     output OF main window := CURENT_project_selection_display
!
! **** end of method
   END
 WITH design_discipline STRING
  WHEN CHANGED
   BEGIN
!
    EXEC l5odbc 2 SQL select * from building_systems where discipline = :NEW_to_make_a_new_project.design_discipline
      END SQL INTO NEW_building_systems
!
   END
 WITH building_system STRING
  WHEN CHANGED
   BEGIN
!
    EXEC l5odbc 2 SQL SELECT * from [components_of_building_system] where building_system = :NEW_to_make_a_new_project.building_system
                   END SQL INTO Building element
!
   END
 WITH ignore highlighted component SIMPLE
  WHEN CHANGED
   BEGIN
    FORGET CURRENT Building element
   END
 WITH add system to the new project SIMPLE
  WHEN CHANGED
   BEGIN
!
! **** check that there is an inserted name and that this name does not exist
    IF ( CONF(building_system OF NEW_to_make_a_new_project) >= 0) THEN
     BEGIN
!
!
!
      FOR (i := 1 TO number instances OF navigate Building element)
        BEGIN
         instance number OF navigate Building element := i
!
! **** get the attributes of the building element
         tt := building_element OF Building element
         EXEC l5odbc 2 SQL select * from [GENERAL-AB-attribute-designer] where building_element = :domain.tt
         END SQL INTO building_element_attribute
!
! **** build the tables and the attributes in the new project data
! **** create the database table with its id attribute
         general statement of sql := CONCAT( "CREATE TABLE [", building_element OF Building element, "] ([", building_element OF Building element, "_id] TEXT(50));")
         EXEC l5odbc 1 SQL WITH general statement of sql END SQL
!
! ***** add the rest of attributes to the created table
         FOR (ii := 1 TO number instances OF navigate building element attributes)
           BEGIN
            instance number OF navigate building element attributes := ii
        ! **** ignore the attribute that has the _id of the table
             IF SEARCHSTR("_id", attribute_of_building_element OF building_element_attribute) = 0 THEN
              BEGIN
        ! **** put the attributes in the database
               general statement of sql := CONCAT( "alter table [", building_element OF Building element, "] add [", attribute_of_building_element OF building_element_attribute, "] ")
              IF attribute_type OF building_element_attribute = "t" THEN
               general statement of sql := CONCAT( general statement of sql, "TEXT (50);")
              IF attribute_type OF building_element_attribute = "n" THEN
               general statement of sql := CONCAT( general statement of sql, "Number;")
              EXEC l5odbc 1 SQL WITH general statement of sql END SQL
              END
            END
! **** add the attributes to the table [AB-attribute-designer] in the n\
ew project
          FOR (ii := 1 TO number instances OF navigate building element attributes)
            BEGIN
             instance number OF navigate building element attributes := ii
             IF CONF(linked_building_element OF building_element_attribute) = 100 THEN
              BEGIN
!
!          ****** the following step is necessary as data can not be got directly from access to this attribute
                 EXEC l5odbc 2 SQL SELECT (linked_attribute_of_building_element) from [GENERAL-AB-attribute-designer]
                 where building_element = :domain.tt and attribute_of_building_element = :building_element_attribute.attribute_of_building_element
                      END SQL INTO domain (ttt)
                 linked_attribute_of_building_element OF building_element_attribute := ttt
!
                 EXEC l5odbc 1 SQL INSERT INTO [AB-attribute-designer] (building_element, attribute_of_building_element, attribute_type, designing_discipline, linked_building_element, linked_attribute_of_building_element) values
                 ( :domain.tt, :building_element_attribute.attribute_of_building_element, :building_element_attribute.attribute_type, :building_element_attribute.designing_discipline, :building_element_attribute.linked_building_element, :building_element_attribute.linked_attribute_of_building_element )

                                                        END
SQL
              END
             ELSE
              BEGIN
               EXEC l5odbc 1 SQL INSERT INTO [AB-attribute-designer] (building_element, attribute_of_building_element, attribute_type, designing_discipline) values
                 ( :domain.tt, :building_element_attribute.attribute_of_building_element, :building_element_attribute.attribute_type, :building_element_attribute.designing_discipline)

                                                        END
SQL
              END
            END
! ***** end of FOR i
         END
! **** end of IF
       END
!
! **** end of method
   END
 WITH finish systems of the new project SIMPLE
  WHEN CHANGED
   BEGIN
! **** this method aims to add the general rules of the components of the chosen system to the new project
```

```
database
!
! **** get the names of the components from the new
project database
     EXEC ISodbc 1 SQL select distinct
(building_element) from [AB-attribute-designer]
      END SQL INTO Building element
  !
    FOR (i := 1 TO number instances OF navigate
Building element)
      BEGIN
       instance number OF navigate Building element
:= i
       tt := building_element OF Building element
       EXEC ISodbc 2 SQL select * from
[GENERAL-AB-general-rules] where
building_element = :domain.tt
            END SQL INTO AB_general_rules
!
! ***** add the rules to the new project database
!
       FOR (ii := 1 TO number instances OF rules
navigate 2)
        BEGIN
         instance number OF rules navigate 2 := ii
         EXEC ISodbc 1 SQL INSERT INTO [AB-
general-rules] (building_element,
attribute_of_building_element, affected_discipline,
percent_change, result_in_major_modification,
cause_of_the_effect) values
              ( :AB_general_rules.building_element,
:AB_general_rules.attribute_of_building_element,
:AB_general_rules.affected_discipline,
:AB_general_rules.percent_change,
:AB_general_rules.result_in_major_modification,
:AB_general_rules.cause_of_the_effect)


                                          END
SQL
        END
!
      END
!
! **** move to the
CURRENT_project_selection_display to allow more
configuration
     visible OF configuration window := FALSE
     visible OF main window := TRUE
     output OF main window :=
CURENT_project_selection_display
!
! **** end of method
   END

ATTRIBUTE Building Components SIMPLE
 WHEN CHANGED
  BEGIN
   action OF ISodbc 1 IS connect := TRUE
!
   EXEC ISodbc 1 SQL SELECT distinct
(building_element), graph_name from [AB-attribute-
designer]
      END SQL INTO Building element
!
   EXEC ISodbc 1 SQL SELECT distinct
(building_element) from [AB-attribute-designer]
      END SQL INTO Linked building element
!
   visible OF main window := FALSE
   output OF configuration window := config
   visible OF configuration window := TRUE
!
  END
ATTRIBUTE tt STRING
ATTRIBUTE i NUMERIC
ATTRIBUTE general statement of sql STRING
ATTRIBUTE done of new component SIMPLE
 WHEN CHANGED
  BEGIN
   i := 0
!
! **** check that there is an inserted name and that this
name does not exist
   IF ( CONF(new_component_name) >= 0) THEN
    BEGIN
     FIND Building element
      WHERE building_element OF Building
element = new_component_name
      WHEN FOUND
       i := 1
       WHEN NONE FOUND
        i := 2
      FIND END
!
      IF i = 1 THEN
       BEGIN
        text OF message box 2 := "There is already a
building component with that name"
        put up OF message box 2 := TRUE
        FORGET new_component_name
       END
!
! If the name was not used befor
      IF i = 2 THEN
       BEGIN
! **** hide the temporary put elements and put the
temporary elements for ID data
         location OF border 6 invisible := 0,0,0,0
         location OF textbox 17 invisible := 0,0,0,0
         location OF promptbox 2 invisible := 0,0,0,0
         location OF pushbutton 10 invisible := 0,0,0.0
         location OF pushbutton 11 invisible := 0,0,0.0
         location OF pushbutton 26 invisible2 :=
25,265,220,285
         location OF promptbox 3 invisible2 :=
25,195,220,220
         location OF border 7 invisible2 :=
15,150,235,290
         location OF textbox 19 invisible2 :=
25,225,220,260
!
! **** create the database table with its id attribute
         general statement of sql := CONCAT(
"CREATE TABLE [", new_component_name, "] ([",
new_component_name, "_id] TEXT(50));")
         EXEC ISodbc 1 SQL WITH general statement
of sql END SQL
!
! **** add the information to [AB-attribute-designer]
table
         new_attribute_name := CONCAT(
new_component_name, "_id")
         EXEC ISodbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element) values
 ( :domain.new_component_name,
:domain.new_attribute_name )
         END SQL
!
         MAKE Building element
          WITH building_element :=
new_component_name
!
         MAKE building_element_attribute
          WITH attribute_of_building_element :=
new_attribute_name
          WITH attribute_type := "t"
!
         building_element OF current_data :=
new_component_name
         attribute_of_building_element OF
current_data := new_attribute_name
         attribute_type OF current_data := "t"
!
       END
     END
!
  END
ATTRIBUTE new_component_name STRING
ATTRIBUTE new_attribute_name STRING
ATTRIBUTE done of new attribute SIMPLE
 WHEN CHANGED
  BEGIN
!
   i := 0
!
   IF ( CONF(new_attribute_name) >= 0 AND
CONF( attribute_type OF current_data) >= 0 AND
CONF( designing_discipline OF current_data) >= 0)
THEN
     BEGIN
!
      attribute_of_building_element OF current_data
:= new_attribute_name
      attribute_type OF building_element_attribute :=
attribute_type OF current_data
      designing_discipline OF
building_element_attribute := designing_discipline OF
current_data
      IF CONF(linked_building_element OF
current_data) >= 0 THEN
        BEGIN
         linked_building_element OF
building_element_attribute := linked_building_element
OF current_data
         linked_attribute_of_building_element OF
building_element_attribute :=
linked_attribute_of_building_element OF current_data
        END
!
! **** put in the database
      general statement of sql := CONCAT( "alter
table [", building_element OF current_data, "] add [",
attribute_of_building_element OF current_data, "] ")
      IF attribute_type OF current_data = "t" THEN
       general statement of sql := CONCAT( general
statement of sql, "TEXT (50);")
      IF attribute_type OF current_data = "n" THEN
       general statement of sql := CONCAT( general
statement of sql, "Number;")
      EXEC ISodbc 1 SQL WITH general statement of
sql END SQL
!
      EXEC ISodbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline) values
 ( :current_data.building_element,
:current_data.attribute_of_building_element,
:current_data.attribute_type,
:current_data.designing_discipline )
        END SQL
!
      IF i = 1 THEN
       BEGIN
        EXEC ISodbc 1 SQL UPDATE [AB-attribute-
designer] set
 linked_building_element =
:current_data.linked_building_element,
 linked_attribute_of_building_element =
:current_data.linked_attribute_of_building_element
 WHERE building_element =
:current_data.building_element AND
attribute_of_building_element =
:current_data.attribute_of_building_element
       END SQL
       END
!
      IF CONF(graph_name OF current_data) >= 0
THEN
       BEGIN
        EXEC ISodbc 1 SQL UPDATE [AB-attribute-
designer] set graph_name = :current_data.graph_name
 WHERE building_element =
:current_data.building_element AND
attribute_of_building_element =
:current_data.attribute_of_building_element
       END SQL
       END
!
!
      FORGET new_attribute_name
      FORGET attribute type OF input data
      FORGET discipline OF input data
      location OF pushbutton 12 invisible2 := 0,0,0,0
      location OF pushbutton 13 invisible2 := 0,0,0,0
      location OF border 7 invisible2 := 0,0,0,0
      location OF textbox 18 invisible2 := 0,0,0,0
      location OF textbox 19 invisible2 := 0,0,0,0
      location OF pushbutton 16 invisible2 := 0,0,0,0
      location OF promptbox 3 invisible2 := 0,0,0,0
!
     END
    ELSE
     BEGIN
      text OF message box 2 := "Some essential data
are missing. Check attribute name, type, and designing
discipline."
      put up OF message box 2 := TRUE
     END
  END
ATTRIBUTE next new attribute SIMPLE
 WHEN CHANGED
  BEGIN
   IF ( CONF(new_attribute_name) >= 0 AND
CONF( attribute_type OF current_data) >= 0 AND
CONF( designing_discipline OF current_data) >= 0)
THEN
     BEGIN
!
      attribute_type OF building_element_attribute :=
attribute_type OF current_data
```

```
        designing_discipline OF
building_element_attribute := designing_discipline OF
current_data
        IF CONF(linked_building_element OF
current_data) >= 0 THEN
          BEGIN
           linked_building_element OF
building_element_attribute := linked_building_element
OF current_data
           linked_attribute_of_building_element OF
building_element_attribute :=
linked_attribute_of_building_element OF current_data
          END
!
        FORGET new_attribute_name
        FORGET attribute_of_building_element OF
current_data
        FORGET attribute_type OF current_data
        FORGET designing_discipline OF current_data
        FORGET linked_building_element OF
current_data
        FORGET linked_attribute_of_building_element
OF current_data
        FORGET attribute type OF input data
        FORGET discipline OF input data
        location OF pushbutton 16 invisible2 :=
180,195,220,220
        location OF promptbox 3 invisible2 :=
25,195,220,220
        location OF textbox 18 invisible2 :=
25,155,220,190
!
      END
     ELSE
      BEGIN
       text OF message box 2 := "Some essential data
are missing. Check attribute name, type, and designing
discipline."
       put up OF message box 2 := TRUE
      END
    END
ATTRIBUTE ok of attribute name SIMPLE
 WHEN CHANGED
  BEGIN
   IF ( CONF(new_attribute_name) >= 0) THEN
    BEGIN
! **** check if there is an attribute with the same name
     FIND building_element_attribute
      WHERE attribute_of_building_element OF
building_element_attribute = new_attribute_name
      WHEN FOUND
       i := 1
      WHEN NONE FOUND
       i := 2
     FIND END
!
     IF i = 2 THEN
      BEGIN
       MAKE building_element_attribute
        WITH attribute_of_building_element :=
new_attribute_name
       location OF pushbutton 12 invisible2 :=
25,265,225,285
       location OF pushbutton 16 invisible2 :=
0,0,0,0
      END
    END
!
! **** end of method
  END
ATTRIBUTE General Rules SIMPLE
 WHEN CHANGED
  BEGIN
!
   action OF lSodbc 1 IS connect := TRUE
!
   EXEC lSodbc 1 SQL SELECT distinct
(building_element) from [AB-attribute-designer]
     END SQL INTO Building element
!
   visible OF main window := FALSE
   output OF configuration window := General rules
display
   visible OF configuration window := TRUE
!
! ***** end of method
  END
ATTRIBUTE update rule SIMPLE
 WHEN CHANGED
  BEGIN
   IF ( CONF(building_element OF
AB_general_rules) >= 0 AND CONF(
attribute_of_building_element OF AB_general_rules)
>= 0 AND CONF( affected_discipline OF
AB_general_rules) >= 0) THEN
     BEGIN
      IF CONF(AB_general_rules_ID OF
AB_general_rules) >= 0 THEN
       BEGIN
        EXEC lSodbc 1 SQL update [AB-general-
rules] set
 affected_discipline =
:AB_general_rules.affected_discipline,
 percent_change = :AB_general_rules.percent_change,
 result_in_major_modification =
:AB_general_rules.result_in_major_modification,
 rule_ignored = :AB_general_rules.rule_ignored,
 cause_of_the_effect =
:AB_general_rules.cause_of_the_effect
 where AB_general_rules_ID =
:AB_general_rules.AB_general_rules_ID
 END SQL
       END
      ELSE
       BEGIN
        IF CONF(percent_change OF
AB_general_rules) < 0 THEN
          percent_change OF AB_general_rules := 0
        IF CONF(result_in_major_modification OF
AB_general_rules) < 0 THEN
          result_in_major_modification OF
AB_general_rules := "No"
        IF CONF(rule_ignored OF AB_general_rules)
< 0 THEN
          rule_ignored OF AB_general_rules := "No"
        IF CONF(cause_of_the_effect OF
AB_general_rules) < 0 THEN
          cause_of_the_effect OF AB_general_rules :=
" "
        EXEC lSodbc 1 SQL insert into [AB-general-
rules]
 (building_element, attribute_of_building_element,
affected_discipline, percent_change,
result_in_major_modification,
rule_ignored,cause_of_the_effect)
  values
 ( :AB_general_rules.building_element,
:AB_general_rules.attribute_of_building_element,
:AB_general_rules.affected_discipline,
:AB_general_rules.percent_change,
:AB_general_rules.result_in_major_modification,
:AB_general_rules.rule_ignored,
:AB_general_rules.cause_of_the_effect)
 END SQL
       END
!
     END
    ELSE
     BEGIN
      text OF message box 2 := "Some important data
are missing.
You may need to puch New Rule botton"
      put up OF message box 2 := TRUE
     END
   END
ATTRIBUTE new rule SIMPLE
 WHEN CHANGED
  BEGIN
   IF ( CONF(building_element OF
Current_rule_data) >= 0 AND CONF(
attribute_of_building_element OF Current_rule_data)
>= 0) THEN
    BEGIN
     FORGET discipline OF input data
     MAKE AB_general_rules
      WITH building_element := building_element
OF Current_rule_data
      WITH attribute_of_building_element :=
attribute_of_building_element OF Current_rule_data
    END
   END
ATTRIBUTE delete a component SIMPLE
 WHEN CHANGED
  BEGIN
   IF CONF(building_element OF current_data) >= 0
THEN
    BEGIN
     general statement of sql := CONCAT( "drop
table ", building_element OF current_data)
     EXEC lSodbc 1 SQL WITH general statement of
sql END SQL
     EXEC lSodbc 1 SQL delete from [AB-attribute-
designer] where building_element =
:current_data.building_element END SQL
     EXEC lSodbc 1 SQL SELECT distinct
(building_element), graph_name from [AB-attribute-
designer]
         END SQL INTO Building element
     EXEC lSodbc 1 SQL SELECT distinct
(building_element) from [AB-attribute-designer]
         END SQL INTO Linked building element
     FORGET current_data
     FORGET building_element_attribute
    END
   ELSE
    BEGIN
     text OF message box 2 := "No Building
Component is currently chosen"
     put up OF message box 2 := TRUE
    END
!
! **** end of method
  END
ATTRIBUTE done of ID attribute SIMPLE
 WHEN CHANGED
  BEGIN
!
   i := 0
!
   IF ( CONF(new_attribute_name) >= 0 AND
CONF( attribute_type OF current_data) >= 0 AND
CONF( designing_discipline OF current_data) >= 0)
THEN
    BEGIN
!
     attribute_type OF building_element_attribute :=
attribute_type OF current_data
     designing_discipline OF
building_element_attribute := designing_discipline OF
current_data
     IF CONF(linked_building_element OF
current_data) >= 0 THEN
      BEGIN
       linked_building_element OF
building_element_attribute := linked_building_element
OF current_data
       linked_attribute_of_building_element OF
building_element_attribute :=
linked_attribute_of_building_element OF current_data
       i := 1
      END
!
! **** put in the database
     EXEC lSodbc 1 SQL UPDATE [AB-attribute-
designer] set
 attribute_type = :current_data.attribute_type,
 designing_discipline =
:current_data.designing_discipline
 WHERE building_element =
:current_data.building_element AND
attribute_of_building_element =
:current_data.attribute_of_building_element
     END SQL
!
     IF i = 1 THEN
      BEGIN
       EXEC lSodbc 1 SQL UPDATE [AB-attribute-
designer] set
 linked_building_element =
:current_data.linked_building_element,
 linked_attribute_of_building_element =
:current_data.linked_attribute_of_building_element
 WHERE building_element =
:current_data.building_element AND
attribute_of_building_element =
:current_data.attribute_of_building_element
       END SQL
      END
!
     IF CONF(graph_name OF current_data) >= 0
THEN
      BEGIN
       EXEC lSodbc 1 SQL UPDATE [AB-attribute-
designer] set graph_name = :current_data.graph_name
 WHERE building_element =
:current_data.building_element AND
attribute_of_building_element =
:current_data.attribute_of_building_element
       END SQL
      END
!
     FORGET new_attribute_name
     FORGET attribute type OF input data
```

```
        FORGET discipline OF input data
        location OF pushbutton 12 invisible2 := 0,0,0,0
        location OF pushbutton 13 invisible2 := 0,0,0,0
        location OF promptbox 3 invisible2 := 0,0,0,0
        location OF border 7 invisible2 := 0,0,0,0
        location OF textbox 18 invisible2 := 0,0,0,0
        location OF textbox 19 invisible2 := 0,0,0,0
        location OF pushbutton 16 invisible2 := 0,0,0,0
        location OF pushbutton 26 invisible2 := 0,0,0,0
!
     END
    ELSE
     BEGIN
      text OF message box 2 := "Some essential data
are missing. Check attribute name, type, and designing
discipline."
      put up OF message box 2 := TRUE
     END
   END
ATTRIBUTE delete of attribute SIMPLE
 WHEN CHANGED
  BEGIN
   IF CONF(attribute_of_building_element OF
current_data) >= 0 THEN
     BEGIN
!
! *** delete from its table and from table [AB-attribute-
designer]
       general statement of sql := CONCAT( "alter
table [", building_element OF current_data, "] drop [",
attribute_of_building_element OF current_data, "];")
       EXEC l5odbc 1 SQL WITH general statement of
sql END SQL
       EXEC l5odbc 1 SQL delete from [AB-attribute-
designer] where building_element =
:current_data.building_element AND
attribute_of_building_element =
:current_data.attribute_of_building_element  END SQL
!
! **** delete the related data from Level 5
       FIND building_element_attribute
        WHERE attribute_of_building_element OF
building_element_attribute =
attribute_of_building_element OF current_data
        WHEN FOUND
         FORGET CURRENT
building_element_attribute
       FIND END
       FORGET attribute_of_building_element OF
current_data
       FORGET attribute_type OF current_data
       FORGET designing_discipline OF current_data
       FORGET linked_building_element OF
current_data
       FORGET linked_attribute_of_building_element
OF current_data
     END
    ELSE
     BEGIN
      text OF message box 2 := "No Building
Component Attribute is currently chosen"
      put up OF message box 2 := TRUE
     END
!
! **** end of method
   END
ATTRIBUTE Menus SIMPLE
 WHEN CHANGED
  BEGIN
!
   action OF l5odbc 1 IS connect := TRUE
!
   EXEC l5odbc 1 SQL SELECT distinct
(building_element) from [AB-attribute-designer]
              END SQL INTO Building element
!
   EXEC l5odbc 1 SQL SELECT distinct
(main_menu_label) from [AB-menu_item]
              END SQL INTO Menus_group (label)
!
   EXEC l5odbc 1 SQL SELECT label from [AB-
menu_item]
              END SQL INTO
Menus_classified_B_comp
!
   FOR (i := 1 TO number instances OF navigate
Building element)
     BEGIN
      instance number OF navigate Building element
:= i
      FIND Menus_classified_B_comp
        WHERE label OF Menus_classified_B_comp
= building_element OF Building element
        WHEN NONE FOUND
         MAKE Menus_unclassified_B_comp
          WITH label := building_element OF
Building element
       FIND END
     END
!
   visible OF main window := FALSE
   output OF configuration window := Menus display
   visible OF configuration window := TRUE
!
! *** end of method
  END
ATTRIBUTE project_name STRING
 WHEN CHANGED
  BEGIN
   data source OF l5odbc 1 := project_name
   title OF configuration window := CONCAT(
"Configuring Project : ", project_name)
   attribute attachment OF pushbutton 38 :=
check_the_existance_of_new_project_name
   display attachment OF pushbutton 37 :=
CURENT_project_selection_display
  END
ATTRIBUTE New_project SIMPLE
 WHEN CHANGED
  BEGIN
   action OF l5odbc 2 IS connect := TRUE
   EXEC l5odbc 2 SQL select Project_name from
Current_projects
      END SQL INTO Current_projects
  END
ATTRIBUTE Current_project SIMPLE
 WHEN CHANGED
  BEGIN
   action OF l5odbc 2 IS connect := TRUE
   EXEC l5odbc 2 SQL select Project_name from
Current_projects
      END SQL INTO Current_projects
  END
ATTRIBUTE back_to_current_project_display
SIMPLE
 WHEN CHANGED
  BEGIN
   visible OF configuration window := FALSE
   visible OF main window := TRUE
   output OF main window :=
CURENT_project_selection_display
  END
ATTRIBUTE
check_the_existance_of_new_project_name SIMPLE
 WHEN CHANGED
  BEGIN
   FIND Current_projects
    WHERE project_name OF Current_projects =
project_name
    WHEN FOUND
     text OF message box 2 := "This name already
exists for a current project.
Type another name please. "
     put up OF message box 2 := TRUE
    WHEN NONE FOUND
     setup a new project := TRUE
   FIND END
! ---- end of method
  END
ATTRIBUTE setup a new project SIMPLE
 WHEN CHANGED
  BEGIN
!
! ***** this method does the following:
! ***** 1) Read the paths of the ODBC.ini file and the
path of the directorey
! *****    that is used for this program and contains an
"empty" database
! ***** 2) Modify the ODBC.INI file so it links to the
new database
! ***** 3) Add the file name to the General database so
as to be considered existing project
! ***** 4) Prepare a batch file to exceute the next step
! ***** 5) Make a new database by copy the empty
database to a file with
! *****    the new name
!
!
! ------ read the path of the files from the file
project.ini
   action OF file 1 IS open old := TRUE
   WHILE (NOT eof OF file 1)
    BEGIN
     read line OF file 1 := TRUE
     IF SUBSTR(current line OF file 1, 1, 16) =
"path of ODBC.ini" THEN
       path_of_odbc := SUBSTR( current line OF file
1, 36, 11)
     IF SUBSTR(current line OF file 1, 1, 29) =
"path of the developed program" THEN
       current_path := SUBSTR( current line OF file
1, 36, 16)
    END
   action OF file 1 IS close := TRUE
!
! ------ modify the ODBC.ini
   filename OF file 3 := CONCAT( path_of_odbc,
"ODBC.INI")
   action OF file 3 IS open old := TRUE
   WHILE (NOT eof OF file 3)
    BEGIN
     read line OF file 3 := TRUE
    END
   write line OF file 3 := CONCAT( "[",
project_name, "]")
   write line OF file 3 := CONCAT( "Driver=",
path_of_odbc, "SYSTEM\ODBCJT16.DLL")
   write line OF file 3 := CONCAT( "DBQ=",
project_name, ".MDB")
   write line OF file 3 := CONCAT( "DefaultDir=",
current_path)
   write line OF file 3 := "FIL=Microsoft Access"
   write line OF file 3 := "JetIniPath=msacc20.ini"
   write line OF file 3 := "UID=Admin"
   write line OF file 3 := "  "
   action OF file 3 IS close := TRUE
!
! ------ add the new file to the general database
   EXEC l5odbc 2 SQL insert into Current_projects
(Project_name) values ( :domain.project_name )
    END SQL
!
! ------ make a batch file to have a new database
   action OF file 2 IS delete := TRUE
   action OF file 2 IS open new := TRUE
   write line OF file 2 := CONCAT( "copy ",
current_path, "empty.mdb ", current_path,
project_name, ".mdb ")
   write line OF file 2 := CONCAT( "copy ",
current_path, "empty.ldb ", current_path, project_name,
".ldb ")
   action OF file 2 IS close := TRUE
!
! ------ make a copy of the empty database
   ACTIVATE "IPU, EXTERN, project.bat"
!
! ------ connect the display to the window
   output OF main window :=
NEW_project_selection_display
!
! *** end of method
  END
ATTRIBUTE path_of_odbc STRING
ATTRIBUTE current_path STRING
ATTRIBUTE ii NUMERIC
ATTRIBUTE ttt STRING
ATTRIBUTE get from general database SIMPLE
 WHEN CHANGED
  BEGIN
!
!
   EXEC l5odbc 2 SQL select distinct
(building_element) from [General-AB-attribute-
designer]
      END SQL INTO
GENERAL_Building_element
!
! **** remove the building elements that are already in
use
   FOR (i := 1 TO number instances OF navigate
Building element)
    BEGIN
     instance number OF navigate Building element
:= i
     FIND GENERAL_Building_element
      WHERE building_element OF
GENERAL_Building_element = building_element OF
Building element
      WHEN FOUND
       FORGET CURRENT
GENERAL_Building_element
     FIND END
    END
```

```
!
    visible OF get from general database window :=
TRUE
    output OF get from general database window := add
from general database display
!
! **** end of method
  END
ATTRIBUTE GENERAL_Building_component
STRING
 WHEN CHANGED
  BEGIN
   EXEC ISodbc 2 SQL SELECT * from [General-
AB-attribute-designer] where building_element =
:domain.GENERAL_Building_component
               END SQL INTO
GENERAL_building_element_attribute
  END
ATTRIBUTE add component from _get from general
datab SIMPLE
 WHEN CHANGED
  BEGIN
   i := 0
   FIND Building element
    WHERE LOWCASE( building_element OF
Building element) = LOWCASE(
GENERAL_Building_component)
    WHEN FOUND
     i := 1
    WHEN NONE FOUND
     i := 2
   FIND END
!
!
   IF i = 1 THEN
    BEGIN
     text OF message box 2 := "This Component
Already exists"
     put up OF message box 2 := TRUE
    END
!
!
   IF i = 2 THEN
    BEGIN
!
! **** create the database table with its id attribute
       general statement of sql := CONCAT( "CREATE
TABLE [", GENERAL_Building_component, "] ([",
GENERAL_Building_component, "_id] TEXT(50));")
     EXEC ISodbc 1 SQL WITH general statement of
sql END SQL
!
! ***** add the rest of attributes to the created table
     FOR (ii := 1 TO number instances OF navigate
GENERAL building element attributes)
       BEGIN
        instance number OF navigate GENERAL
building element attributes := ii
       ! **** ignore the attribute that has the _id of the
table
        IF SEARCHSTR("_id",
attribute_of_building_element OF
GENERAL_building_element_attribute) = 0 THEN
          BEGIN
        ! **** put the attributes in the database
           general statement of sql := CONCAT( "alter
table [", building_element OF
GENERAL_Building_element, "] add [",
attribute_of_building_element OF
GENERAL_building_element_attribute, "] ")
           IF attribute_type OF
GENERAL_building_element_attribute = "t" THEN
            general statement of sql := CONCAT(
general statement of sql, "TEXT (50);")
           IF attribute_type OF
GENERAL_building_element_attribute = "n" THEN
            general statement of sql := CONCAT(
general statement of sql, "Number;")
           EXEC ISodbc 1 SQL WITH general
statement of sql END SQL
          END
       END
!
! **** add the attributes to the table [AB-attribute-
designer] in the new project
     FOR (ii := 1 TO number instances OF navigate
GENERAL building element attributes)
       BEGIN
        instance number OF navigate GENERAL
building element attributes := ii
        IF CONF(linked_building_element OF
GENERAL_building_element_attribute) = 100 THEN
          BEGIN
!
!          ****** the following step is necessary as data
can not be got directly from access to this attribute
           EXEC ISodbc 2 SQL SELECT
(linked_attribute_of_building_element) from
[GENERAL-AB-attribute-designer]
           where building_element =
:domain.GENERAL_Building_component and
attribute_of_building_element =
:GENERAL_building_element_attribute.attribute_of_b
uilding_element
                 END SQL INTO domain (ttt)
           linked_attribute_of_building_element OF
GENERAL_building_element_attribute := ttt
!
           EXEC ISodbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline, linked_building_element,
linked_attribute_of_building_element) values
              (
:domain.GENERAL_Building_component,
:GENERAL_building_element_attribute.attribute_of_b
uilding_element,
:GENERAL_building_element_attribute.attribute_type,
:GENERAL_building_element_attribute.designing_dis
cipline,:GENERAL_building_element_attribute.linked
_building_element,:GENERAL_building_element_attri
bute.linked_attribute_of_building_element )

                                              END
SQL
         END
        ELSE
         BEGIN
           EXEC ISodbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline) values
              (
:domain.GENERAL_Building_component,
:GENERAL_building_element_attribute.attribute_of_b
uilding_element,
:GENERAL_building_element_attribute.attribute_type,
:GENERAL_building_element_attribute.designing_dis
cipline)

                                              END
SQL
         END
       END
    END
!
! *** end of method
  END
ATTRIBUTE return from _get from general datab
SIMPLE
 WHEN CHANGED
  BEGIN
!
   EXEC ISodbc 1 SQL SELECT distinct
(building_element), graph_name from [AB-attribute-
designer]
     END SQL INTO Building element
!
   EXEC ISodbc 1 SQL SELECT distinct
(building_element) from [AB-attribute-designer]
     END SQL INTO Linked building element
!
   visible OF get from general database window :=
FALSE
  END
ATTRIBUTE add component and general rule
SIMPLE
 WHEN CHANGED
  BEGIN
   i := 0
   FIND Building element
    WHERE LOWCASE( building_element OF
Building element) = LOWCASE(
GENERAL_Building_component)
    WHEN FOUND
     i := 1
    WHEN NONE FOUND
     i := 2
   FIND END
!
!
   IF i = 1 THEN
    BEGIN
     text OF message box 2 := "This Component
Already exists"
     put up OF message box 2 := TRUE
    END
!
!
   IF i = 2 THEN
    BEGIN
!
! **** create the database table with its id attribute
       general statement of sql := CONCAT( "CREATE
TABLE [", GENERAL_Building_component, "] ([",
GENERAL_Building_component, "_id] TEXT(50));")
     EXEC ISodbc 1 SQL WITH general statement of
sql END SQL
!
! ***** add the rest of attributes to the created table
     FOR (ii := 1 TO number instances OF navigate
GENERAL building element attributes)
       BEGIN
        instance number OF navigate GENERAL
building element attributes := ii
       ! **** ignore the attribute that has the _id of the
table
        IF SEARCHSTR("_id",
attribute_of_building_element OF
GENERAL_building_element_attribute) = 0 THEN
          BEGIN
        ! **** put the attributes in the database
           general statement of sql := CONCAT( "alter
table [", building_element OF
GENERAL_Building_element, "] add [",
attribute_of_building_element OF
GENERAL_building_element_attribute, "] ")
           IF attribute_type OF
GENERAL_building_element_attribute = "t" THEN
            general statement of sql := CONCAT(
general statement of sql, "TEXT (50);")
           IF attribute_type OF
GENERAL_building_element_attribute = "n" THEN
            general statement of sql := CONCAT(
general statement of sql, "Number;")
           EXEC ISodbc 1 SQL WITH general
statement of sql END SQL
          END
       END
!
! **** add the attributes to the table [AB-attribute-
designer] in the new project
     FOR (ii := 1 TO number instances OF navigate
GENERAL building element attributes)
       BEGIN
        instance number OF navigate GENERAL
building element attributes := ii
        IF CONF(linked_building_element OF
GENERAL_building_element_attribute) = 100 THEN
          BEGIN
!
!          ****** the following step is necessary as data
can not be got directly from access to this attribute
           EXEC ISodbc 2 SQL SELECT
(linked_attribute_of_building_element) from
[GENERAL-AB-attribute-designer]
           where building_element =
:domain.GENERAL_Building_component and
attribute_of_building_element =
:GENERAL_building_element_attribute.attribute_of_b
uilding_element
                 END SQL INTO domain (ttt)
           linked_attribute_of_building_element OF
GENERAL_building_element_attribute := ttt
!
           EXEC ISodbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline, linked_building_element,
linked_attribute_of_building_element) values
              (
:domain.GENERAL_Building_component,
:GENERAL_building_element_attribute.attribute_of_b
uilding_element,
:GENERAL_building_element_attribute.attribute_type,
:GENERAL_building_element_attribute.designing_dis
cipline,:GENERAL_building_element_attribute.linked
_building_element,:GENERAL_building_element_attri
bute.linked_attribute_of_building_element )
```

```
                                        END
SQL
        END
       ELSE
        BEGIN
         EXEC l5odbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline) values
          (
:domain.GENERAL_Building_component,
:GENERAL_building_element_attribute.attribute_of_b
uilding_element,
:GENERAL_building_element_attribute.attribute_type,
:GENERAL_building_element_attribute.designing_dis
cipline)


                                        END
SQL
        END
      END
!
! **** Add the General Rules
!
     EXEC l5odbc 2 SQL select * from [GENERAL-
AB-general-rules] where building_element =
:domain.GENERAL_Building_component
     END SQL INTO AB_general_rules
!
! ***** add the rules to the new project database
!
     FOR (ii := 1 TO number instances OF rules
navigate 2)
      BEGIN
       instance number OF rules navigate 2 := ii
       EXEC l5odbc 1 SQL INSERT INTO [AB-
general-rules] (building_element,
attribute_of_building_element, affected_discipline,
percent_change, result_in_major_modification,
cause_of_the_effect) values
          ( :AB_general_rules.building_element,
:AB_general_rules.attribute_of_building_element,
:AB_general_rules.affected_discipline,
:AB_general_rules.percent_change,
:AB_general_rules.result_in_major_modification,
:AB_general_rules.cause_of_the_effect)


                                        END
SQL
      END
!
!
! *** end of IF
    END
!
! *** end of method
  END

INSTANCE border 1 ISA border
  WITH style IS shadow
  WITH perspective IS in
  WITH border width := 4
  WITH background color := 192,192,192
  WITH fill color := 0,0,128
  WITH highlight color := 0,0,0
  WITH shadow color := 0,0,0
  WITH location := 5,5,165,100

INSTANCE border 2 ISA border
  WITH style IS group
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 5,40,420,135

INSTANCE border 3 ISA border
  WITH style IS group
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 5,140,500,410

INSTANCE border 4 ISA border
  WITH style IS group
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 15,295,490,400

INSTANCE border 5 ISA border
  WITH style IS picture frame
  WITH perspective IS in
  WITH border width := 4
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 5,40,595,245

INSTANCE border 6 invisible ISA border
  WITH style IS picture frame
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 0,0,0,0

INSTANCE border 7 invisible2 ISA border
  WITH style IS picture frame
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 0,0,0,0

INSTANCE border 8 ISA border
  WITH style IS edit control
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 5,50,250,395

INSTANCE border 9 ISA border
  WITH style IS edit control
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 253,50,500,395

INSTANCE border 10 ISA border
  WITH style IS group
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 5,45,175,415

INSTANCE border 11 ISA border
  WITH style IS group
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 180,45,340,415

INSTANCE border 12 ISA border
  WITH style IS group
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 345,45,500,355

INSTANCE border 13 ISA border
  WITH style IS shadow
  WITH perspective IS in
  WITH border width := 4
  WITH background color := 192,192,192
  WITH fill color := 0,0,128
  WITH highlight color := 0,0,0
  WITH shadow color := 0,0,0
  WITH location := 5,5,165,75

INSTANCE border 14 ISA border
  WITH style IS shadow
  WITH perspective IS in
  WITH border width := 4
  WITH background color := 192,192,192
  WITH fill color := 0,0,128
  WITH highlight color := 0,0,0
  WITH shadow color := 0,0,0
  WITH location := 10,5,170,60

INSTANCE border 15 ISA border
  WITH style IS group
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 5,40,490,400

INSTANCE border 16 ISA border
  WITH style IS group
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 10,45,485,395

INSTANCE border 17 ISA border
  WITH style IS picture frame
  WITH perspective IS in
  WITH border width := 3
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 20,55,475,195

INSTANCE border 18 ISA border
  WITH style IS picture frame
  WITH perspective IS in
  WITH border width := 3
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 20,205,475,345

INSTANCE border 19 ISA border
  WITH style IS group
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 5,40,490,400

INSTANCE border 20 ISA border
  WITH style IS group
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 10,45,485,395

INSTANCE border 21 ISA border
  WITH style IS picture frame
  WITH perspective IS in
  WITH border width := 3
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 20,110,240,385

INSTANCE border 22 ISA border
  WITH style IS picture frame
  WITH perspective IS in
```

```
WITH border width := 3
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 255,110,475,320

INSTANCE border 23 ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 3
 WITH background color := 192,192,192
 WITH fill color := 0,128,128
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 20,55,475,100

INSTANCE border 24 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,40,415,340

INSTANCE border 25 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 10,45,410,335

INSTANCE edit table column 1 ISA edit table column
 WITH attachment := attribute_of_building_element
OF building_element_attribute
 WITH heading label :=
"attribute_of_building_element"
 WITH width := 70
 WITH justify IS left
 WITH pen color [1] := UNDETERMINED
 WITH fill color [1] := UNDETERMINED

INSTANCE edit table column 2 ISA edit table column
 WITH attachment := attribute_type OF
building_element_attribute
 WITH heading label := "attribute_type"
 WITH width := 70
 WITH justify IS left
 WITH pen color [1] := UNDETERMINED
 WITH fill color [1] := UNDETERMINED

INSTANCE edit table column 3 ISA edit table column
 WITH attachment := designing_discipline OF
building_element_attribute
 WITH heading label := "designing_discipline"
 WITH width := 70
 WITH justify IS left
 WITH pen color [1] := UNDETERMINED
 WITH fill color [1] := UNDETERMINED

INSTANCE edit table column 4 ISA edit table column
 WITH attachment := linked_building_element OF
building_element_attribute
 WITH heading label := "linked_building_element"
 WITH width := 70
 WITH justify IS left
 WITH pen color [1] := UNDETERMINED
 WITH fill color [1] := UNDETERMINED

INSTANCE edit table column 5 ISA edit table column
 WITH attachment :=
linked_attribute_of_building_element OF
building_element_attribute
 WITH heading label :=
"linked_attribute_of_building_element"
 WITH width := 70
 WITH justify IS left
 WITH pen color [1] := UNDETERMINED
 WITH fill color [1] := UNDETERMINED

INSTANCE l5odbc 1 ISA l5odbc
 WITH connection prompting := FALSE
 WITH auto commit := TRUE
 WITH append := FALSE
 WITH default error handling := TRUE

INSTANCE l5odbc 2 ISA l5odbc
 WITH data source := "general"
 WITH connection prompting := FALSE
 WITH auto commit := TRUE
 WITH append := FALSE
 WITH default error handling := TRUE

INSTANCE l5odbc 3 ISA l5odbc
 WITH connection prompting := FALSE
 WITH auto commit := TRUE
 WITH append := FALSE
 WITH default error handling := TRUE

INSTANCE message box 1 ISA message box
 WITH title := "Warning Message"
 WITH text := "Are you sure that you want to
DELETE the current building component"
 WITH modal style IS sys modal
 WITH icon IS question
 WITH button IS yes no
 WITH default button IS one

INSTANCE message box 2 ISA message box
 WITH title := "INPUT ERROR"
 WITH modal style IS app modal
 WITH icon IS stop sign
 WITH button IS ok
 WITH default button IS one

INSTANCE message box 3 ISA message box
 WITH title := "Warning Message"
 WITH text := "Are you sure that you want to
DELETE the current component attribute
"
 WITH modal style IS sys modal
 WITH icon IS question
 WITH button IS yes no
 WITH default button IS one

INSTANCE navigate 1 ISA navigate
 WITH class attachment := building_element_attribute

INSTANCE rules navigate 2 ISA navigate
 WITH class attachment := AB_general_rules

INSTANCE navigate Building element ISA navigate
 WITH class attachment := Building element

INSTANCE navigate menu_group_items ISA navigate
 WITH class attachment := Menus_group_items

INSTANCE navigate building element attributes ISA
navigate
 WITH class attachment := building_element_attribute

INSTANCE navigate GENERAL building elements
ISA navigate
 WITH class attachment :=
GENERAL_Building_element

INSTANCE navigate GENERAL building element
attributes ISA navigate
 WITH class attachment :=
GENERAL_building_element_attribute

INSTANCE the application ISA application
 WITH unknowns fail := TRUE
 WITH threshold := 50
 WITH title display := Starting display
 WITH ignore breakpoints := FALSE
 WITH reasoning on := FALSE
 WITH numeric precision := 8
 WITH demon strategy IS fire first

INSTANCE column 1 ISA column
 WITH attachment := attribute_of_building_element
OF building_element_attribute
 WITH width := 160
 WITH justify IS left
 WITH wordwrap := TRUE
 WITH heading label := "Attribute"
 WITH heading justify IS heading center
 WITH heading wordwrap := TRUE

INSTANCE column 2 ISA column
 WITH attachment := attribute_type OF
building_element_attribute
 WITH width := 40
 WITH justify IS left
 WITH wordwrap := TRUE
 WITH heading label := "Type"
 WITH heading justify IS heading center
 WITH heading wordwrap := TRUE

INSTANCE column 3 ISA column
 WITH attachment := designing_discipline OF
building_element_attribute
 WITH width := 60
 WITH justify IS left
 WITH wordwrap := TRUE
 WITH heading label := "Design
Discipl"
 WITH heading justify IS heading center
 WITH heading wordwrap := TRUE

INSTANCE column 4 ISA column
 WITH attachment := linked_building_element OF
building_element_attribute
 WITH width := 160
 WITH justify IS left
 WITH wordwrap := TRUE
 WITH heading label := "Linked
Building
Component"
 WITH heading justify IS heading center
 WITH heading wordwrap := TRUE

INSTANCE column 5 ISA column
 WITH attachment :=
linked_attribute_of_building_element OF
building_element_attribute
 WITH width := 160
 WITH justify IS left
 WITH wordwrap := TRUE
 WITH heading label := "Linked
Component
Attribute"
 WITH heading justify IS heading center
 WITH heading wordwrap := TRUE

INSTANCE Starting display ISA display
 WITH wait := TRUE
 WITH delay changes := FALSE
 WITH items [1] := UNDETERMINED
 WITH items [2] := border 1
 WITH items [3] := textbox 1
 WITH items [4] := pushbutton 2
 WITH items [5] := UNDETERMINED
 WITH items [6] := UNDETERMINED
 WITH items [7] := UNDETERMINED
 WITH items [8] := UNDETERMINED
 WITH items [9] := pushbutton 34
 WITH items [10] := pushbutton 35
 WITH fill color := 192,192,192
 WITH menus [1] := UNDETERMINED

INSTANCE config ISA display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1] := textbox 2
 WITH items [2] := border 2
 WITH items [3] := listbox 1
 WITH items [4] := valuebox 1
 WITH items [5] := textbox 3
 WITH items [6] := textbox 4
 WITH items [7] := border 3
 WITH items [8] := listbox 2
 WITH items [9] := textbox 5
 WITH items [10] := valuebox 2
 WITH items [11] := border 4
 WITH items [12] := textbox 6
 WITH items [13] := radiobutton group 2
 WITH items [14] := UNDETERMINED
 WITH items [15] := textbox 7
 WITH items [16] := promptbox 1
 WITH items [17] := textbox 8
 WITH items [18] := pushbutton 3
 WITH items [19] := pushbutton 4
 WITH items [20] := UNDETERMINED
 WITH items [21] := listbox 3
 WITH items [22] := textbox 9
 WITH items [23] := listbox 4
 WITH items [24] := valuebox 3
 WITH items [25] := valuebox 4
 WITH items [26] := textbox 10
 WITH items [27] := textbox 11
 WITH items [28] := valuebox 5
 WITH items [29] := valuebox 6
 WITH items [30] := textbox 12
 WITH items [31] := textbox 13
 WITH items [32] := pushbutton 5
 WITH items [33] := pushbutton 6
```

```
WITH items [34 ] := textbox 14
WITH items [35 ] := radiobutton group 1
WITH items [36 ] := pushbutton 14
WITH items [37 ] := pushbutton 15
WITH items [38 ] := UNDETERMINED
WITH items [39 ] := border 6 invisible
WITH items [40 ] := promptbox 2 invisible
WITH items [41 ] := textbox 17 invisible
WITH items [42 ] := pushbutton 10 invisible
WITH items [43 ] := UNDETERMINED
WITH items [44 ] := pushbutton 11 invisible
WITH items [45 ] := border 7 invisible2
WITH items [46 ] := promptbox 3 invisible2
WITH items [47 ] := textbox 18 invisible2
WITH items [48 ] := textbox 19 invisible2
WITH items [49 ] := pushbutton 12 invisible2
WITH items [50 ] := UNDETERMINED
WITH items [51 ] := UNDETERMINED
WITH items [52 ] := pushbutton 16 invisible2
WITH items [53 ] := pushbutton 26 invisible2
WITH items [54 ] := pushbutton 52
WITH items [55 ] := textbox 64
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE attributes table display ISA display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 5
WITH items [2 ] := table 1
WITH items [3 ] := textbox 15
WITH items [4 ] := textbox 16
WITH items [5 ] := UNDETERMINED
WITH items [6 ] := pushbutton 8
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE General rules display ISA display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := textbox 20
WITH items [2 ] := border 8
WITH items [3 ] := UNDETERMINED
WITH items [4 ] := UNDETERMINED
WITH items [5 ] := textbox 23
WITH items [6 ] := textbox 24
WITH items [7 ] := UNDETERMINED
WITH items [8 ] := promptbox 4
WITH items [9 ] := border 9
WITH items [10 ] := textbox 26
WITH items [11 ] := valuebox 7
WITH items [12 ] := promptbox 6
WITH items [13 ] := listbox 5
WITH items [14 ] := UNDETERMINED
WITH items [15 ] := textbox 27
WITH items [16 ] := textbox 28
WITH items [17 ] := textbox 29
WITH items [18 ] := valuebox 9
WITH items [19 ] := valuebox 10
WITH items [20 ] := pushbutton 18
WITH items [21 ] := pushbutton 19
WITH items [22 ] := pushbutton 20
WITH items [23 ] := pushbutton 21
WITH items [24 ] := listbox 6
WITH items [25 ] := textbox 30
WITH items [26 ] := valuebox 11
WITH items [27 ] := radiobutton group 3
WITH items [28 ] := textbox 31
WITH items [29 ] := pushbutton 22
WITH items [30 ] := pushbutton 23
WITH items [31 ] := pushbutton 24
WITH items [32 ] := textbox 32
WITH items [33 ] := textbox 33
WITH items [34 ] := promptbox 7
WITH items [35 ] := textbox 69
WITH items [36 ] := promptbox 5
WITH items [37 ] := textbox 70
WITH items [38 ] := valuebox 8
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE Menus display ISA display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 12
WITH items [2 ] := border 11
WITH items [3 ] := border 10
WITH items [4 ] := textbox 34
WITH items [5 ] := listbox 8
WITH items [6 ] := textbox 36
WITH items [7 ] := listbox 9
WITH items [8 ] := textbox 37
WITH items [9 ] := pushbutton 27
WITH items [10 ] := listbox 10
WITH items [11 ] := textbox 38
WITH items [12 ] := valuebox 13
WITH items [13 ] := textbox 39
WITH items [14 ] := textbox 40
WITH items [15 ] := pushbutton 28
WITH items [16 ] := pushbutton 29
WITH items [17 ] := valuebox 14
WITH items [18 ] := pushbutton 30
WITH items [19 ] := pushbutton 31
WITH items [20 ] := pushbutton 32
WITH items [21 ] := valuebox 15
WITH items [22 ] := promptbox 8
WITH items [23 ] := textbox 41
WITH items [24 ] := textbox 42
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE CURENT_project_start_display ISA
display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 1
WITH items [2 ] := UNDETERMINED
WITH items [3 ] := UNDETERMINED
WITH items [4 ] := UNDETERMINED
WITH items [5 ] := UNDETERMINED
WITH items [6 ] := textbox 43
WITH items [7 ] := textbox 44
WITH items [8 ] := pushbutton 33
WITH items [9 ] := listbox 11
WITH items [10 ] := pushbutton 37
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE NEW_project_start_display ISA display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 1
WITH items [2 ] := textbox 47
WITH items [3 ] := pushbutton 33
WITH items [4 ] := textbox 48
WITH items [5 ] := promptbox 9
WITH items [6 ] := pushbutton 38
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE CURENT_project_selection_display ISA
display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 1
WITH items [2 ] := pushbutton 1
WITH items [3 ] := pushbutton 17
WITH items [4 ] := pushbutton 26
WITH items [5 ] := textbox 45
WITH items [6 ] := pushbutton 36
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE NEW_project_selection_display ISA
display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 1
WITH items [2 ] := textbox 49
WITH items [3 ] := pushbutton 39
WITH items [4 ] := pushbutton 40
WITH items [5 ] := pushbutton 41
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE NEW from another project display ISA
display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 13
WITH items [2 ] := UNDETERMINED
WITH items [3 ] := textbox 50
WITH items [4 ] := textbox 51
WITH items [5 ] := listbox 12
WITH items [6 ] := pushbutton 42
WITH items [7 ] := pushbutton 43
WITH items [8 ] := pushbutton 44
WITH items [9 ] := pushbutton 45
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE NEW from components display ISA
display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 15
WITH items [2 ] := border 16
WITH items [3 ] := border 17
WITH items [4 ] := border 18
WITH items [5 ] := textbox 53
WITH items [6 ] := listbox 13
WITH items [7 ] := textbox 54
WITH items [8 ] := valuebox 16
WITH items [9 ] := textbox 55
WITH items [10 ] := UNDETERMINED
WITH items [11 ] := UNDETERMINED
WITH items [12 ] := listbox 14
WITH items [13 ] := textbox 57
WITH items [14 ] := pushbutton 47
WITH items [15 ] := pushbutton 48
WITH items [16 ] := UNDETERMINED
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE NEW from systems display ISA display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := UNDETERMINED
WITH items [2 ] := UNDETERMINED
WITH items [3 ] := UNDETERMINED
WITH items [4 ] := UNDETERMINED
WITH items [5 ] := UNDETERMINED
WITH items [6 ] := UNDETERMINED
WITH items [7 ] := UNDETERMINED
WITH items [8 ] := UNDETERMINED
WITH items [9 ] := textbox 58
WITH items [10 ] := border 19
WITH items [11 ] := border 20
WITH items [12 ] := border 21
WITH items [13 ] := border 22
WITH items [14 ] := textbox 59
WITH items [15 ] := textbox 60
WITH items [16 ] := textbox 61
WITH items [17 ] := valuebox 17
WITH items [18 ] := textbox 62
WITH items [19 ] := valuebox 18
WITH items [20 ] := listbox 15
WITH items [21 ] := listbox 16
WITH items [22 ] := pushbutton 49
WITH items [23 ] := pushbutton 50
WITH items [24 ] := border 23
WITH items [25 ] := textbox 63
WITH items [26 ] := listbox 17
WITH items [27 ] := pushbutton 51
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE add from general database display ISA
display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := UNDETERMINED
WITH items [2 ] := UNDETERMINED
WITH items [3 ] := UNDETERMINED
WITH items [4 ] := UNDETERMINED
WITH items [5 ] := UNDETERMINED
WITH items [6 ] := UNDETERMINED
WITH items [7 ] := UNDETERMINED
WITH items [8 ] := UNDETERMINED
WITH items [9 ] := UNDETERMINED
WITH items [10 ] := border 24
WITH items [11 ] := border 25
WITH items [12 ] := listbox 18
WITH items [13 ] := valuebox 19
WITH items [14 ] := textbox 65
WITH items [15 ] := textbox 66
WITH items [16 ] := listbox 19
WITH items [17 ] := textbox 67
WITH items [18 ] := textbox 68
WITH items [19 ] := pushbutton 53
WITH items [20 ] := pushbutton 54
WITH items [21 ] := pushbutton 55
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE file 1 ISA file
WITH filename := "project.ini"
WITH shared := FALSE
WITH default error handling := TRUE

INSTANCE file 2 ISA file
WITH filename := "project.bat"
WITH shared := FALSE
```

```
WITH default error handling := TRUE

INSTANCE file 3 ISA file
  WITH shared := FALSE
  WITH default error handling := TRUE

INSTANCE listbox 1 ISA listbox
  WITH show current instance := TRUE
  WITH source := building_element OF Building element
  WITH destination := building_element OF current_data
  WITH location := 16,71,210,95

INSTANCE listbox 2 ISA listbox
  WITH show current instance := TRUE
  WITH source := attribute_of_building_element OF building_element_attribute
  WITH destination := attribute_of_building_element OF current_data
  WITH location := 16,171,235,240

INSTANCE listbox 3 ISA listbox
  WITH show current instance := TRUE
  WITH source := building_element OF Linked building element
  WITH destination := linked_building_element OF current_data
  WITH location := 25,320,235,345

INSTANCE listbox 4 ISA listbox
  WITH show current instance := TRUE
  WITH source := attribute_of_building_element OF Linked element attribute
  WITH destination :=
linked_attribute_of_building_element OF current_data
  WITH location := 25,365,235,390

INSTANCE listbox 5 ISA listbox
  WITH show current instance := TRUE
  WITH source := building_element OF Building element
  WITH destination := building_element OF Current_rule_data
  WITH location := 265,75,489,99

INSTANCE listbox 6 ISA listbox
  WITH show current instance := TRUE
  WITH source := attribute_of_building_element OF building_element_attribute
  WITH destination := attribute_of_building_element OF Current_rule_data
  WITH location := 265,120,489,144

INSTANCE listbox 8 ISA listbox
  WITH show current instance := TRUE
  WITH source := label OF
Menus_unclassified_B_comp
  WITH destination := current_menu_B_comp OF Menus_manipulation_data
  WITH location := 16,91,165,315

INSTANCE listbox 9 ISA listbox
  WITH show current instance := TRUE
  WITH source := label OF Menus_group
  WITH destination := current_menu_group OF Menus_manipulation_data
  WITH location := 185,90,335,205

INSTANCE listbox 10 ISA listbox
  WITH show current instance := TRUE
  WITH source := label OF Menus_group_items
  WITH destination := current_menu_B_comp OF Menus_manipulation_data
  WITH location := 350,90,495,255

INSTANCE listbox 11 ISA listbox
  WITH show current instance := TRUE
  WITH source := project_name OF Current_projects
  WITH destination := project_name
  WITH location := 11,140,160,165

INSTANCE listbox 12 ISA listbox
  WITH show current instance := TRUE
  WITH source := project_name OF Current_projects
  WITH destination := another_project_name OF NEW_to_make_a_new_project
  WITH location := 10,95,160,115

INSTANCE listbox 13 ISA listbox
  WITH show current instance := TRUE
  WITH source := building_element OF Building element
  WITH destination := building_element OF NEW_to_make_a_new_project
  WITH location := 35,95,460,180

INSTANCE listbox 14 ISA listbox
  WITH show current instance := TRUE
  WITH source := attribute_of_building_element OF building_element_attribute
  WITH location := 115,255,460,330

INSTANCE listbox 15 ISA listbox
  WITH show current instance := TRUE
  WITH source := building_element OF Building element
  WITH location := 265,200,465,285

INSTANCE listbox 16 ISA listbox
  WITH show current instance := TRUE
  WITH source := building_system OF NEW_building_systems
  WITH destination := building_system OF NEW_to_make_a_new_project
  WITH location := 30,150,230,270

INSTANCE listbox 17 ISA listbox
  WITH show current instance := TRUE
  WITH source := discipline OF NEW_design_disciplines
  WITH destination := design_discipline OF NEW_to_make_a_new_project
  WITH location := 265,65,460,87

INSTANCE listbox 18 ISA listbox
  WITH show current instance := TRUE
  WITH source := building_element OF GENERAL_Building_element
  WITH destination :=
GENERAL_Building_component
  WITH location := 21,76,400,160

INSTANCE listbox 19 ISA listbox
  WITH show current instance := TRUE
  WITH source := attribute_of_building_element OF GENERAL_building_element_attribute
  WITH location := 110,205,400,280

INSTANCE menu c_Foundation ISA menu
  WITH label := "Foundation"
  WITH items [1] := UNDETERMINED

INSTANCE menu c_Floor ISA menu
  WITH label := "Floor"
  WITH items [1] := UNDETERMINED

INSTANCE menu c_Wall ISA menu
  WITH label := "Wall"
  WITH items [1] := UNDETERMINED

INSTANCE menu c_Roof ISA menu
  WITH label := "Roof"
  WITH items [1] := UNDETERMINED

INSTANCE menu c_Opening ISA menu
  WITH label := "Opening"
  WITH items [1] := UNDETERMINED

INSTANCE menu c_Protection ISA menu
  WITH label := "Protection"
  WITH items [1] := UNDETERMINED

INSTANCE menu c_Special ISA menu
  WITH label := "Special"
  WITH items [1] := UNDETERMINED

INSTANCE menu c_Finishing ISA menu
  WITH label := "Finishing"
  WITH items [1] := UNDETERMINED

INSTANCE menu c_Mechanical ISA menu
  WITH label := "Mechanical"
  WITH items [1] := UNDETERMINED

INSTANCE menu c_Electrical ISA menu
  WITH label := "Electrical"
  WITH items [1] := UNDETERMINED

INSTANCE menu c_Pier ISA menu
  WITH label := "Pier"
  WITH items [1] := UNDETERMINED

INSTANCE menu c_Wood_Pier_Foundation ISA menu
  WITH label := "Wood_Pier_Foundation"
  WITH items [1] := menu item c_Circular_Wood_Pier_Foundation

INSTANCE menu 13 ISA menu
  WITH label := "menu 13"
  WITH items [1] := menu item 1

INSTANCE menu item 1 ISA menu item
  WITH label := "menu item 1"

INSTANCE menu item
c_Circular_Wood_Pier_Foundation ISA menu item
  WITH label := "Circular_Wood_Pier_Foundation"

INSTANCE promptbox 1 ISA promptbox
  WITH font := "System"
  WITH justify IS center
  WITH frame := TRUE
  WITH show current := TRUE
  WITH attachment := graph_name OF Building element
  WITH location := 100,100,210,125

INSTANCE promptbox 2 invisible ISA promptbox
  WITH pen color := 255,255,255
  WITH fill color := 0,0,255
  WITH font := "System"
  WITH justify IS center
  WITH frame := TRUE
  WITH show current := TRUE
  WITH attachment := new_component_name
  WITH location := 0,0,0,0

INSTANCE promptbox 3 invisible2 ISA promptbox
  WITH pen color := 255,255,255
  WITH fill color := 0,0,255
  WITH font := "System"
  WITH justify IS center
  WITH frame := TRUE
  WITH show current := TRUE
  WITH attachment := new_attribute_name
  WITH location := 0,0,0,0

INSTANCE promptbox 4 ISA promptbox
  WITH pen color := 255,0,0
  WITH fill color := 255,255,255
  WITH font := "System"
  WITH justify IS left
  WITH frame := TRUE
  WITH scroll := TRUE
  WITH show current := TRUE
  WITH attachment := cause_of_the_effect OF AB_general_rules
  WITH location := 15,230,240,275

INSTANCE promptbox 5 ISA promptbox
  WITH pen color := 255,0,0
  WITH fill color := 255,255,255
  WITH font := "System"
  WITH justify IS center
  WITH frame := TRUE
  WITH show current := TRUE
  WITH attachment := percent_change OF AB_general_rules
  WITH location := 110,55,155,80

INSTANCE promptbox 6 ISA promptbox
  WITH pen color := 255,0,0
  WITH fill color := 255,255,255
  WITH font := "System"
  WITH justify IS center
  WITH frame := TRUE
  WITH show current := TRUE
  WITH attachment := result_in_major_modification OF AB_general_rules
  WITH location := 190,295,240,320

INSTANCE promptbox 7 ISA promptbox
  WITH pen color := 255,0,0
  WITH fill color := 255,255,255
  WITH font := "System"
  WITH justify IS center
  WITH frame := TRUE
  WITH show current := TRUE
  WITH attachment := rule_ignored OF AB_general_rules
  WITH location := 190,345,240,370
```

```
INSTANCE promptbox 8 ISA promptbox
 WITH pen color := 128,0,0
 WITH fill color := 255,255,255
 WITH font := "System"
 WITH justify IS center
 WITH frame := TRUE
 WITH show current := TRUE
 WITH attachment := new_name_of_menu_group OF
Menus_manipulation_data
 WITH location := 185,300,335,325

INSTANCE promptbox 9 ISA promptbox
 WITH font := "System"
 WITH justify IS center
 WITH frame := TRUE
 WITH show current := TRUE
 WITH attachment := project_name
 WITH location := 10,135,160,165

INSTANCE pushbutton 1 ISA pushbutton
 WITH label := "Building Components"
 WITH attribute attachment := Building Components
 WITH location := 10,105,160,130

INSTANCE pushbutton 2 ISA pushbutton
 WITH label := "EXIT"
 WITH attribute attachment := exit OF application
 WITH location := 10,185,160,215

INSTANCE pushbutton 3 ISA pushbutton
 WITH label := "Delete"
 WITH location := 215,100,290,125

INSTANCE pushbutton 4 ISA pushbutton
 WITH label := "New Component"
 WITH location := 290,100,410,125

INSTANCE pushbutton 5 ISA pushbutton
 WITH label := "END"
 WITH attribute attachment :=
back_to_current_project_display
 WITH location := 425,5,500,35

INSTANCE pushbutton 6 ISA pushbutton
 WITH label := ""
 WITH location := 425,90,500,135

INSTANCE pushbutton 8 ISA pushbutton
 WITH label := "Return"
 WITH location := 175,250,395,275

INSTANCE pushbutton 10 invisible ISA pushbutton
 WITH label := "Done"
 WITH attribute attachment := done of new component
 WITH location := 0,0,0,0

INSTANCE pushbutton 11 invisible ISA pushbutton
 WITH label := "Cancel"
 WITH location := 0,0,0,0

INSTANCE pushbutton 12 invisible2 ISA pushbutton
 WITH label := "Done"
 WITH attribute attachment := done of new attribute
 WITH location := 0,0,0,0

INSTANCE pushbutton 13 invisible2 ISA pushbutton
 WITH label := "Next Attribute"
 WITH attribute attachment := next new attribute
 WITH location := 0,0,0,0

INSTANCE pushbutton 14 ISA pushbutton
 WITH label := "Delete"
 WITH location := 180,250,235,270

INSTANCE pushbutton 15 ISA pushbutton
 WITH label := "New"
 WITH location := 180,270,235,290

INSTANCE pushbutton 16 invisible2 ISA pushbutton
 WITH label := "OK"
 WITH attribute attachment := ok of attribute name
 WITH location := 0,0,0,0

INSTANCE pushbutton 17 ISA pushbutton
 WITH label := "General Rules"
 WITH attribute attachment := General Rules
 WITH location := 10,165,160,190

INSTANCE pushbutton 18 ISA pushbutton
 WITH label := "First"
 WITH attribute attachment := action OF rules
navigate 2 IS first
 WITH location := 400,240,490,265

INSTANCE pushbutton 19 ISA pushbutton
 WITH label := "Next"
 WITH attribute attachment := action OF navigate IS
next
 WITH location := 400,265,490,290

INSTANCE pushbutton 20 ISA pushbutton
 WITH label := "Previous"
 WITH attribute attachment := action OF navigate IS
previous
 WITH location := 400,290,490,315

INSTANCE pushbutton 21 ISA pushbutton
 WITH label := "Last"
 WITH attribute attachment := action OF navigate IS
last
 WITH location := 400,315,490,340

INSTANCE pushbutton 22 ISA pushbutton
 WITH label := "END"
 WITH attribute attachment :=
back_to_current_project_display
 WITH location := 280,400,480,425

INSTANCE pushbutton 23 ISA pushbutton
 WITH label := "Update Rule"
 WITH attribute attachment := update rule
 WITH location := 30,400,230,425

INSTANCE pushbutton 24 ISA pushbutton
 WITH label := "New Rule"
 WITH attribute attachment := new rule
 WITH location := 400,355,490,380

INSTANCE pushbutton 25 ISA pushbutton
 WITH location := 10,10,210,35

INSTANCE pushbutton 26 invisible2 ISA pushbutton
 WITH label := "Done"
 WITH attribute attachment := done of ID attribute
 WITH location := 0,0,0,0

INSTANCE pushbutton 26 ISA pushbutton
 WITH label := "Menus"
 WITH attribute attachment := Menus
 WITH location := 10,135,160,160

INSTANCE pushbutton 27 ISA pushbutton
 WITH label := "END"
 WITH attribute attachment :=
back_to_current_project_display
 WITH location := 345,360,500,415

INSTANCE pushbutton 28 ISA pushbutton
 WITH label := "Add to the Menu Group"
 WITH attribute attachment := add build comp OF
Menus_manipulation_data
 WITH location := 10,385,170,410

INSTANCE pushbutton 29 ISA pushbutton
 WITH label := "Del. Component"
 WITH attribute attachment := delete build comp OF
Menus_manipulation_data
 WITH location := 350,325,495,350

INSTANCE pushbutton 30 ISA pushbutton
 WITH label := "Add A Menu Group"
 WITH attribute attachment := add menu group OF
Menus_manipulation_data
 WITH location := 185,360,335,385

INSTANCE pushbutton 31 ISA pushbutton
 WITH label := "Delete Menu Group"
 WITH attribute attachment := delete menu group OF
Menus_manipulation_data
 WITH location := 185,260,335,285

INSTANCE pushbutton 32 ISA pushbutton
 WITH label := "Rename Menu Group"
 WITH attribute attachment := rename menu group OF
Menus_manipulation_data
 WITH location := 185,385,335,410

INSTANCE pushbutton 33 ISA pushbutton
 WITH label := "EXIT"
 WITH attribute attachment := exit OF application
 WITH location := 10,195,160,220

INSTANCE pushbutton 34 ISA pushbutton
 WITH label := "New Project"
 WITH attribute attachment := New_project
 WITH display attachment :=
NEW_project_start_display
 WITH location := 10,105,160,135

INSTANCE pushbutton 35 ISA pushbutton
 WITH label := "Existing Project"
 WITH attribute attachment := Current_project
 WITH display attachment :=
CURENT_project_start_display
 WITH location := 10,145,160,175

INSTANCE pushbutton 36 ISA pushbutton
 WITH label := "EXIT"
 WITH attribute attachment := exit OF application
 WITH location := 10,195,160,220

INSTANCE pushbutton 37 ISA pushbutton
 WITH label := "OK"
 WITH location := 10,170,160,195

INSTANCE pushbutton 38 ISA pushbutton
 WITH label := "OK"
 WITH location := 10,170,160,195

INSTANCE pushbutton 39 ISA pushbutton
 WITH label := "from Another Project"
 WITH display attachment := NEW from another
project display
 WITH location := 10,105,160,140

INSTANCE pushbutton 40 ISA pushbutton
 WITH label := "from Systems"
 WITH attribute attachment := from systems OF
NEW_to_make_a_new_project
 WITH location := 10,145,160,180

INSTANCE pushbutton 41 ISA pushbutton
 WITH label := "from Components"
 WITH attribute attachment := from components OF
NEW_to_make_a_new_project
 WITH location := 10,185,160,220

INSTANCE pushbutton 42 ISA pushbutton
 WITH label := "Modify components"
 WITH location := 10,120,160,145

INSTANCE pushbutton 43 ISA pushbutton
 WITH label := "Modify Gen. Rules"
 WITH location := 10,145,160,170

INSTANCE pushbutton 44 ISA pushbutton
 WITH label := "Config. Menus"
 WITH location := 10,170,160,195

INSTANCE pushbutton 45 ISA pushbutton
 WITH label := "Back"
 WITH display attachment :=
NEW_project_selection_display
 WITH location := 10,195,160,220

INSTANCE pushbutton 46 ISA pushbutton
 WITH label := "OK"
 WITH attribute attachment := from systems OF
NEW_to_make_a_new_project
 WITH location := 20,195,160,220

INSTANCE pushbutton 47 ISA pushbutton
 WITH label := "Add selected component to the new
project"
 WITH attribute attachment := add component to the
new project OF NEW_to_make_a_new_project
 WITH location := 20,355,335,380

INSTANCE pushbutton 48 ISA pushbutton
 WITH label := "Finish"
 WITH attribute attachment := finish components of
the new project OF NEW_to_make_a_new_project
 WITH location := 345,355,475,380

INSTANCE pushbutton 49 ISA pushbutton
 WITH label := "Add to the new project"
 WITH attribute attachment := add system to the new
project OF NEW_to_make_a_new_project
 WITH location := 255,330,475,355

INSTANCE pushbutton 50 ISA pushbutton
 WITH label := "Finish"
```

```
 WITH attribute attachment := finish systems of the
new project OF NEW_to_make_a_new_project
 WITH location := 255,360,475,385

INSTANCE pushbutton 51 ISA pushbutton
 WITH label := "Ignore highlighted compon."
 WITH attribute attachment := ignore highlighted
component OF NEW_to_make_a_new_project
 WITH location := 265,285,465,310

INSTANCE pushbutton 52 ISA pushbutton
 WITH label := " "
 WITH attribute attachment := get from general
database
 WITH location := 425,40,500,85

INSTANCE pushbutton 53 ISA pushbutton
 WITH label := "Add the Component"
 WITH attribute attachment := add component from
_get from general datab
 WITH location := 20,285,215,305

INSTANCE pushbutton 54 ISA pushbutton
 WITH label := "Return"
 WITH attribute attachment := return from _get from
general datab
 WITH location := 215,285,400,305

INSTANCE pushbutton 55 ISA pushbutton
 WITH label := "Add the Component and its related
General Rules "
 WITH attribute attachment := add component and
general rule
 WITH location := 20,305,400,325

INSTANCE radiobutton group 1 ISA radiobutton
group
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH frame := TRUE
 WITH group label := ""
 WITH show current := TRUE
 WITH attachment := discipline OF input data
 WITH location := 235,145,355,295

INSTANCE radiobutton group 2 ISA radiobutton
group
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH frame := TRUE
 WITH group label := "attribute type"
 WITH show current := TRUE
 WITH attachment := attribute type OF input data
 WITH location := 355,145,495,225

INSTANCE radiobutton group 3 ISA radiobutton
group
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH frame := TRUE
 WITH group label := ""
 WITH show current := TRUE
 WITH attachment := discipline OF input data
 WITH location := 260,220,395,385

INSTANCE table 1 ISA table
 WITH attachment := building_element_attribute
 WITH columns [1 ] := column 1
 WITH columns [2 ] := column 2
 WITH columns [3 ] := column 3
 WITH columns [4 ] := column 4
 WITH columns [5 ] := column 5
 WITH heading := TRUE
 WITH heading height := 50
 WITH fill color := 0,255,255
 WITH column lines := TRUE
 WITH row lines := TRUE
 WITH frame := TRUE
 WITH show current instance := TRUE
 WITH location := 10,45,590,240

INSTANCE textbox 1 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALSE
 WITH font size := 12
 WITH text := "CONFIGURATION
MODULE"
 WITH location := 10,30,155,80

INSTANCE textbox 2 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 12
 WITH frame := TRUE
 WITH text := "Configuration of Building Components
and Attributes"
 WITH location := 5,5,420,35

INSTANCE textbox 3 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "List of Building Components"
 WITH location := 15,50,205,70

INSTANCE textbox 4 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Building Components"
 WITH location := 215,50,410,70

INSTANCE textbox 5 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Building Component Attributes"
 WITH location := 15,150,220,170

INSTANCE textbox 6 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Attribute"
 WITH location := 15,240,130,260

INSTANCE textbox 7 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Select Linked Component"
 WITH location := 25,300,225,320

INSTANCE textbox 8 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Graph name"
 WITH location := 15,105,100,125

INSTANCE textbox 9 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Select Linked Attribute"
 WITH location := 25,345,185,365

INSTANCE textbox 10 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Linked Component"
 WITH location := 260,300,460,320

INSTANCE textbox 11 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Linked Attribute"
 WITH location := 260,345,420,365

INSTANCE textbox 12 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Type"
 WITH location := 355,225,445,250

INSTANCE textbox 13 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current
Discipline"
 WITH location := 355,250,425,290

INSTANCE textbox 14 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Review
Attributes"
 WITH location := 430,95,495,130

INSTANCE textbox 15 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 12
 WITH text := "Summary of Attributes of the Building
Component:"
 WITH location := 10,10,355,35

INSTANCE textbox 16 ISA textbox
 WITH pen color := 128,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "Times New Roman"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALSE
 WITH font size := 12
 WITH text := " "
 WITH location := 355,10,590,35

INSTANCE textbox 17 invisible ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Type the name of
building component"
 WITH location := 0,0,0,0

INSTANCE textbox 18 invisible2 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Type the attribute name of the
building component and press OK"
 WITH location := 0,0,0,0

INSTANCE textbox 19 invisible2 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Fill the rest of the attribute data
(discipline, type)"
 WITH location := 0,0,0,0

INSTANCE textbox 20 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 18
 WITH frame := TRUE
 WITH text := "GENERAL RULE
CONFIGURATION"
 WITH location := 5,5,500,45

INSTANCE textbox 23 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "then the discipline"
```

```
WITH location := 15,170,140,190

INSTANCE textbox 24 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "If such a change results in major
redesign, please type YES"
 WITH location := 10,285,190,335

INSTANCE textbox 26 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Select a Building Component"
 WITH location := 270,60,465,80

INSTANCE textbox 27 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Select a Component Attribute"
 WITH location := 270,105,465,125

INSTANCE textbox 28 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "# of Current Related Rules:"
 WITH location := 275,155,455,175

INSTANCE textbox 29 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Related Rules #:"
 WITH location := 275,180,445,200

INSTANCE textbox 30 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "of the following Building Component"
 WITH location := 10,125,245,145

INSTANCE textbox 31 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Related General Rule"
 WITH location := 405,205,495,240

INSTANCE textbox 32 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Affected Discipline"
 WITH location := 265,205,390,225

INSTANCE textbox 33 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "If you need this rule to be ignored,
please type YES"
 WITH location := 10,340,180,375

INSTANCE textbox 34 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 16
 WITH frame := TRUE
 WITH text := "Configuration of Menu of Building
Components"
 WITH location := 5,5,500,40

INSTANCE textbox 36 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Unclassified Building Components"
 WITH location := 15,55,160,90

INSTANCE textbox 37 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "List of Menu Groups"
 WITH location := 200,55,320,90

INSTANCE textbox 38 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Components of Current Menu Group"
 WITH location := 350,50,490,85

INSTANCE textbox 39 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Selected Menu Group"
 WITH location := 185,210,335,230

INSTANCE textbox 40 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Selected Building Component"
 WITH location := 15,320,165,355

INSTANCE temp invisible textbox 41 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Write the new name"
 WITH location := 0,0,0,0

INSTANCE textbox 41 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Type Added or Renamed Name above"
 WITH location := 185,325,335,360

INSTANCE textbox 42 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Selected Building Component"
 WITH location := 355,260,490,295

INSTANCE textbox 43 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Double click to select a project then
click OK"
 WITH location := 10,100,165,140

INSTANCE textbox 44 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 16
 WITH text := "Configure Existing Project"
 WITH location := 15,15,150,85

INSTANCE textbox 45 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 12
 WITH text := "What would you like to configure?"
 WITH location := 15,25,145,75

INSTANCE textbox 46 ISA textbox
 WITH justify IS left
 WITH font := "System"
 WITH text := "textbox 46"
 WITH location := 210,65,360,140

INSTANCE textbox 47 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 16
 WITH text := "Assemble New Project"
 WITH location := 10,20,155,75

INSTANCE textbox 48 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Type the project name then click OK"
 WITH location := 10,100,165,135

INSTANCE textbox 49 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 14
 WITH text := "Select an Assembly Method"
 WITH location := 20,15,145,80

INSTANCE textbox 50 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 12
 WITH text := "Assemble from another project"
 WITH location := 25,15,140,60

INSTANCE textbox 51 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Select project"
 WITH location := 40,75,140,95

INSTANCE textbox 52 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 12
 WITH text := "Select Participating Disciplines"
 WITH location := 15,10,155,55

INSTANCE textbox 53 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 14
 WITH frame := TRUE
 WITH text := "Assemble the New Project from the
Components"
 WITH location := 5,5,490,35

INSTANCE textbox 54 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Double click to select a building
component"
 WITH location := 105,65,395,85

INSTANCE textbox 55 ISA textbox
```

```
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Selected Component"
 WITH location := 30,215,110,250

INSTANCE textbox 57 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Attributes
of the Component"
 WITH location := 35,270,115,325

INSTANCE textbox 58 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 14
 WITH frame := TRUE
 WITH text := "Assemble the New Project from
Building Systems"
 WITH location := 5,5,490,35

INSTANCE textbox 59 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Double click to select a building
system"
 WITH location := 50,115,215,150

INSTANCE textbox 60 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Selected Building System"
 WITH location := 280,115,450,135

INSTANCE textbox 61 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Components in the building system"
 WITH location := 275,165,460,202

INSTANCE textbox 62 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Description of the highlighted building
system"
 WITH location := 40,275,225,312

INSTANCE textbox 63 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,128,128
 WITH justify IS center
 WITH font := "System"
 WITH text := "Double click to select a design
discipline"
 WITH location := 30,60,255,95

INSTANCE textbox 64 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "From
General"
 WITH location := 430,45,495,80

INSTANCE textbox 65 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Selected Component"
 WITH location := 20,170,100,205

INSTANCE textbox 66 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Attributes
of the Component"
 WITH location := 20,215,100,270

INSTANCE textbox 67 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 14
 WITH frame := TRUE
 WITH text := "Components in the General Database"
 WITH location := 5,5,415,35

INSTANCE textbox 68 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Double Click to Select a Component"
 WITH location := 90,55,330,75

INSTANCE textbox 69 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "If a change of          % occurs
to the following attribute"
 WITH location := 15,65,245,100

INSTANCE textbox 70 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "need to be notified because it may
affect "
 WITH location := 15,193,245,230

INSTANCE valuebox 1 ISA valuebox
 WITH pen color := 128,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := building_element OF
current_data
 WITH location := 215,70,410,95

INSTANCE valuebox 2 ISA valuebox
 WITH pen color := 128,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := attribute_of_building_element
OF current_data
 WITH location := 15,260,170,285

INSTANCE valuebox 3 ISA valuebox
 WITH pen color := 128,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := linked_building_element OF
current_data
 WITH location := 260,320,480,345

INSTANCE valuebox 4 ISA valuebox
 WITH pen color := 128,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment :=
linked_attribute_of_building_element OF current_data
 WITH location := 260,365,480,390

INSTANCE valuebox 5 ISA valuebox
 WITH pen color := 128,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := designing_discipline OF
current_data
 WITH location := 435,260,490,285

INSTANCE valuebox 6 ISA valuebox
 WITH pen color := 128,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := attribute_type OF current_data
 WITH location := 465,225,490,250

INSTANCE valuebox 7 ISA valuebox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := building_element OF
Current_rule_data
 WITH location := 15,145,240,165

INSTANCE valuebox 8 ISA valuebox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := attribute_of_building_element
OF Current_rule_data
 WITH location := 15,100,240,120

INSTANCE valuebox 9 ISA valuebox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := number instances OF rules
navigate 2
 WITH location := 455,155,490,175

INSTANCE valuebox 10 ISA valuebox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := instance number OF rules
navigate 2
 WITH location := 455,180,490,200

INSTANCE valuebox 11 ISA valuebox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := affected_discipline OF
AB_general_rules
 WITH location := 155,170,240,190

INSTANCE valuebox 13 ISA valuebox
 WITH pen color := 128,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := current_menu_B_comp OF
Menus_manipulation_data
 WITH location := 10,355,170,380

INSTANCE valuebox 14 ISA valuebox
 WITH pen color := 128,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
```

```
WITH clipped := TRUE
WITH attachment := current_menu_B_comp OF
Menus_manipulation_data
WITH location := 350,295,495,320

INSTANCE valuebox 15 ISA valuebox
WITH pen color := 128,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := current_menu_group OF
Menus_manipulation_data
WITH location := 185,230,335,255

INSTANCE valuebox 16 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := building_element OF
NEW_to_make_a_new_project
WITH location := 115,215,460,245

INSTANCE valuebox 17 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := building_system OF
NEW_to_make_a_new_project
WITH location := 265,135,465,160

INSTANCE valuebox 18 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := description OF
NEW_building_systems
WITH location := 35,315,230,370

INSTANCE valuebox 19 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment :=
GENERAL_Building_component
WITH location := 110,170,400,200

INSTANCE main window ISA window
WITH location := 207,160,381,413
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := ""
WITH visible := TRUE

INSTANCE configuration window ISA window
WITH location := 61,11,578,464
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable CF
FALSE
WITH title := ""
WITH visible := FALSE

INSTANCE attribute window ISA window
WITH location := 22,62,627,371
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := " "
WITH visible := FALSE

INSTANCE get from general database window ISA
window
WITH location := 192,114,617,490
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := " "
WITH visible := FALSE

! DEMON GROUP: affected_discipline OF
AB_general_rules

DEMON 11
IF CONF(affected_discipline OF AB_general_rules)
>= 0
THEN FORGET discipline OF input data

! DEMON GROUP: button selected OF message box

DEMON 5
IF button selected OF message box 1 IS yes
THEN delete a component := TRUE

DEMON 10
IF button selected OF message box 3 IS yes
THEN delete of attribute := TRUE

! DEMON GROUP: selected OF pushbutton

DEMON 1
IF selected OF pushbutton 6
THEN text OF textbox 16 := building_element OF
current_data
AND output OF attribute window := attributes table
display
AND visible OF attribute window := TRUE

DEMON 2
IF selected OF pushbutton 8
THEN visible OF attribute window := FALSE

DEMON 4
IF selected OF pushbutton 3
THEN put up OF message box 1 := TRUE

DEMON 6
IF selected OF pushbutton 4
THEN location OF border 6 invisible := 15,50,410,95
AND location OF textbox 17 invisible := 25,55,160,90
AND location OF promptbox 2 invisible :=
170,60,340,85
AND location OF pushbutton 10 invisible :=
355,50,410,70
AND location OF pushbutton 11 invisible :=
355,75,410,95
AND location OF pushbutton 12 invisible2 := 0,0,0,0
AND location OF promptbox 3 invisible2 := 0,0,0,0
AND location OF border 7 invisible2 := 0,0,0,0
AND location OF textbox 18 invisible2 := 0,0,0,0
AND location OF textbox 19 invisible2 := 0,0,0,0
AND location OF pushbutton 13 invisible2 := 0,0,0,0
AND FORGET current_data
AND FORGET building_element_attribute

DEMON 7
IF selected OF pushbutton 11 invisible
THEN location OF border 6 invisible := 0,0,0,0
AND location OF textbox 17 invisible := 0,0,0,0
AND location OF promptbox 2 invisible := 0,0,0,0
AND location OF pushbutton 10 invisible := 0,0,0,0
AND location OF pushbutton 11 invisible := 0,0,0,0

DEMON 8
IF selected OF pushbutton 15
THEN location OF pushbutton 16 invisible2 :=
180,195,220,220
AND location OF promptbox 3 invisible2 :=
25,195,220,220
AND location OF border 7 invisible2 :=
15,150,235,290
AND location OF textbox 18 invisible2 :=
25,155,220,190
AND location OF textbox 19 invisible2 :=
25,225,220,260
AND FORGET attribute_of_building_element OF
current_data
AND FORGET attribute_type OF current_data
AND FORGET designing_discipline OF current_data
AND FORGET linked_building_element OF
current_data
AND FORGET linked_attribute_of_building_element
OF current_data

DEMON 9
IF selected OF pushbutton 14
THEN put up OF message box 3 := TRUE

! DEMON GROUP: double clicked OF table

DEMON 3
IF double clicked OF table 1
THEN visible OF attribute window := FALSE
AND attribute_of_building_element OF current_data
:= attribute_of_building_element OF
building_element_attribute

END
```

C.2. DATA MANIPULATION MODULE

```
$VERSION35
$LOCATIONS ARE PIXELS

CLASS AB_general_rules
 WITH AB_general_rules_ID NUMERIC
 WITH building_element STRING
 WITH attribute_of_building_element STRING
 WITH affected_discipline STRING
 WITH percent_change NUMERIC
 WITH result_in_major_modification STRING
 WITH cause_of_the_effect STRING
 WITH rule_ignored STRING

CLASS border INHERITS add on, display item
 WITH style COMPOUND
  picture frame,
  edit control,
  group,
  shadow
  INIT picture frame
 WITH perspective COMPOUND
  in,
  out
  INIT in
 WITH border width NUMERIC
  INIT 1
 WITH background color COLOR
  INIT 192,192,192
 WITH fill color COLOR
  INIT 192,192,192
 WITH highlight color COLOR
  INIT 255,255,255
 WITH shadow color COLOR
  INIT 128,128,128

CLASS Building element
 WITH building_element STRING
 WITH graph_name STRING
  WHEN CHANGED
   BEGIN
    graph_name OF current_data := graph_name OF
Building element
   END

CLASS building_element_attribute
 WITH attribute_of_building_element STRING
 WITH attribute_type STRING
 WITH designing_discipline STRING
 WITH linked_building_element STRING
 WITH linked_attribute_of_building_element STRING

CLASS current_data
 WITH building_element STRING
  WHEN CHANGED
   BEGIN
    EXEC l5odbc 1 SQL SELECT *  from [AB-
attribute-designer] where building_element =
:current_data.building_element
               END SQL INTO
building_element_attribute
!
    FOR (i := 1 TO number instances OF navigate
1)
     BEGIN
      instance number OF navigate 1 := i
      IF ( CONF(linked_building_element OF
building_element_attribute) >= 0) THEN
       BEGIN
        EXEC l5odbc 1 SQL SELECT
linked_attribute_of_building_element from [AB-
attribute-designer] where building_element =
:current_data.building_element AND
linked_building_element =
:building_element_attribute.linked_building_element
               END SQL INTO domain (tt)
        linked_attribute_of_building_element OF
building_element_attribute := tt
       END
     END
!
    FORGET attribute type OF input data
    FORGET discipline OF input data
!
   END
 WITH attribute_of_building_element STRING
  WHEN CHANGED
   BEGIN
    IF ( CONF(attribute_of_building_element OF
current_data) >= 0) THEN
     BEGIN
      attribute_type OF current_data := attribute_type
OF building_element_attribute
      designing_discipline OF current_data :=
designing_discipline OF building_element_attribute
      linked_building_element OF current_data :=
linked_building_element OF
building_element_attribute
      linked_attribute_of_building_element OF
current_data := linked_attribute_of_building_element
OF building_element_attribute
      FORGET attribute type OF input data
      FORGET discipline OF input data
     END
   END
 WITH attribute_type STRING
 WITH designing_discipline STRING
 WITH linked_building_element STRING
  WHEN CHANGED
   BEGIN
    IF ( CONF(linked_building_element OF
current_data) >= 0) THEN
     BEGIN
      EXEC l5odbc 1 SQL SELECT *  from [AB-
attribute-designer] where building_element =
:current_data.linked_building_element
               END SQL INTO Linked element
attribute
!
      FIND Linked building element
       WHERE building_element OF Linked
building element = linked_building_element OF
current_data
       FIND END
!
      linked_building_element OF
building_element_attribute := linked_building_element
OF current_data
     END
!
   END
 WITH linked_attribute_of_building_element STRING
  WHEN CHANGED
   BEGIN
    IF ( CONF(linked_attribute_of_building_element
OF current_data) >= 0) THEN
     BEGIN
      linked_attribute_of_building_element OF
building_element_attribute := linked_building_element
OF current_data
     END
   END
 WITH graph_name STRING

CLASS Current_projects
 WITH project_name STRING

CLASS Current_rule_data
 WITH building_element STRING
  WHEN CHANGED
   BEGIN
    EXEC l5odbc 1 SQL SELECT *  from [AB-
attribute-designer] where building_element =
:Current_rule_data.building_element
               END SQL INTO
building_element_attribute
   END
 WITH attribute_of_building_element STRING
  WHEN CHANGED
   BEGIN
    EXEC l5odbc 1 SQL SELECT *  from [AB-
general-rules] where building_element =
:Current_rule_data.building_element AND
attribute_of_building_element =
:Current_rule_data.attribute_of_building_element
               END SQL INTO AB_general_rules
   END
 WITH affected_discipline STRING
 WITH result_in_major_modification STRING
 WITH cause_of_the_effect STRING
 WITH percent_change NUMERIC
 WITH rule_ignored STRING

CLASS edit table INHERITS add on, display item
 WITH attachment CLASS REFERENCE
 WITH columns INSTANCE REFERENCE
  COLLECTION
 WITH heading SIMPLE
  INIT TRUE
 WITH heading height NUMERIC
 WITH row height NUMERIC
 WITH fill color COLOR
 WITH row separator SIMPLE
  INIT TRUE
 WITH column separator SIMPLE
  INIT TRUE
 WITH max rows NUMERIC
 WITH total rows NUMERIC
 WITH current cell NUMERIC
  ARRAY SIZE 2
  INIT [1 ] 1
  INIT [2 ] 1
 WITH current cell data STRING
 WITH highlight text color COLOR
 WITH highlight fill color COLOR
 WITH display only SIMPLE
 WITH selected SIMPLE
 WITH double clicked SIMPLE

CLASS edit table column
 WITH attachment ATTRIBUTE REFERENCE
 WITH heading label STRING
 WITH heading style INSTANCE REFERENCE
 WITH column style INSTANCE REFERENCE
 WITH width NUMERIC
 WITH max characters NUMERIC
 WITH format STRING
 WITH justify COMPOUND
  left,
  center,
  right
  INIT left
 WITH pen color COLOR
  COLLECTION
 WITH fill color COLOR
  COLLECTION

CLASS GENERAL_Building_element
 WITH building_element STRING
 WITH graph_name STRING

CLASS GENERAL_building_element_attribute
 WITH attribute_of_building_element STRING
 WITH attribute_type STRING
 WITH designing_discipline STRING
 WITH linked_building_element STRING
 WITH linked_attribute_of_building_element STRING

CLASS input data
 WITH discipline COMPOUND
  Architect,
  Structure,
  HVAC,
  Illuminat,
  Interior,
  Envelope
  WHEN CHANGED
   BEGIN
!
    IF ( CONF(discipline OF input data) >= 0) THEN
     BEGIN
!
      IF discipline OF input data IS Architect THEN
       BEGIN
        designing_discipline OF
building_element_attribute := "arch"
        designing_discipline OF current_data :=
"arch"
        affected_discipline OF AB_general_rules :=
"arch"
       END
!
      IF discipline OF input data IS Structure THEN
```

```
        BEGIN
          designing_discipline OF
building_element_attribute := "stru"
          designing_discipline OF current_data :=
"stru"
          affected_discipline OF AB_general_rules :=
"stru"
        END
!
      IF discipline OF input data IS HVAC THEN
        BEGIN
          designing_discipline OF
building_element_attribute := "hvac"
          designing_discipline OF current_data :=
"hvac"
          affected_discipline OF AB_general_rules :=
"hvac"
        END
!
      IF discipline OF input data IS Illuminat THEN
        BEGIN
          designing_discipline OF
building_element_attribute := "illu"
          designing_discipline OF current_data :=
"illu"
          affected_discipline OF AB_general_rules :=
"illu"
        END
!
      IF discipline OF input data IS Interior THEN
        BEGIN
          designing_discipline OF
building_element_attribute := "inte"
          designing_discipline OF current_data :=
"inte"
          affected_discipline OF AB_general_rules :=
"inte"
        END
!
      IF discipline OF input data IS Envelope THEN
        BEGIN
          designing_discipline OF
building_element_attribute := "enve"
          designing_discipline OF current_data :=
"enve"
          affected_discipline OF AB_general_rules :=
"enve"
        END
!
      END
!
   END
 WITH attribute type COMPOUND
  Text data,
  Numeric data
  WHEN CHANGED
   BEGIN
!
    IF ( CONF(attribute type OF input data) >= 0)
THEN
     BEGIN
!
      IF attribute type OF input data IS Text data
THEN
       BEGIN
        attribute_type OF current_data := "t"
        attribute_type OF building_element_attribute
:= "t"
       END
!
      IF attribute type OF input data IS Numeric data
THEN
       BEGIN
        attribute_type OF current_data := "n"
        attribute_type OF building_element_attribute
:= "n"
       END
!
     END
!
   END

CLASS l5odbc INHERITS add on
 WITH data source STRING
 WITH userid STRING
 WITH password STRING
 WITH connection string STRING
 WITH connection prompting SIMPLE
  INIT FALSE
 WITH auto commit SIMPLE
  INIT TRUE
 WITH action COMPOUND
  connect,
  disconnect
 WITH records NUMERIC
 WITH transaction COMPOUND
  commit,
  rollback
 WITH append SIMPLE
  INIT FALSE
 WITH status STRING
 WITH show error SIMPLE
 WITH default error handling SIMPLE
  INIT TRUE
 WITH error message STRING
 WITH native error NUMERIC
 WITH trace file STRING

CLASS Linked building element
 WITH building_element STRING

CLASS Linked element attribute
 WITH attribute_of_building_element STRING

CLASS Menus_classified_B_comp
 WITH label STRING

CLASS Menus_group
 WITH label STRING

CLASS Menus_group_items
 WITH label STRING

CLASS Menus_manipulation_data
 WITH current_menu_group STRING
  WHEN CHANGED
   BEGIN
!
    IF CONF(current_menu_group OF
Menus_manipulation_data) > 0 THEN
     BEGIN
      EXEC l5odbc 1 SQL SELECT label from [AB-
menu_item] WHERE main_menu_label =
:Menus_manipulation_data.current_menu_group
              END SQL INTO
Menus_group_items
!
      FORGET current_menu_B_comp OF
Menus_manipulation_data
!
     END
!
! *** end of method
   END
 WITH current_menu_B_comp STRING
 WITH add build comp SIMPLE
  WHEN CHANGED
   BEGIN
!
    IF CONF(current_menu_B_comp OF
Menus_manipulation_data) > 0 AND CONF(
current_menu_group OF Menus_manipulation_data) >
0 THEN
     BEGIN
!
      EXEC l5odbc 1 SQL INSERT into [AB-
menu_item] (label, main_menu_label) values
    (
:Menus_manipulation_data.current_menu_B_comp,
:Menus_manipulation_data.current_menu_group)
              END SQL
!
      EXEC l5odbc 1 SQL SELECT label from [AB-
menu_item] WHERE main_menu_label =
:Menus_manipulation_data.current_menu_group
              END SQL INTO
Menus_group_items
!
      FIND Menus_unclassified_B_comp
        WHERE label OF
Menus_unclassified_B_comp = current_menu_B_comp
OF Menus_manipulation_data
        WHEN FOUND
         FORGET CURRENT
Menus_unclassified_B_comp
      FIND END
!
      FORGET current_menu_B_comp OF
Menus_manipulation_data
!
! *** end of IF
     END
     ELSE
      BEGIN
       text OF message box 2 := "A selected Menu
Group or Building Component is missing"
       put up OF message box 2 := TRUE
      END
!
!
! *** end of method
   END
 WITH delete build comp SIMPLE
  WHEN CHANGED
   BEGIN
!
    IF CONF(current_menu_B_comp OF
Menus_manipulation_data) > 0 AND CONF(
current_menu_group OF Menus_manipulation_data) >
0 THEN
     BEGIN
!
      EXEC l5odbc 1 SQL DELETE from [AB-
menu_item] WHERE label =
:Menus_manipulation_data.current_menu_B_comp
              END SQL
!
      EXEC l5odbc 1 SQL SELECT label from [AB-
menu_item] WHERE main_menu_label =
:Menus_manipulation_data.current_menu_group
              END SQL INTO
Menus_group_items
!
      MAKE Menus_unclassified_B_comp
        WITH label := current_menu_B_comp OF
Menus_manipulation_data
!
      FORGET current_menu_B_comp OF
Menus_manipulation_data
!
! *** end of IF
     END
    ELSE
     BEGIN
      text OF message box 2 := "A selected Menu
Group or Building Component is missing"
      put up OF message box 2 := TRUE
     END
!
! *** end of method
   END
 WITH add menu group SIMPLE
  WHEN CHANGED
   BEGIN
!
    IF CONF(current_menu_B_comp OF
Menus_manipulation_data) > 0 AND CONF(
new_name_of_menu_group OF
Menus_manipulation_data) > 0 THEN
     BEGIN
!
      EXEC l5odbc 1 SQL INSERT into [AB-
menu_item] (label, main_menu_label) values
    (
:Menus_manipulation_data.current_menu_B_comp,
:Menus_manipulation_data.new_name_of_menu_group
)
              END SQL
!
      EXEC l5odbc 1 SQL SELECT label from [AB-
menu_item] WHERE main_menu_label =
:Menus_manipulation_data.new_name_of_menu_group
              END SQL INTO
Menus_group_items
!
      FIND Menus_unclassified_B_comp
        WHERE label OF
Menus_unclassified_B_comp = current_menu_B_comp
OF Menus_manipulation_data
        WHEN FOUND
         FORGET CURRENT
Menus_unclassified_B_comp
      FIND END
!
      MAKE Menus_group
        WITH label := new_name_of_menu_group
OF Menus_manipulation_data
!
      FORGET current_menu_B_comp OF
Menus_manipulation_data
      FORGET current_menu_group OF
Menus_manipulation_data
      FORGET new_name_of_menu_group OF
```

```
Menus_manipulation_data
!
! *** end of IF
      END
     ELSE
      BEGIN
       text OF message box 2 := "Type a New Menu Group and select a Building Component"
       put up OF message box 2 := TRUE
      END
!
!
! *** end of method
   END
 WITH delete menu group SIMPLE
  WHEN CHANGED
   BEGIN
!
     IF CONF(current_menu_group OF Menus_manipulation_data) > 0 THEN
      BEGIN
!
       EXEC 15odbc 1 SQL DELETE from [AB-menu_item] WHERE main_menu_label = :Menus_manipulation_data.current_menu_group
                 END SQL
!
       FORGET current_menu_B_comp OF Menus_manipulation_data
       FORGET current_menu_group OF Menus_manipulation_data
       FORGET Menus_group_items
!
       EXEC 15odbc 1 SQL SELECT distinct (main_menu_label) from [AB-menu_item]
                 END SQL INTO Menus_group (label)
!
       EXEC 15odbc 1 SQL SELECT label from [AB-menu_item]
                 END SQL INTO Menus_classified_B_comp
!
       FOR (i := 1 TO number instances OF navigate Building element)
        BEGIN
         instance number OF navigate Building element := i
         FIND Menus_classified_B_comp
          WHERE label OF Menus_classified_B_comp = building_element OF Building element
          WHEN NONE FOUND
           MAKE Menus_unclassified_B_comp
            WITH label := building_element OF Building element
         FIND END
        END
!
! *** end of IF
      END
     ELSE
      BEGIN
       text OF message box 2 := "A selected Menu Group is missing"
       put up OF message box 2 := TRUE
      END
!
! *** end of method
   END
 WITH rename menu group SIMPLE
  WHEN CHANGED
   BEGIN
!
     IF CONF(new_name_of_menu_group OF Menus_manipulation_data) > 0 AND CONF( current_menu_group OF Menus_manipulation_data) > 0 THEN
      BEGIN
!
       FOR (i := 1 TO number instances OF navigate menu_group_items)
        BEGIN
         instance number OF navigate menu_group_items := i
         EXEC 15odbc 1 SQL update [AB-menu_item] set
           main_menu_label = :Menus_manipulation_data.new_name_of_menu_group
            WHERE label = :Menus_group_items.label
          END SQL
        END
!
       FIND Menus_group
        WHERE label OF Menus_group = current_menu_group OF Menus_manipulation_data
         WHEN FOUND
          label OF Menus_group := new_name_of_menu_group OF Menus_manipulation_data
       FIND END
!
       current_menu_group OF Menus_manipulation_data := new_name_of_menu_group OF Menus_manipulation_data
       FORGET new_name_of_menu_group OF Menus_manipulation_data
! *** end of IF
      END
     ELSE
      BEGIN
       text OF message box 2 := "A selected Menu Group or a New name for the Menu Group is missing"
       put up OF message box 2 := TRUE
      END
!
! *** end of method
   END
 WITH new_name_of_menu_group STRING

CLASS Menus_unclassified_B_comp
 WITH label STRING

CLASS message box INHERITS add on
 WITH title STRING
 WITH text STRING
 WITH variable text STRING
 WITH modal style COMPOUND
  app modal,
  sys modal,
  not modal
  INIT app modal
 WITH icon COMPOUND
  exclamation,
  information,
  question,
  stop sign
  INIT exclamation
 WITH button COMPOUND
  abort retry ignore,
  ok,
  ok cancel,
  retry cancel,
  yes no,
  yes no cancel
  INIT ok
 WITH default button COMPOUND
  one,
  two,
  three
  INIT one
 WITH button selected COMPOUND
  abort,
  cancel,
  ignore,
  no,
  ok,
  retry,
  yes
 WITH put up SIMPLE

CLASS navigate INHERITS add on
 WITH class attachment CLASS REFERENCE
 WITH action COMPOUND
  first,
  previous,
  next,
  last
 WITH instance number NUMERIC
 WITH number instances NUMERIC

CLASS NEW_building_systems
 WITH building_system STRING
 WITH description STRING
 WITH discipline STRING

CLASS NEW_design_disciplines
 WITH discipline STRING

CLASS NEW_other_project_components
 WITH building_element STRING

CLASS NEW_to_make_a_new_project
 WITH from another project SIMPLE
 WITH from systems SIMPLE
  WHEN CHANGED
   BEGIN
    EXEC 15odbc 2 SQL select distinct (discipline) from [building_systems]
        END SQL INTO NEW_design_disciplines
!
    action OF 15odbc 1 IS connect := TRUE
!
    visible OF main window := FALSE
    visible OF configuration window := TRUE
    output OF configuration window := NEW from systems display
   END
 WITH from components SIMPLE
  WHEN CHANGED
   BEGIN
    EXEC 15odbc 2 SQL select distinct (building_element) from [General-AB-attribute-designer]
        END SQL INTO Building element
!
    action OF 15odbc 1 IS connect := TRUE
!
    visible OF main window := FALSE
    visible OF configuration window := TRUE
    output OF configuration window := NEW from components display
   END
 WITH another_project_name STRING
  WHEN CHANGED
   BEGIN
!
! **** this part will do the following
! **** 1) make connection to the other project database
! **** 2) read the components from the table AB-attribute-designer form the database of the
! ****    other project
! **** 3) create tables in the new project database
! **** 4) insert the tables data into the table AB-attribute-designer of the new table
! **** 5) read the general rules and menus from the old project database and put them
! ****    in the database of the new project database
!
! ------ connect to the new project database
    action OF 15odbc 1 IS connect := TRUE
!
! --------- make connection with the database of the other project
    data source OF 15odbc 3 := another_project_name OF NEW_to_make_a_new_project
    action OF 15odbc 3 IS connect := TRUE
!
! --------- read the components from the other project
    EXEC 15odbc 3 SQL SELECT distinct (building_element), graph_name from [AB-attribute-designer]
      END SQL INTO Building element
    FOR (i := 1 TO number instances OF navigate Building element)
      BEGIN
       instance number OF navigate Building element := i
     ! **** create the database table with its id attribute
       general statement of sql := CONCAT( "CREATE TABLE [", building_element OF Building element, "] ([", building_element OF Building element, "_id] TEXT(50));")
       EXEC 15odbc 1 SQL WITH general statement of sql END SQL
      END
!
! --------- read the attributes of the components from the other project
    FOR (i := 1 TO number instances OF navigate Building element)
      BEGIN
       instance number OF navigate Building element := i
     ! **** the next step is to overcome the name "Building element" which can not be linked to Access
       tt := building_element OF Building element
       EXEC 15odbc 3 SQL SELECT * from [AB-attribute-designer] where building_element = :domain.tt
           END SQL INTO
```

```
building_element_attribute
        FOR (ii := 1 TO number instances OF
navigate building element attributes)
          BEGIN
            instance number OF navigate building
element attributes := ii
        ! **** ignore the attribute that has the _id of the
table
            IF SEARCHSTR("_id",
attribute_of_building_element OF
building_element_attribute) = 0 THEN
              BEGIN
        ! **** put the attributes in the database
                general statement of sql := CONCAT(
"alter table [", building_element OF Building element,
"] add [", attribute_of_building_element OF
building_element_attribute, "] ")
              IF attribute_type OF
building_element_attribute = "t" THEN
                general statement of sql := CONCAT(
general statement of sql, "TEXT (50);")
              IF attribute_type OF
building_element_attribute = "n" THEN
                general statement of sql := CONCAT(
general statement of sql, "Number;")
              EXEC lSodbc 1 SQL WITH general
statement of sql END SQL
              END
!
          END
        END
!
! ------- insert the tables data into the table AB-
attribute-designer of the new table
    FOR (i := 1 TO number instances OF navigate
Building element)
      BEGIN
        instance number OF navigate Building element
:= i
    ! **** the next step is to overcome the name
"Building element" which can not be linked to Access
        tt := building_element OF Building element
!
        EXEC lSodbc 3 SQL SELECT * from [AB-
attribute-designer] where building_element =
:domain.tt
                END SQL INTO
building_element_attribute
!
        FOR (ii := 1 TO number instances OF
navigate building element attributes)
          BEGIN
            instance number OF navigate building
element attributes := ii
            IF CONF(linked_building_element OF
building_element_attribute) = 100 THEN
              BEGIN
!
!             ****** the following step is necessary as data
can not be got directly from access to this attribute
              EXEC lSodbc 3 SQL SELECT
(linked_attribute_of_building_element) from [AB-
attribute-designer]
              where building_element = :domain.tt and
attribute_of_building_element =
:building_element_attribute.attribute_of_building_elem
ent
                END SQL INTO domain (ttt)
              linked_attribute_of_building_element OF
building_element_attribute := ttt
!
              EXEC lSodbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline, linked_building_element,
linked_attribute_of_building_element) values
              ( :domain.tt,
:building_element_attribute.attribute_of_building_elem
ent, :building_element_attribute.attribute_type,
:building_element_attribute.designing_discipline,:build
ing_element_attribute.linked_building_element,:buildin
g_element_attribute.linked_attribute_of_building_elem
ent )
    END SQL
              END
            ELSE
              BEGIN
              EXEC lSodbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline) values
```

```
                ( :domain.tt,
:building_element_attribute.attribute_of_building_elem
ent, :building_element_attribute.attribute_type,
:building_element_attribute.designing_discipline)


                                                  END
SQL
              END
            END
          END
!
!
! ------- get the general rules from the old database
and save them in the new one (ignore the id attribute)
      EXEC lSodbc 3 SQL SELECT * from [AB-
general-rules]
                END SQL INTO AB_general_rules
!
      FOR (i := 1 TO number instances OF rules
navigate 2)
        BEGIN
          instance number OF rules navigate 2 := i
          EXEC lSodbc 1 SQL INSERT INTO [AB-
general-rules] (building_element,
attribute_of_building_element, affected_discipline,
percent_change, result_in_major_modification,
cause_of_the_effect) values
            ( :AB_general_rules.building_element,
:AB_general_rules.attribute_of_building_element,
:AB_general_rules.affected_discipline,
:AB_general_rules.percent_change,
:AB_general_rules.result_in_major_modification,
:AB_general_rules.cause_of_the_effect)
      END SQL
        END
!
!
!
! ------- to activate the push bottons
      attribute attachment OF pushbutton 42 := Building
Components
      attribute attachment OF pushbutton 43 := Menus
      attribute attachment OF pushbutton 44 := General
Rules
!
! **** end of method
    END
  WITH building_element STRING
    WHEN CHANGED
    BEGIN
      EXEC lSodbc 2 SQL SELECT * from [General-
AB-attribute-designer] where building_element =
:NEW_to_make_a_new_project.building_element
                END SQL INTO
building_element_attribute
    END
  WITH add component to the new project SIMPLE
    WHEN CHANGED
    BEGIN
      i := 0
      CONF(tt) := -2
!
! **** check that there is an inserted name and that this
name does not exist
      IF ( CONF(building_element OF
NEW_to_make_a_new_project) >= 0) THEN
        BEGIN
!
        EXEC lSodbc 1 SQL select distinct
building_element from [AB-attribute-designer]
            where building_element =
:NEW_to_make_a_new_project.building_element
            END SQL INTO domain (tt)
!
        END
!
!
!
      IF CONF(tt) = 100 THEN
        i := 1
      ELSE
        i := 2
!
!
!
      IF i = 1 THEN
        BEGIN
          text OF message box 2 := "There is already a
building component with that name"
          put up OF message box 2 := TRUE
```

```
          END
!
!
!
! ****** If the name was not used before
!
      IF i = 2 THEN
        BEGIN
!
! **** create the database table with its id attribute
          general statement of sql := CONCAT(
"CREATE TABLE [", building_element OF
NEW_to_make_a_new_project, "] ([",
building_element OF NEW_to_make_a_new_project,
"_id] TEXT(50));")
          EXEC lSodbc 1 SQL WITH general statement
of sql END SQL
!
! ***** add the rest of attributes to the created table
        FOR (ii := 1 TO number instances OF
navigate building element attributes)
          BEGIN
            instance number OF navigate building
element attributes := ii
        ! **** ignore the attribute that has the _id of the
table
            IF SEARCHSTR("_id",
attribute_of_building_element OF
building_element_attribute) = 0 THEN
              BEGIN
        ! **** put the attributes in the database
                general statement of sql := CONCAT(
"alter table [", building_element OF Building element,
"] add [", attribute_of_building_element OF
building_element_attribute, "] ")
              IF attribute_type OF
building_element_attribute = "t" THEN
                general statement of sql := CONCAT(
general statement of sql, "TEXT (50);")
              IF attribute_type OF
building_element_attribute = "n" THEN
                general statement of sql := CONCAT(
general statement of sql, "Number;")
              EXEC lSodbc 1 SQL WITH general
statement of sql END SQL
              END
            END
!
! **** add the attributes to the table [AB-attribute-
designer] in the new project
        FOR (ii := 1 TO number instances OF
navigate building element attributes)
          BEGIN
            instance number OF navigate building
element attributes := ii
            IF CONF(linked_building_element OF
building_element_attribute) = 100 THEN
              BEGIN
!
!             ****** the following step is necessary as data
can not be got directly from access to this attribute
              EXEC lSodbc 2 SQL SELECT
(linked_attribute_of_building_element) from
[GENERAL-AB-attribute-designer]
              where building_element =
:NEW_to_make_a_new_project.building_element and
attribute_of_building_element =
:building_element_attribute.attribute_of_building_elem
ent
                END SQL INTO domain (ttt)
              linked_attribute_of_building_element OF
building_element_attribute := ttt
!
              EXEC lSodbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline, linked_building_element,
linked_attribute_of_building_element) values
              (
:NEW_to_make_a_new_project.building_element,
:building_element_attribute.attribute_of_building_elem
ent, :building_element_attribute.attribute_type,
:building_element_attribute.designing_discipline,:build
ing_element_attribute.linked_building_element,:buildin
g_element_attribute.linked_attribute_of_building_elem
ent )


                                                  END
SQL
          END
```

```
        ELSE
          BEGIN
            EXEC lSodbc 1 SQL INSERT INTO [AB-attribute-designer] (building_element, attribute_of_building_element, attribute_type, designing_discipline) values
              (
:NEW_to_make_a_new_project.building_element,
:building_element_attribute.attribute_of_building_element, :building_element_attribute.attribute_type,
:building_element_attribute.designing_discipline)
END SQL
            END
          END
        END
!
! **** end of method
   END
 WITH finish components of the new project SIMPLE
  WHEN CHANGED
   BEGIN
!
! **** this method aims to add the general rules of the chosen components to the new project database
!
! **** get the names of the components from the new project database
     EXEC lSodbc 1 SQL select distinct (building_element) from [AB-attribute-designer]
       END SQL INTO Building element
  !
     FOR (i := 1 TO number instances OF navigate Building element)
       BEGIN
        instance number OF navigate Building element := i
        tt := building_element OF Building element
        EXEC lSodbc 2 SQL select * from [GENERAL-AB-general-rules] where building_element = :domain.tt
          END SQL INTO AB_general_rules
!
! ***** add the rules to the new project database
!
        FOR (ii := 1 TO number instances OF rules navigate 2)
          BEGIN
           instance number OF rules navigate 2 := ii
           EXEC lSodbc 1 SQL INSERT INTO [AB-general-rules] (building_element, attribute_of_building_element, affected_discipline, percent_change, result_in_major_modification, cause_of_the_effect) values
              ( :AB_general_rules.building_element,
:AB_general_rules.attribute_of_building_element,
:AB_general_rules.affected_discipline,
:AB_general_rules.percent_change,
:AB_general_rules.result_in_major_modification,
:AB_general_rules.cause_of_the_effect)
END SQL
          END
!
       END
!
! **** move to the CURRENT_project_selection_display to allow more configuration
     visible OF configuration window := FALSE
     visible OF main window := TRUE
     output OF main window := CURENT_project_selection_display
!
! **** end of method
   END
 WITH design_discipline STRING
  WHEN CHANGED
   BEGIN
!
     EXEC lSodbc 2 SQL select * from building_systems where discipline = :NEW_to_make_a_new_project.design_discipline
       END SQL INTO NEW_building_systems
!
   END
 WITH building_system STRING
  WHEN CHANGED
   BEGIN
!
     EXEC lSodbc 2 SQL SELECT * from [components_of_building_system] where building_system = :NEW_to_make_a_new_project.building_system
                 END SQL INTO Building element
!
   END
 WITH ignore highlighted component SIMPLE
  WHEN CHANGED
   BEGIN
    FORGET  CURRENT Building element
   END
 WITH add system to the new project SIMPLE
  WHEN CHANGED
   BEGIN
!
! **** check that there is an inserted name and that this name does not exist
     IF ( CONF(building_system OF NEW_to_make_a_new_project) >= 0) THEN
      BEGIN
!
!
!
       FOR (i := 1 TO number instances OF navigate Building element)
         BEGIN
          instance number OF navigate Building element := i
!
!  **** get the attributes of the building element
          tt := building_element OF Building element
          EXEC lSodbc 2 SQL select * from [GENERAL-AB-attribute-designer] where building_element = :domain.tt
         END SQL INTO building_element_attribute
!
! **** build the tables and the attributes in the new project data
! **** create the database table with its id attribute
          general statement of sql := CONCAT( "CREATE TABLE [", building_element OF Building element, "] ([", building_element OF Building element, "_id] TEXT(50));")
          EXEC lSodbc 1 SQL WITH general statement of sql END SQL
!
! ***** add the rest of attributes to the created table
          FOR (ii := 1 TO number instances OF navigate building element attributes)
            BEGIN
             instance number OF navigate building element attributes := ii
       ! **** ignore the attribute that has the _id of the table
             IF SEARCHSTR("_id", attribute_of_building_element OF building_element_attribute) = 0 THEN
               BEGIN
       ! **** put the attributes in the database
                general statement of sql := CONCAT( "alter table [", building_element OF Building element, "] add [", attribute_of_building_element OF building_element_attribute, "] ")
               IF attribute_type OF building_element_attribute = "t" THEN
                 general statement of sql := CONCAT( general statement of sql, "TEXT (50);")
               IF attribute_type OF building_element_attribute = "n" THEN
                 general statement of sql := CONCAT( general statement of sql, "Number;")
               EXEC lSodbc 1 SQL WITH general statement of sql END SQL
               END
            END
! **** add the attributes to the table [AB-attribute-designer] in the n\
ew project
          FOR (ii := 1 TO number instances OF navigate building element attributes)
            BEGIN
             instance number OF navigate building element attributes := ii
           - IF CONF(linked_building_element OF building_element_attribute) = 100 THEN
               BEGIN
!
!          ****** the following step is necessary as data can not be got directly from access to this attribute
               EXEC lSodbc 2 SQL SELECT (linked_attribute_of_building_element) from [GENERAL-AB-attribute-designer]
               where building_element = :domain.tt and attribute_of_building_element = :building_element_attribute.attribute_of_building_element
                  END SQL INTO domain (ttt)
                linked_attribute_of_building_element OF building_element_attribute := ttt
!
                EXEC lSodbc 1 SQL INSERT INTO [AB-attribute-designer] (building_element, attribute_of_building_element, attribute_type, designing_discipline, linked_building_element, linked_attribute_of_building_element) values
              ( :domain.tt,
:building_element_attribute.attribute_of_building_element, :building_element_attribute.attribute_type,
:building_element_attribute.designing_discipline,:building_element_attribute linked_building_element,:building_element_attribute.linked_attribute_of_building_element )
END SQL
               END
              ELSE
               BEGIN
                EXEC lSodbc 1 SQL INSERT INTO [AB-attribute-designer] (building_element, attribute_of_building_element, attribute_type, designing_discipline) values
              ( :domain.tt,
:building_element_attribute.attribute_of_building_element, :building_element_attribute.attribute_type,
:building_element_attribute.designing_discipline)
END SQL
               END
            END
! ***** end of FOR i
         END
! **** end of IF
      END
!
! **** end of method
   END
 WITH finish systems of the new project SIMPLE
  WHEN CHANGED
   BEGIN
! **** this method aims to add the general rules of the components of the chosen system to the new project database
!
! **** get the names of the components from the new project database
     EXEC lSodbc 1 SQL select distinct (building_element) from [AB-attribute-designer]
       END SQL INTO Building element
  !
     FOR (i := 1 TO number instances OF navigate Building element)
       BEGIN
        instance number OF navigate Building element := i
        tt := building_element OF Building element
        EXEC lSodbc 2 SQL select * from [GENERAL-AB-general-rules] where building_element = :domain.tt
            END SQL INTO AB_general_rules
!
! ***** add the rules to the new project database
!
        FOR (ii := 1 TO number instances OF rules navigate 2)
          BEGIN
           instance number OF rules navigate 2 := ii
           EXEC lSodbc 1 SQL INSERT INTO [AB-general-rules] (building_element, attribute_of_building_element, affected_discipline, percent_change, result_in_major_modification, cause_of_the_effect) values
              ( :AB_general_rules.building_element,
:AB_general_rules.attribute_of_building_element,
:AB_general_rules.affected_discipline,
:AB_general_rules.percent_change,
:AB_general_rules.result_in_major_modification,
:AB_general_rules.cause_of_the_effect)
END SQL
          END
!
       END
!
! **** move to the CURRENT_project_selection_display to allow more configuration
     visible OF configuration window := FALSE
```

```
    visible OF main window := TRUE
    output OF main window :=
CURENT_project_selection_display
!
! **** end of method
   END

ATTRIBUTE Building Components SIMPLE
 WHEN CHANGED
  BEGIN
   action OF l5odbc 1 IS connect := TRUE
!
   EXEC l5odbc 1 SQL SELECT distinct
(building_element), graph_name from [AB-attribute-
designer]
      END SQL INTO Building element
!
   EXEC l5odbc 1 SQL SELECT distinct
(building_element) from [AB-attribute-designer]
      END SQL INTO Linked building element
!
   visible OF main window := FALSE
   output OF configuration window := config
   visible OF configuration window := TRUE
!
  END
ATTRIBUTE tt STRING
ATTRIBUTE i NUMERIC
ATTRIBUTE general statement of sql STRING
ATTRIBUTE done of new component SIMPLE
 WHEN CHANGED
  BEGIN
   i := 0
!
! **** check that there is an inserted name and that this
name does not exist
   IF ( CONF(new_component_name) >= 0) THEN
    BEGIN
     FIND Building element
      WHERE  building_element OF Building
element = new_component_name
      WHEN FOUND
       i := 1
      WHEN NONE FOUND
       i := 2
     FIND END
!
     IF i = 1 THEN
      BEGIN
       text OF message box 2 := "There is already a
building component with that name"
       put up OF message box 2 := TRUE
       FORGET  new_component_name
      END
!
! If the name was not used befor
     IF i = 2 THEN
      BEGIN
! **** hide the temporary put elements and put the
temporary elements for ID data
       location OF border 6 invisible := 0,0,0,0
       location OF textbox 17 invisible := 0,0,0,0
       location OF promptbox 2 invisible := 0,0,0,0
       location OF pushbutton 10 invisible := 0,0,0,0
       location OF pushbutton 11 invisible := 0,0,0,0
       location OF pushbutton 26 invisible2 :=
25,265,220,285
       location OF promptbox 3 invisible2 :=
25,195,220,220
       location OF border 7 invisible2 :=
15,150,235,290
       location OF textbox 19 invisible2 :=
25,225,220,260
!
! **** create the database table with its id attribute
       general statement of sql := CONCAT(
"CREATE TABLE [", new_component_name, "] ([",
new_component_name, "_id] TEXT(50));")
       EXEC l5odbc 1 SQL WITH general statement
of sql END SQL
!
! **** add the information to [AB-attribute-designer]
table
       new_attribute_name := CONCAT(
new_component_name, "_id")
       EXEC l5odbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element) values
 ( :domain.new_component_name,
domain.new_attribute_name )
       END SQL
!
       MAKE Building element
        WITH building_element :=
new_component_name
!
       MAKE building_element_attribute
        WITH attribute_of_building_element :=
new_attribute_name
        WITH attribute_type :=  "t"
!
       building_element OF current_data :=
new_component_name
       attribute_of_building_element OF
current_data := new_attribute_name
       attribute_type OF current_data := "t"
!
      END
    END
!
  END
ATTRIBUTE new_component_name STRING
ATTRIBUTE new_attribute_name STRING
ATTRIBUTE done of new attribute SIMPLE
 WHEN CHANGED
  BEGIN
!
   i := 0
!
   IF ( CONF(new_attribute_name) >= 0 AND
CONF( attribute_type OF current_data) >= 0 AND
CONF( designing_discipline OF current_data) >= 0)
THEN
    BEGIN
!
     attribute_of_building_element OF current_data
:= new_attribute_name
     attribute_type OF building_element_attribute :=
attribute_type OF current_data
     designing_discipline OF
building_element_attribute := designing_discipline OF
current_data
     IF CONF(linked_building_element OF
current_data) >= 0 THEN
      BEGIN
       linked_building_element OF
building_element_attribute := linked_building_element
OF current_data
       linked_attribute_of_building_element OF
building_element_attribute :=
linked_attribute_of_building_element OF current_data
      END
!
! **** put in the database
     general statement of sql := CONCAT( "alter
table [", building_element OF current_data, "] add [",
attribute_of_building_element OF current_data, "] ")
     IF attribute_type OF current_data = "t" THEN
      general statement of sql := CONCAT( general
statement of sql, "TEXT (50);")
     IF attribute_type OF current_data = "n" THEN
      general statement of sql := CONCAT( general
statement of sql, "Number;")
     EXEC l5odbc 1 SQL WITH general statement of
sql END SQL
!
     EXEC l5odbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline) values
 ( :current_data.building_element,
:current_data.attribute_of_building_element,
:current_data.attribute_type,
:current_data.designing_discipline )
       END SQL
!
     IF i = 1 THEN
      BEGIN
       EXEC l5odbc 1 SQL UPDATE [AB-attribute-
designer] set
 linked_building_element =
:current_data.linked_building_element,
 linked_attribute_of_building_element =
:current_data.linked_attribute_of_building_element
 WHERE building_element =
:current_data.building_element AND
attribute_of_building_element =
:current_data.attribute_of_building_element
      END SQL
      END
!
     IF CONF(graph_name OF current_data) >= 0
THEN
      BEGIN
       EXEC l5odbc 1 SQL UPDATE [AB-attribute-
designer] set graph_name = :current_data.graph_name
 WHERE building_element =
:current_data.building_element AND
attribute_of_building_element =
:current_data.attribute_of_building_element
      END SQL
      END
!
!
     FORGET  new_attribute_name
     FORGET  attribute type OF input data
     FORGET  discipline OF input data
     location OF pushbutton 12 invisible2 := 0,0,0,0
     location OF pushbutton 13 invisible2 := 0,0,0,0
     location OF border 7 invisible2 := 0,0,0,0
     location OF textbox 18 invisible2 := 0,0,0,0
     location OF textbox 19 invisible2 := 0,0,0,0
     location OF pushbutton 16 invisible2 := 0,0,0,0
     location OF promptbox 3 invisible2 := 0,0,0,0
!
    END
   ELSE
    BEGIN
     text OF message box 2 := "Some essential data
are missing. Check attribute name, type, and designing
discipline."
     put up OF message box 2 := TRUE
    END
  END
ATTRIBUTE next new attribute SIMPLE
 WHEN CHANGED
  BEGIN
   IF ( CONF(new_attribute_name) >= 0 AND
CONF( attribute_type OF current_data) >= 0 AND
CONF( designing_discipline OF current_data) >= 0)
THEN
    BEGIN
!
     attribute_type OF building_element_attribute :=
attribute_type OF current_data
     designing_discipline OF
building_element_attribute := designing_discipline OF
current_data
     IF CONF(linked_building_element OF
current_data) >= 0 THEN
      BEGIN
       linked_building_element OF
building_element_attribute := linked_building_element
OF current_data
       linked_attribute_of_building_element OF
building_element_attribute :=
linked_attribute_of_building_element OF current_data
      END
!
     FORGET  new_attribute_name
     FORGET  attribute_of_building_element OF
current_data
     FORGET  attribute_type OF current_data
     FORGET  designing_discipline OF current_data
     FORGET  linked_building_element OF
current_data
     FORGET  linked_attribute_of_building_element
OF current_data
     FORGET  attribute type OF input data
     FORGET  discipline OF input data
     location OF pushbutton 16 invisible2 :=
180,195,220,220
     location OF promptbox 3 invisible2 :=
25,195,220,220
     location OF textbox 18 invisible2 :=
25,155,220,190
!
    END
   ELSE
    BEGIN
     text OF message box 2 := "Some essential data
are missing. Check attribute name, type, and designing
discipline."
     put up OF message box 2 := TRUE
    END
  END
ATTRIBUTE ok of attribute name SIMPLE
 WHEN CHANGED
  BEGIN
   IF ( CONF(new_attribute_name) >= 0) THEN
    BEGIN
! **** check if there is an attribute with the same name
     FIND building_element_attribute
```

```
        WHERE attribute_of_building_element OF
building_element_attribute = new_attribute_name
        WHEN FOUND
        i := 1
        WHEN NONE FOUND
        i := 2
      FIND END
!
      IF i = 2 THEN
        BEGIN
         MAKE building_element_attribute
          WITH attribute_of_building_element :=
new_attribute_name
         location OF pushbutton 12 invisible2 :=
25,265,225,285
         location OF pushbutton 16 invisible2 :=
0,0,0,0
        END
      END
!
! **** end of method
  END
ATTRIBUTE General Rules SIMPLE
 WHEN CHANGED
  BEGIN
!
   action OF I5odbc 1 IS connect := TRUE
!
   EXEC I5odbc 1 SQL SELECT distinct
(building_element) from [AB-attribute-designer]
      END SQL INTO Building element
!
   visible OF main window := FALSE
   output OF configuration window := General rules
display
   visible OF configuration window := TRUE
!
! ***** end of method
  END
ATTRIBUTE update rule SIMPLE
 WHEN CHANGED
  BEGIN
   IF ( CONF(building_element OF
AB_general_rules) >= 0 AND CONF(
attribute_of_building_element OF AB_general_rules)
>= 0 AND CONF( affected_discipline OF
AB_general_rules) >= 0) THEN
     BEGIN
      IF CONF(AB_general_rules_ID OF
AB_general_rules) >= 0 THEN
       BEGIN
        EXEC I5odbc 1 SQL update [AB-general-
rules] set
 affected_discipline =
:AB_general_rules.affected_discipline,
 percent_change = :AB_general_rules.percent_change,
 result_in_major_modification =
:AB_general_rules.result_in_major_modification,
 rule_ignored = :AB_general_rules.rule_ignored,
 cause_of_the_effect =
:AB_general_rules.cause_of_the_effect
 where AB_general_rules_ID =
:AB_general_rules.AB_general_rules_ID
 END SQL
       END
      ELSE
       BEGIN
        IF CONF(percent_change OF
AB_general_rules) < 0 THEN
         percent_change OF AB_general_rules := 0
        IF CONF(result_in_major_modification OF
AB_general_rules) < 0 THEN
         result_in_major_modification OF
AB_general_rules := "No"
        IF CONF(rule_ignored OF AB_general_rules)
< 0 THEN
         rule_ignored OF AB_general_rules := "No"
        IF CONF(cause_of_the_effect OF
AB_general_rules) < 0 THEN
         cause_of_the_effect OF AB_general_rules :=
""
        EXEC I5odbc 1 SQL insert into [AB-general-
rules]
 (building_element, attribute_of_building_element,
affected_discipline, percent_change,
result_in_major_modification,
rule_ignored,cause_of_the_effect)
  values
 ( :AB_general_rules.building_element,
:AB_general_rules.attribute_of_building_element,
:AB_general_rules.affected_discipline,
:AB_general_rules.percent_change,
:AB_general_rules.result_in_major_modification,
:AB_general_rules.rule_ignored,
:AB_general_rules.cause_of_the_effect)
 END SQL
       END
!
     END
    ELSE
     BEGIN
      text OF message box 2 := "Some important data
are missing.
You may need to puch New Rule botton"
      put up OF message box 2 := TRUE
     END
  END
ATTRIBUTE new rule SIMPLE
 WHEN CHANGED
  BEGIN
   IF ( CONF(building_element OF
Current_rule_data) >= 0 AND CONF(
attribute_of_building_element OF Current_rule_data)
>= 0) THEN
     BEGIN
      FORGET discipline OF input data
      MAKE AB_general_rules
       WITH building_element := building_element
OF Current_rule_data
       WITH attribute_of_building_element :=
attribute_of_building_element OF Current_rule_data
     END
  END
ATTRIBUTE delete a component SIMPLE
 WHEN CHANGED
  BEGIN
   IF CONF(building_element OF current_data) >= 0
THEN
     BEGIN
      general statement of sql := CONCAT( "drop
table ", building_element OF current_data)
      EXEC I5odbc 1 SQL WITH general statement of
sql END SQL
      EXEC I5odbc 1 SQL delete from [AB-attribute-
designer] where building_element =
:current_data.building_element END SQL
      EXEC I5odbc 1 SQL SELECT distinct
(building_element), graph_name from [AB-attribute-
designer]
         END SQL INTO Building element
      EXEC I5odbc 1 SQL SELECT distinct
(building_element) from [AB-attribute-designer]
         END SQL INTO Linked building element
      FORGET current_data
      FORGET building_element_attribute
     END
    ELSE
     BEGIN
      text OF message box 2 := "No Building
Component is currently chosen"
      put up OF message box 2 := TRUE
     END
!
! **** end of method
  END
ATTRIBUTE done of ID attribute SIMPLE
 WHEN CHANGED
  BEGIN
!
   i := 0
!
   IF ( CONF(new_attribute_name) >= 0 AND
CONF( attribute_type OF current_data) >= 0 AND
CONF( designing_discipline OF current_data) >= 0)
THEN
     BEGIN
!
      attribute_type OF building_element_attribute :=
attribute_type OF current_data
      designing_discipline OF
building_element_attribute := designing_discipline OF
current_data
      IF CONF(linked_building_element OF
current_data) >= 0 THEN
        BEGIN
         linked_building_element OF
building_element_attribute := linked_building_element
OF current_data
         linked_attribute_of_building_element OF
building_element_attribute :=
linked_attribute_of_building_element OF current_data
         i := 1
        END
!
! **** put in the database
      EXEC I5odbc 1 SQL UPDATE [AB-attribute-
designer] set
 attribute_type = :current_data.attribute_type,
 designing_discipline =
:current_data.designing_discipline
 WHERE building_element =
:current_data.building_element AND
attribute_of_building_element =
:current_data.attribute_of_building_element
      END SQL
!
      IF i = 1 THEN
       BEGIN
        EXEC I5odbc 1 SQL UPDATE [AB-attribute-
designer] set
 linked_building_element =
:current_data.linked_building_element,
 linked_attribute_of_building_element =
:current_data.linked_attribute_of_building_element
 WHERE building_element =
:current_data.building_element AND
attribute_of_building_element =
:current_data.attribute_of_building_element
       END SQL
       END
!
      IF CONF(graph_name OF current_data) >= 0
THEN
       BEGIN
        EXEC I5odbc 1 SQL UPDATE [AB-attribute-
designer] set graph_name = :current_data.graph_name
 WHERE building_element =
:current_data.building_element AND
attribute_of_building_element =
:current_data.attribute_of_building_element
       END SQL
       END
!
      FORGET new_attribute_name
      FORGET attribute type OF input data
      FORGET discipline OF input data
      location OF pushbutton 12 invisible2 := 0,0,0,0
      location OF pushbutton 13 invisible2 := 0,0,0,0
      location OF promptbox 3 invisible2 := 0,0,0,0
      location OF border 7 invisible2 := 0,0,0,0
      location OF textbox 18 invisible2 := 0,0,0,0
      location OF textbox 19 invisible2 := 0,0,0,0
      location OF pushbutton 16 invisible2 := 0,0,0,0
      location OF pushbutton 26 invisible2 := 0,0,0,0
!
     END
    ELSE
     BEGIN
      text OF message box 2 := "Some essential data
are missing. Check attribute name, type, and designing
discipline."
      put up OF message box 2 := TRUE
     END
  END
ATTRIBUTE delete of attribute SIMPLE
 WHEN CHANGED
  BEGIN
   IF CONF(attribute_of_building_element OF
current_data) >= 0 THEN
     BEGIN
!
! *** delete from its table and from table [AB-attribute-
designer]
      general statement of sql := CONCAT( "alter
table [", building_element OF current_data, "] drop [",
attribute_of_building_element OF current_data, "];")
      EXEC I5odbc 1 SQL WITH general statement of
sql END SQL
      EXEC I5odbc 1 SQL delete from [AB-attribute-
designer] where building_element =
:current_data.building_element AND
attribute_of_building_element =
:current_data.attribute_of_building_element END SQL
!
! **** delete the related data from Level 5
      FIND building_element_attribute
       WHERE attribute_of_building_element OF
building_element_attribute =
attribute_of_building_element OF current_data
       WHEN FOUND
        FORGET CURRENT
building_element_attribute
      FIND END
```

```
      FORGET attribute_of_building_element OF
current_data
      FORGET attribute_type OF current_data
      FORGET designing_discipline OF current_data
      FORGET linked_building_element OF
current_data
      FORGET linked_attribute_of_building_element
OF current_data
     END
    ELSE
     BEGIN
      text OF message box 2 := "No Building
Component Attribute is currently chosen"
      put up OF message box 2 := TRUE
     END
!
! **** end of method
  END
ATTRIBUTE Menus SIMPLE
 WHEN CHANGED
  BEGIN
!
    action OF ISodbc 1 IS connect := TRUE
!
    EXEC ISodbc 1 SQL SELECT distinct
(building_element) from [AB-attribute-designer]
              END SQL INTO Building element
!
    EXEC ISodbc 1 SQL SELECT distinct
(main_menu_label) from [AB-menu_item]
              END SQL INTO Menus_group (label)
!
    EXEC ISodbc 1 SQL SELECT label from [AB-
menu_item]
              END SQL INTO
Menus_classified_B_comp
!
    FOR (i := 1 TO number instances OF navigate
Building element)
     BEGIN
      instance number OF navigate Building element
:= i
      FIND Menus_classified_B_comp
       WHERE label OF Menus_classified_B_comp
= building_element OF Building element
       WHEN NONE FOUND
        MAKE Menus_unclassified_B_comp
         WITH label := building_element OF
Building element
      FIND END
     END
!
    visible OF main window := FALSE
    output OF configuration window := Menus display
    visible OF configuration window := TRUE
!
! *** end of method
  END
ATTRIBUTE project_name STRING
 WHEN CHANGED
  BEGIN
   data source OF ISodbc 1 := project_name
   title OF configuration window := CONCAT(
"Configuring Project : ", project_name)
   attribute attachment OF pushbutton 38 :=
check_the_existance_of_new_project_name
   display attachment OF pushbutton 37 :=
CURENT_project_selection_display
  END
ATTRIBUTE New_project SIMPLE
 WHEN CHANGED
  BEGIN
   action OF ISodbc 2 IS connect := TRUE
   EXEC ISodbc 2 SQL select Project_name from
Current_projects
      END SQL INTO Current_projects
  END
ATTRIBUTE Current_project SIMPLE
 WHEN CHANGED
  BEGIN
   action OF ISodbc 2 IS connect := TRUE
   EXEC ISodbc 2 SQL select Project_name from
Current_projects
      END SQL INTO Current_projects
  END
ATTRIBUTE back_to_current_project_display
SIMPLE
 WHEN CHANGED
  BEGIN
   visible OF configuration window := FALSE
   visible OF main window := TRUE
   output OF main window :=
CURENT_project_selection_display
   END
ATTRIBUTE
check_the_existance_of_new_project_name SIMPLE
 WHEN CHANGED
  BEGIN
   FIND Current_projects
    WHERE project_name OF Current_projects =
project_name
    WHEN FOUND
     text OF message box 2 := "This name already
exists for a current project.
Type another name please. "
     put up OF message box 2 := TRUE
    WHEN NONE FOUND
     setup a new project := TRUE
   FIND END
! --- end of method
  END
ATTRIBUTE setup a new project SIMPLE
 WHEN CHANGED
  BEGIN
!
! ***** this method does the following:
! ***** 1) Read the paths of the ODBC.ini file and the
path of the directorey
! *****     that is used for this program and contains an
"empty" database
! ***** 2) Modify the ODBC.INI file so it links to the
new database
! ***** 3) Add the file name to the General database so
as to be considered existing project
! ***** 4) Prepare a batch file to exceute the next step
! ***** 5) Make a new database by copy the empty
database to a file with
! *****     the new name
!
!
! ----- read the path of the files from the file
project.ini
   action OF file 1 IS open old := TRUE
   WHILE (NOT eof OF file 1)
    BEGIN
     read line OF file 1 := TRUE
     IF SUBSTR(current line OF file 1, 1, 16) =
"path of ODBC.ini" THEN
       path_of_odbc := SUBSTR( current line OF file
1, 36, 11)
     IF SUBSTR(current line OF file 1, 1, 29) =
"path of the developed program" THEN
       current_path := SUBSTR( current line OF file
1, 36, 16)
    END
   action OF file 1 IS close := TRUE
!
! ----- modify the ODBC.ini
   filename OF file 3 := CONCAT( path_of_odbc,
"ODBC.INI")
   action OF file 3 IS open old := TRUE
   WHILE (NOT eof OF file 3)
    BEGIN
     read line OF file 3 := TRUE
    END
   write line OF file 3 := CONCAT( "[",
project_name, "]")
   write line OF file 3 := CONCAT( "Driver=",
path_of_odbc, "SYSTEM\ODBCJT16.DLL")
   write line OF file 3 := CONCAT( "DBQ=",
project_name, ".MDB")
   write line OF file 3 := CONCAT( "DefaultDir=",
current_path)
   write line OF file 3 := "FIL=Microsoft Access"
   write line OF file 3 := "JetIniPath=msacc20.ini"
   write line OF file 3 := "UID=Admin"
   write line OF file 3 := "  "
   action OF file 3 IS close := TRUE
!
! ----- add the new file to the general database
   EXEC ISodbc 2 SQL insert into Current_projects
(Project_name) values ( :domain.project_name )
     END SQL
!
! ----- make a batch file to have a new database
   action OF file 2 IS delete := TRUE
   action OF file 2 IS open new := TRUE
   write line OF file 2 := CONCAT( "copy ",
current_path, "empty.mdb ", current_path,
project_name, ".mdb ")
   write line OF file 2 := CONCAT( "copy ",
current_path, "empty.ldb ", current_path, project_name,
".ldb ")
   action OF file 2 IS close := TRUE
!
! ----- make a copy of the empty database
   ACTIVATE "IPU, EXTERN, project.bat"
!
! ----- connect the display to the window
   output OF main window :=
NEW_project_selection_display
!
! *** end of method
  END
ATTRIBUTE path_of_odbc STRING
ATTRIBUTE current_path STRING
ATTRIBUTE ii NUMERIC
ATTRIBUTE ttt STRING
ATTRIBUTE get from general database SIMPLE
 WHEN CHANGED
  BEGIN
!
!
    EXEC ISodbc 2 SQL select distinct
(building_element) from [General-AB-attribute-
designer]
        END SQL INTO
GENERAL_Building_element
!
! **** remove the building elements that are already in
use
   FOR (i := 1 TO number instances OF navigate
Building element)
    BEGIN
     instance number OF navigate Building element
:= i
     FIND GENERAL_Building_element
      WHERE building_element OF
GENERAL_Building_element = building_element OF
Building element
      WHEN FOUND
       FORGET CURRENT
GENERAL_Building_element
     FIND END
    END
!
   visible OF get from general database window :=
TRUE
   output OF get from general database window := add
from general database display
!
! **** end of method
  END
ATTRIBUTE GENERAL_Building_component
STRING
 WHEN CHANGED
  BEGIN
   EXEC ISodbc 2 SQL SELECT * from [General-
AB-attribute-designer] where building_element =
:domain.GENERAL_Building_component
        END SQL INTO
GENERAL_building_element_attribute
  END
ATTRIBUTE add component from _get from general
datab SIMPLE
 WHEN CHANGED
  BEGIN
   i := 0
   FIND Building element
    WHERE LOWCASE( building_element OF
Building element) = LOWCASE(
GENERAL_Building_component)
    WHEN FOUND
     i := 1
    WHEN NONE FOUND
     i := 2
   FIND END
!
!
   IF i = 1 THEN
    BEGIN
     text OF message box 2 := "This Component
Already exists"
     put up OF message box 2 := TRUE
    END
!
!
   IF i = 2 THEN
    BEGIN
!
! **** create the database table with its id attribute
     general statement of sql := CONCAT( "CREATE
TABLE [", GENERAL_Building_component, "] ([",
```

```
GENERAL_Building_component, "_id] TEXT(50));")
      EXEC l5odbc 1 SQL WITH general statement of
sql END SQL
!
! ***** add the rest of attributes to the created table
      FOR (ii := 1 TO number instances OF navigate
GENERAL building element attributes)
         BEGIN
          instance number OF navigate GENERAL
building element attributes := ii
         ! **** ignore the attribute that has the _id of the
table
          IF SEARCHSTR("_id",
attribute_of_building_element OF
GENERAL_building_element_attribute) = 0 THEN
            BEGIN
      ! **** put the attributes in the database
          general statement of sql := CONCAT( "alter
table [", building_element OF
GENERAL_Building_element, "] add [",
attribute_of_building_element OF
GENERAL_building_element_attribute, "] ")
             IF attribute_type OF
GENERAL_building_element_attribute = "t" THEN
               general statement of sql := CONCAT(
general statement of sql, "TEXT (50);")
             IF attribute_type OF
GENERAL_building_element_attribute = "n" THEN
               general statement of sql := CONCAT(
general statement of sql, "Number;")
             EXEC l5odbc 1 SQL WITH general
statement of sql END SQL
            END
          END
!
! **** add the attributes to the table [AB-attribute-
designer] in the new project
      FOR (ii := 1 TO number instances OF navigate
GENERAL building element attributes)
         BEGIN
          instance number OF navigate GENERAL
building element attributes := ii
          IF CONF(linked_building_element OF
GENERAL_building_element_attribute) = 100 THEN
            BEGIN
!
!          ****** the following step is necessary as data
can not be got directly from access to this attribute
             EXEC l5odbc 2 SQL SELECT
(linked_attribute_of_building_element) from
[GENERAL-AB-attribute-designer]
             where building_element =
:domain.GENERAL_Building_component and
attribute_of_building_element =
:GENERAL_building_element_attribute.attribute_of_b
uilding_element
                 END SQL INTO domain (ttt)
             linked_attribute_of_building_element OF
GENERAL_building_element_attribute := ttt
!
             EXEC l5odbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline, linked_building_element,
linked_attribute_of_building_element) values
               (
:domain.GENERAL_Building_component,
:GENERAL_building_element_attribute.attribute_of_b
uilding_element,
:GENERAL_building_element_attribute.attribute_type,
:GENERAL_building_element_attribute.designing_dis
cipline,:GENERAL_building_element_attribute.linked
_building_element,:GENERAL_building_element_attri
bute.linked_attribute_of_building_element )

                                                END
SQL
            END
           ELSE
            BEGIN
             EXEC l5odbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline) values
               (
:domain.GENERAL_Building_component,
:GENERAL_building_element_attribute.attribute_of_b
uilding_element,
:GENERAL_building_element_attribute. atribute_type,
:GENERAL_building_element_attribute designing_dis
cipline)

                                                END
SQL
          END
        END
      END
!
! *** end of method
  END
ATTRIBUTE return from _get from general datab
SIMPLE
 WHEN CHANGED
  BEGIN
!
   EXEC l5odbc 1 SQL SELECT distinct
(building_element), graph_name from [AB-attribute-
designer]
     END SQL INTO Building element
!
   EXEC l5odbc 1 SQL SELECT distinct
(building_element) from [AB-attribute-designer]
     END SQL INTO Linked building element
!
   visible OF get from general database window :=
FALSE
  END
ATTRIBUTE add component and general rule
SIMPLE
 WHEN CHANGED
  BEGIN
   i := 0
   FIND Building element
    WHERE  LOWCASE( building_element OF
Building element) = LOWCASE(
GENERAL_Building_component)
    WHEN FOUND
     i := 1
    WHEN NONE FOUND
     i := 2
   FIND END
!
!
   IF i = 1 THEN
    BEGIN
     text OF message box 2 := "This Component
Already exists"
     put up OF message box 2 := TRUE
    END
!
!
   IF i = 2 THEN
    BEGIN
!
! **** create the database table with its id attribute
      general statement of sql := CONCAT( "CREATE
TABLE [", GENERAL_Building_component, "] ([",
GENERAL_Building_component, "_id] TEXT(50));")
      EXEC l5odbc 1 SQL WITH general statement of
sql END SQL
!
! ***** add the rest of attributes to the created table
      FOR (ii := 1 TO number instances OF navigate
GENERAL building element attributes)
        BEGIN
         instance number OF navigate GENERAL
building element attributes := ii
         ! **** ignore the attribute that has the _id of the
table
         IF SEARCHSTR("_id",
attribute_of_building_element OF
GENERAL_building_element_attribute) = 0 THEN
           BEGIN
      ! **** put the attributes in the database
          general statement of sql := CONCAT( "alter
table [", building_element OF
GENERAL_Building_element, "] add [",
attribute_of_building_element OF
GENERAL_building_element_attribute, "] ")
            IF attribute_type OF
GENERAL_building_element_attribute = "t" THEN
              general statement of sql := CONCAT(
general statement of sql, "TEXT (50);")
            IF attribute_type OF
GENERAL_building_element_attribute = "n" THEN
              general statement of sql := CONCAT(
general statement of sql, "Number;")
            EXEC l5odbc 1 SQL WITH general
statement of sql END SQL
           END
          END
!
! **** add the attributes to the table [AB-attribute-
designer] in the new project
      FOR (ii := 1 TO number instances OF navigate
GENERAL building element attributes)
        BEGIN
         instance number OF navigate GENERAL
building element attributes := ii
         IF CONF(linked_building_element OF
GENERAL_building_element_attribute) = 100 THEN
           BEGIN
!
!          ****** the following step is necessary as data
can not be got directly from access to this attribute
             EXEC l5odbc 2 SQL SELECT
(linked_attribute_of_building_element) from
[GENERAL-AB-attribute-designer]
             where building_element =
:domain.GENERAL_Building_component and
attribute_of_building_element =
:GENERAL_building_element_attribute.attribute_of_b
uilding_element
                 END SQL INTO domain (ttt)
             linked_attribute_of_building_element OF
GENERAL_building_element_attribute := ttt
!
             EXEC l5odbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline, linked_building_element,
linked_attribute_of_building_element) values
               (
:domain.GENERAL_Building_component,
:GENERAL_building_element_attribute.attribute_of_b
uilding_element,
:GENERAL_building_element_attribute.attribute_type,
:GENERAL_building_element_attribute.designing_dis
cipline,:GENERAL_building_element_attribute.linked
_building_element,:GENERAL_building_element_attri
bute.linked_attribute_of_building_element )

                                                END
SQL
            END
           ELSE
            BEGIN
             EXEC l5odbc 1 SQL INSERT INTO [AB-
attribute-designer] (building_element,
attribute_of_building_element, attribute_type,
designing_discipline) values
               (
:domain.GENERAL_Building_component,
:GENERAL_building_element_attribute.attribute_of_b
uilding_element,
:GENERAL_building_element_attribute.attribute_type,
:GENERAL_building_element_attribute.designing_dis
cipline)

                                                END
SQL
          END
        END
!
! **** Add the General Rules
!
      EXEC l5odbc 2 SQL select * from [GENERAL-
AB-general-rules] where building_element =
:domain.GENERAL_Building_component
      END SQL INTO AB_general_rules
!
! ***** add the rules to the new project database
!
      FOR (ii := 1 TO number instances OF rules
navigate 2)
        BEGIN
         instance number OF rules navigate 2 := ii
         EXEC l5odbc 1 SQL INSERT INTO [AB-
general-rules] (building_element,
attribute_of_building_element, affected_discipline,
percent_change, result_in_major_modification,
cause_of_the_effect) values
             ( :AB_general_rules.building_element,
:AB_general_rules.attribute_of_building_element,
:AB_general_rules.affected_discipline,
:AB_general_rules.percent_change,
:AB_general_rules.result_in_major_modification,
:AB_general_rules.cause_of_the_effect)
```

```
END
SQL
END
!
!
! *** end of IF
END
!
! *** end of method
END

INSTANCE border 1 ISA border
 WITH style IS shadow
 WITH perspective IS in
 WITH border width := 4
 WITH background color := 192,192,192
 WITH fill color := 0,0,128
 WITH highlight color := 0,0,0
 WITH shadow color := 0,0,0
 WITH location := 5,5,165,100

INSTANCE border 2 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,40,420,135

INSTANCE border 3 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,140,500,410

INSTANCE border 4 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 15,295,490,400

INSTANCE border 5 ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 4
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,40,595,245

INSTANCE border 6 invisible ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 0,0,0,0

INSTANCE border 7 invisible2 ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 0,0,0,0

INSTANCE border 8 ISA border
 WITH style IS edit control
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,50,250,395

INSTANCE border 9 ISA border
 WITH style IS edit control
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 253,50,500,395

INSTANCE border 10 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,45,175,415

INSTANCE border 11 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 180,45,340,415

INSTANCE border 12 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 345,45,500,355

INSTANCE border 13 ISA border
 WITH style IS shadow
 WITH perspective IS in
 WITH border width := 4
 WITH background color := 192,192,192
 WITH fill color := 0,0,128
 WITH highlight color := 0,0,0
 WITH shadow color := 0,0,0
 WITH location := 5,5,165,75

INSTANCE border 14 ISA border
 WITH style IS shadow
 WITH perspective IS in
 WITH border width := 4
 WITH background color := 192,192,192
 WITH fill color := 0,0,128
 WITH highlight color := 0,0,0
 WITH shadow color := 0,0,0
 WITH location := 10,5,170,60

INSTANCE border 15 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,40,490,400

INSTANCE border 16 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 10,45,485,395

INSTANCE border 17 ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 3
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 20,55,475,195

INSTANCE border 18 ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 3
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 20,205,475,345

INSTANCE border 19 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,40,490,400

INSTANCE border 20 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 10,45,485,395

INSTANCE border 21 ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 3
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 20,110,240,385

INSTANCE border 22 ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 3
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 255,110,475,320

INSTANCE border 23 ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 3
 WITH background color := 192,192,192
 WITH fill color := 0,128,128
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 20,55,475,100

INSTANCE border 24 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,40,415,340

INSTANCE border 25 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 10,45,410,335

INSTANCE edit table column 1 ISA edit table column
 WITH attachment := attribute_of_building_element
OF building_element_attribute
 WITH heading label :=
"attribute_of_building_element"
 WITH width := 70
 WITH justify IS left
 WITH pen color [1 ] := UNDETERMINED
 WITH fill color [1 ] := UNDETERMINED

INSTANCE edit table column 2 ISA edit table column
```

```
WITH attachment := attribute_type OF
building_element_attribute
  WITH heading label := "attribute_type"
  WITH width := 70
  WITH justify IS left
  WITH pen color [1 ] := UNDETERMINED
  WITH fill color [1 ] := UNDETERMINED

INSTANCE edit table column 3 ISA edit table column
  WITH attachment := designing_discipline OF
building_element_attribute
  WITH heading label := "designing_discipline"
  WITH width := 70
  WITH justify IS left
  WITH pen color [1 ] := UNDETERMINED
  WITH fill color [1 ] := UNDETERMINED

INSTANCE edit table column 4 ISA edit table column
  WITH attachment := linked_building_element OF
building_element_attribute
  WITH heading label := "linked_building_element"
  WITH width := 70
  WITH justify IS left
  WITH pen color [1 ] := UNDETERMINED
  WITH fill color [1 ] := UNDETERMINED

INSTANCE edit table column 5 ISA edit table column
  WITH attachment :=
linked_attribute_of_building_element OF
building_element_attribute
  WITH heading label :=
"linked_attribute_of_building_element"
  WITH width := 70
  WITH justify IS left
  WITH pen color [1 ] := UNDETERMINED
  WITH fill color [1 ] := UNDETERMINED

INSTANCE l5odbc 1 ISA l5odbc
  WITH connection prompting := FALSE
  WITH auto commit := TRUE
  WITH append := FALSE
  WITH default error handling := TRUE

INSTANCE l5odbc 2 ISA l5odbc
  WITH data source := "general"
  WITH connection prompting := FALSE
  WITH auto commit := TRUE
  WITH append := FALSE
  WITH default error handling := TRUE

INSTANCE l5odbc 3 ISA l5odbc
  WITH connection prompting := FALSE
  WITH auto commit := TRUE
  WITH append := FALSE
  WITH default error handling := TRUE

INSTANCE message box 1 ISA message box
  WITH title := "Warning Message"
  WITH text := "Are you sure that you want to
DELETE the current building component"
  WITH modal style IS sys modal
  WITH icon IS question
  WITH button IS yes no
  WITH default button IS one

INSTANCE message box 2 ISA message box
  WITH title := "INPUT ERROR"
  WITH modal style IS app modal
  WITH icon IS stop sign
  WITH button IS ok
  WITH default button IS one

INSTANCE message box 3 ISA message box
  WITH title := "Warning Message"
  WITH text := "Are you sure that you want to
DELETE the current component attribute
"
  WITH modal style IS sys modal
  WITH icon IS question
  WITH button IS yes no
  WITH default button IS one

INSTANCE navigate 1 ISA navigate
  WITH class attachment := building_element_attribute

INSTANCE rules navigate 2 ISA navigate
  WITH class attachment := AB_general_rules

INSTANCE navigate Building element ISA navigate
  WITH class attachment := Building element

INSTANCE navigate menu_group_items ISA navigate
  WITH class attachment := Menus_group_items

INSTANCE navigate building element attributes ISA
navigate
  WITH class attachment := building_element_attribute

INSTANCE navigate GENERAL building elements
ISA navigate
  WITH class attachment :=
GENERAL_Building_element

INSTANCE navigate GENERAL building element
attributes ISA navigate
  WITH class attachment :=
GENERAL_building_element_attribute

INSTANCE the application ISA application
  WITH unknowns fail := TRUE
  WITH threshold := 50
  WITH title display := Starting display
  WITH ignore breakpoints := FALSE
  WITH reasoning on := FALSE
  WITH numeric precision := 8
  WITH demon strategy IS fire first

INSTANCE column 1 ISA column
  WITH attachment := attribute_of_building_element
OF building_element_attribute
  WITH width := 160
  WITH justify IS left
  WITH wordwrap := TRUE
  WITH heading label := "Attribute"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE column 2 ISA column
  WITH attachment := attribute_type OF
building_element_attribute
  WITH width := 40
  WITH justify IS left
  WITH wordwrap := TRUE
  WITH heading label := "Type"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE column 3 ISA column
  WITH attachment := designing_discipline OF
building_element_attribute
  WITH width := 60
  WITH justify IS left
  WITH wordwrap := TRUE
  WITH heading label := "Design
Discipl"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE column 4 ISA column
  WITH attachment := linked_building_element OF
building_element_attribute
  WITH width := 160
  WITH justify IS left
  WITH wordwrap := TRUE
  WITH heading label := "Linked
Building
Component"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE column 5 ISA column
  WITH attachment :=
linked_attribute_of_building_element OF
building_element_attribute
  WITH width := 160
  WITH justify IS left
  WITH wordwrap := TRUE
  WITH heading label := "Linked
Component
Attribute"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE Starting display ISA display
  WITH wait := TRUE
  WITH delay changes := FALSE
  WITH items [1 ] := UNDETERMINED
  WITH items [2 ] := border 1
  WITH items [3 ] := textbox 1
  WITH items [4 ] := pushbutton 2
  WITH items [5 ] := UNDETERMINED
  WITH items [6 ] := UNDETERMINED
  WITH items [7 ] := UNDETERMINED
  WITH items [8 ] := UNDETERMINED
  WITH items [9 ] := pushbutton 34
  WITH items [10 ] := pushbutton 35
  WITH fill color := 192,192,192
  WITH menus [1 ] := UNDETERMINED

INSTANCE config ISA display
  WITH wait := FALSE
  WITH delay changes := FALSE
  WITH items [1 ] := textbox 2
  WITH items [2 ] := border 2
  WITH items [3 ] := listbox 1
  WITH items [4 ] := valuebox 1
  WITH items [5 ] := textbox 3
  WITH items [6 ] := textbox 4
  WITH items [7 ] := border 3
  WITH items [8 ] := listbox 2
  WITH items [9 ] := textbox 5
  WITH items [10 ] := valuebox 2
  WITH items [11 ] := border 4
  WITH items [12 ] := textbox 6
  WITH items [13 ] := radiobutton group 2
  WITH items [14 ] := UNDETERMINED
  WITH items [15 ] := textbox 7
  WITH items [16 ] := promptbox 1
  WITH items [17 ] := textbox 8
  WITH items [18 ] := pushbutton 3
  WITH items [19 ] := pushbutton 4
  WITH items [20 ] := UNDETERMINED
  WITH items [21 ] := listbox 3
  WITH items [22 ] := textbox 9
  WITH items [23 ] := listbox 4
  WITH items [24 ] := valuebox 3
  WITH items [25 ] := valuebox 4
  WITH items [26 ] := textbox 10
  WITH items [27 ] := textbox 11
  WITH items [28 ] := valuebox 5
  WITH items [29 ] := valuebox 6
  WITH items [30 ] := textbox 12
  WITH items [31 ] := textbox 13
  WITH items [32 ] := pushbutton 5
  WITH items [33 ] := pushbutton 6
  WITH items [34 ] := textbox 14
  WITH items [35 ] := radiobutton group 1
  WITH items [36 ] := pushbutton 14
  WITH items [37 ] := pushbutton 15
  WITH items [38 ] := UNDETERMINED
  WITH items [39 ] := border 6 invisible
  WITH items [40 ] := promptbox 2 invisible
  WITH items [41 ] := textbox 17 invisible
  WITH items [42 ] := pushbutton 10 invisible
  WITH items [43 ] := UNDETERMINED
  WITH items [44 ] := pushbutton 11 invisible
  WITH items [45 ] := border 7 invisible2
  WITH items [46 ] := promptbox 3 invisible2
  WITH items [47 ] := textbox 18 invisible2
  WITH items [48 ] := textbox 19 invisible2
  WITH items [49 ] := pushbutton 12 invisible2
  WITH items [50 ] := UNDETERMINED
  WITH items [51 ] := UNDETERMINED
  WITH items [52 ] := pushbutton 16 invisible2
  WITH items [53 ] := pushbutton 26 invisible2
  WITH items [54 ] := pushbutton 52
  WITH items [55 ] := textbox 64
  WITH fill color := 192,192,192
  WITH menus [1 ] := UNDETERMINED

INSTANCE attributes table display ISA display
  WITH wait := FALSE
  WITH delay changes := FALSE
  WITH items [1 ] := border 5
  WITH items [2 ] := table 1
  WITH items [3 ] := textbox 15
  WITH items [4 ] := textbox 16
  WITH items [5 ] := UNDETERMINED
  WITH items [6 ] := pushbutton 8
  WITH fill color := 192,192,192
  WITH menus [1 ] := UNDETERMINED

INSTANCE General rules display ISA display
  WITH wait := FALSE
  WITH delay changes := FALSE
  WITH items [1 ] := textbox 20
  WITH items [2 ] := border 8
  WITH items [3 ] := UNDETERMINED
  WITH items [4 ] := UNDETERMINED
  WITH items [5 ] := textbox 23
  WITH items [6 ] := textbox 24
  WITH items [7 ] := UNDETERMINED
  WITH items [8 ] := promptbox 4
```

```
WITH items [9 ] := border 9
WITH items [10 ] := textbox 26
WITH items [11 ] := valuebox 7
WITH items [12 ] := promptbox 6
WITH items [13 ] := listbox 5
WITH items [14 ] := UNDETERMINED
WITH items [15 ] := textbox 27
WITH items [16 ] := textbox 28
WITH items [17 ] := textbox 29
WITH items [18 ] := valuebox 9
WITH items [19 ] := valuebox 10
WITH items [20 ] := pushbutton 18
WITH items [21 ] := pushbutton 19
WITH items [22 ] := pushbutton 20
WITH items [23 ] := pushbutton 21
WITH items [24 ] := listbox 6
WITH items [25 ] := textbox 30
WITH items [26 ] := valuebox 11
WITH items [27 ] := radiobutton group 3
WITH items [28 ] := textbox 31
WITH items [29 ] := pushbutton 22
WITH items [30 ] := pushbutton 23
WITH items [31 ] := pushbutton 24
WITH items [32 ] := textbox 32
WITH items [33 ] := textbox 33
WITH items [34 ] := promptbox 7
WITH items [35 ] := textbox 69
WITH items [36 ] := promptbox 5
WITH items [37 ] := textbox 70
WITH items [38 ] := valuebox 8
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE Menus display ISA display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 12
 WITH items [2 ] := border 11
 WITH items [3 ] := border 10
 WITH items [4 ] := textbox 34
 WITH items [5 ] := listbox 8
 WITH items [6 ] := textbox 36
 WITH items [7 ] := listbox 9
 WITH items [8 ] := textbox 37
 WITH items [9 ] := pushbutton 27
 WITH items [10 ] := listbox 10
 WITH items [11 ] := textbox 38
 WITH items [12 ] := valuebox 13
 WITH items [13 ] := textbox 39
 WITH items [14 ] := textbox 40
 WITH items [15 ] := pushbutton 28
 WITH items [16 ] := pushbutton 29
 WITH items [17 ] := valuebox 14
 WITH items [18 ] := pushbutton 30
 WITH items [19 ] := pushbutton 31
 WITH items [20 ] := pushbutton 32
 WITH items [21 ] := valuebox 15
 WITH items [22 ] := promptbox 8
 WITH items [23 ] := textbox 41
 WITH items [24 ] := textbox 42
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE CURENT_project_start_display ISA
display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 1
 WITH items [2 ] := UNDETERMINED
 WITH items [3 ] := UNDETERMINED
 WITH items [4 ] := UNDETERMINED
 WITH items [5 ] := UNDETERMINED
 WITH items [6 ] := textbox 43
 WITH items [7 ] := textbox 44
 WITH items [8 ] := pushbutton 33
 WITH items [9 ] := listbox 11
 WITH items [10 ] := pushbutton 37
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE NEW_project_start_display ISA display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 1
 WITH items [2 ] := textbox 47
 WITH items [3 ] := pushbutton 33
 WITH items [4 ] := textbox 48
 WITH items [5 ] := promptbox 9
 WITH items [6 ] := pushbutton 38
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE CURENT_project_selection_display ISA
display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 1
 WITH items [2 ] := pushbutton 1
 WITH items [3 ] := pushbutton 17
 WITH items [4 ] := pushbutton 26
 WITH items [5 ] := textbox 45
 WITH items [6 ] := pushbutton 36
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE NEW_project_selection_display ISA
display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 1
 WITH items [2 ] := textbox 49
 WITH items [3 ] := pushbutton 39
 WITH items [4 ] := pushbutton 40
 WITH items [5 ] := pushbutton 41
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE NEW from another project display ISA
display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 13
 WITH items [2 ] := UNDETERMINED
 WITH items [3 ] := textbox 50
 WITH items [4 ] := textbox 51
 WITH items [5 ] := listbox 12
 WITH items [6 ] := pushbutton 42
 WITH items [7 ] := pushbutton 43
 WITH items [8 ] := pushbutton 44
 WITH items [9 ] := pushbutton 45
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE NEW from components display ISA
display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 15
 WITH items [2 ] := border 16
 WITH items [3 ] := border 17
 WITH items [4 ] := border 18
 WITH items [5 ] := textbox 53
 WITH items [6 ] := listbox 13
 WITH items [7 ] := textbox 54
 WITH items [8 ] := valuebox 16
 WITH items [9 ] := textbox 55
 WITH items [10 ] := UNDETERMINED
 WITH items [11 ] := UNDETERMINED
 WITH items [12 ] := listbox 14
 WITH items [13 ] := textbox 57
 WITH items [14 ] := pushbutton 47
 WITH items [15 ] := pushbutton 48
 WITH items [16 ] := UNDETERMINED
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE NEW from systems display ISA display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := UNDETERMINED
 WITH items [2 ] := UNDETERMINED
 WITH items [3 ] := UNDETERMINED
 WITH items [4 ] := UNDETERMINED
 WITH items [5 ] := UNDETERMINED
 WITH items [6 ] := UNDETERMINED
 WITH items [7 ] := UNDETERMINED
 WITH items [8 ] := UNDETERMINED
 WITH items [9 ] := textbox 58
 WITH items [10 ] := border 19
 WITH items [11 ] := border 20
 WITH items [12 ] := border 21
 WITH items [13 ] := border 22
 WITH items [14 ] := textbox 59
 WITH items [15 ] := textbox 60
 WITH items [16 ] := textbox 61
 WITH items [17 ] := valuebox 17
 WITH items [18 ] := textbox 62
 WITH items [19 ] := valuebox 18
 WITH items [20 ] := listbox 15
 WITH items [21 ] := listbox 16
 WITH items [22 ] := pushbutton 49
 WITH items [23 ] := pushbutton 50
 WITH items [24 ] := border 23
 WITH items [25 ] := textbox 63
 WITH items [26 ] := listbox 17
 WITH items [27 ] := pushbutton 51
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE add from general database display ISA
display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := UNDETERMINED
 WITH items [2 ] := UNDETERMINED
 WITH items [3 ] := UNDETERMINED
 WITH items [4 ] := UNDETERMINED
 WITH items [5 ] := UNDETERMINED
 WITH items [6 ] := UNDETERMINED
 WITH items [7 ] := UNDETERMINED
 WITH items [8 ] := UNDETERMINED
 WITH items [9 ] := UNDETERMINED
 WITH items [10 ] := border 24
 WITH items [11 ] := border 25
 WITH items [12 ] := listbox 18
 WITH items [13 ] := valuebox 19
 WITH items [14 ] := textbox 65
 WITH items [15 ] := textbox 66
 WITH items [16 ] := listbox 19
 WITH items [17 ] := textbox 67
 WITH items [18 ] := textbox 68
 WITH items [19 ] := pushbutton 53
 WITH items [20 ] := pushbutton 54
 WITH items [21 ] := pushbutton 55
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE file 1 ISA file
 WITH filename := "project.ini"
 WITH shared := FALSE
 WITH default error handling := TRUE

INSTANCE file 2 ISA file
 WITH filename := "project.bat"
 WITH shared := FALSE
 WITH default error handling := TRUE

INSTANCE file 3 ISA file
 WITH shared := FALSE
 WITH default error handling := TRUE

INSTANCE listbox 1 ISA listbox
 WITH show current instance := TRUE
 WITH source := building_element OF Building
element
 WITH destination := building_element OF
current_data
 WITH location := 16,71,210,95

INSTANCE listbox 2 ISA listbox
 WITH show current instance := TRUE
 WITH source := attribute_of_building_element OF
building_element_attribute
 WITH destination := attribute_of_building_element
OF current_data
 WITH location := 16,171,235,240

INSTANCE listbox 3 ISA listbox
 WITH show current instance := TRUE
 WITH source := building_element OF Linked
building element
 WITH destination := linked_building_element OF
current_data
 WITH location := 25,320,235,345

INSTANCE listbox 4 ISA listbox
 WITH show current instance := TRUE
 WITH source := attribute_of_building_element OF
Linked element attribute
 WITH destination :=
linked_attribute_of_building_element OF current_data
 WITH location := 25,365,235,390

INSTANCE listbox 5 ISA listbox
 WITH show current instance := TRUE
 WITH source := building_element OF Building
element
 WITH destination := building_element OF
Current_rule_data
 WITH location := 265,75,489,99

INSTANCE listbox 6 ISA listbox
 WITH show current instance := TRUE
```

```
WITH source := attribute_of_building_element OF
building_element_attribute
WITH destination := attribute_of_building_element
OF Current_rule_data
WITH location := 265,120,489,144

INSTANCE listbox 8 ISA listbox
WITH show current instance := TRUE
WITH source := label OF
Menus_unclassified_B_comp
WITH destination := current_menu_B_comp OF
Menus_manipulation_data
WITH location := 16,91,165,315

INSTANCE listbox 9 ISA listbox
WITH show current instance := TRUE
WITH source := label OF Menus_group
WITH destination := current_menu_group OF
Menus_manipulation_data
WITH location := 185,90,335,205

INSTANCE listbox 10 ISA listbox
WITH show current instance := TRUE
WITH source := label OF Menus_group_items
WITH destination := current_menu_B_comp OF
Menus_manipulation_data
WITH location := 350,90,495,255

INSTANCE listbox 11 ISA listbox
WITH show current instance := TRUE
WITH source := project_name OF Current_projects
WITH destination := project_name
WITH location := 11,140,160,165

INSTANCE listbox 12 ISA listbox
WITH show current instance := TRUE
WITH source := project_name OF Current_projects
WITH destination := another_project_name OF
NEW_to_make_a_new_project
WITH location := 10,95,160,115

INSTANCE listbox 13 ISA listbox
WITH show current instance := TRUE
WITH source := building_element OF Building
element
WITH destination := building_element OF
NEW_to_make_a_new_project
WITH location := 35,95,460,180

INSTANCE listbox 14 ISA listbox
WITH show current instance := TRUE
WITH source := attribute_of_building_element OF
building_element_attribute
WITH location := 115,255,460,330

INSTANCE listbox 15 ISA listbox
WITH show current instance := TRUE
WITH source := building_element OF Building
element
WITH location := 265,200,465,285

INSTANCE listbox 16 ISA listbox
WITH show current instance := TRUE
WITH source := building_system OF
NEW_building_systems
WITH destination := building_system OF
NEW_to_make_a_new_project
WITH location := 30,150,230,270

INSTANCE listbox 17 ISA listbox
WITH show current instance := TRUE
WITH source := discipline OF
NEW_design_disciplines
WITH destination := design_discipline OF
NEW_to_make_a_new_project
WITH location := 265,65,460,87

INSTANCE listbox 18 ISA listbox
WITH show current instance := TRUE
WITH source := building_element OF
GENERAL_Building_element
WITH destination :=
GENERAL_Building_component
WITH location := 21,76,400,160

INSTANCE listbox 19 ISA listbox
WITH show current instance := TRUE
WITH source := attribute_of_building_element OF
GENERAL_building_element_attribute
WITH location := 110,205,400,280

INSTANCE menu c_Foundation ISA menu
WITH label := "Foundation"
WITH items [1] := UNDETERMINED

INSTANCE menu c_Floor ISA menu
WITH label := "Floor"
WITH items [1] := UNDETERMINED

INSTANCE menu c_Wall ISA menu
WITH label := "Wall"
WITH items [1] := UNDETERMINED

INSTANCE menu c_Roof ISA menu
WITH label := "Roof"
WITH items [1] := UNDETERMINED

INSTANCE menu c_Opening ISA menu
WITH label := "Opening"
WITH items [1] := UNDETERMINED

INSTANCE menu c_Protection ISA menu
WITH label := "Protection"
WITH items [1] := UNDETERMINED

INSTANCE menu c_Special ISA menu
WITH label := "Special"
WITH items [1] := UNDETERMINED

INSTANCE menu c_Finishing ISA menu
WITH label := "Finishing"
WITH items [1] := UNDETERMINED

INSTANCE menu c_Mechanical ISA menu
WITH label := "Mechanical"
WITH items [1] := UNDETERMINED

INSTANCE menu c_Electrical ISA menu
WITH label := "Electrical"
WITH items [1] := UNDETERMINED

INSTANCE menu c_Pier ISA menu
WITH label := "Pier"
WITH items [1] := UNDETERMINED

INSTANCE menu c_Wood_Pier_Foundation ISA
menu
WITH label := "Wood_Pier_Foundation"
WITH items [1] := menu item
c_Circular_Wood_Pier_Foundation

INSTANCE menu 13 ISA menu
WITH label := "menu 13"
WITH items [1] := menu item 1

INSTANCE menu item 1 ISA menu item
WITH label := "menu item 1"

INSTANCE menu item
c_Circular_Wood_Pier_Foundation ISA menu item
WITH label := "Circular_Wood_Pier_Foundation"

INSTANCE promptbox 1 ISA promptbox
WITH font := "System"
WITH justify IS center
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := graph_name OF Building
element
WITH location := 100,100,210,125

INSTANCE promptbox 2 invisible ISA promptbox
WITH pen color := 255,255,255
WITH fill color := 0,0,255
WITH font := "System"
WITH justify IS center
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := new_component_name
WITH location := 0,0,0,0

INSTANCE promptbox 3 invisible2 ISA promptbox
WITH pen color := 255,255,255
WITH fill color := 0,0,255
WITH font := "System"
WITH justify IS center
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := new_attribute_name
WITH location := 0,0,0,0

INSTANCE promptbox 4 ISA promptbox
WITH pen color := 255,0,0
WITH fill color := 255,255,255
WITH font := "System"
WITH justify IS left
WITH frame := TRUE
WITH scroll := TRUE
WITH show current := TRUE
WITH attachment := cause_of_the_effect OF
AB_general_rules
WITH location := 15,230,240,275

INSTANCE promptbox 5 ISA promptbox
WITH pen color := 255,0,0
WITH fill color := 255,255,255
WITH font := "System"
WITH justify IS center
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := percent_change OF
AB_general_rules
WITH location := 110,55,155,80

INSTANCE promptbox 6 ISA promptbox
WITH pen color := 255,0,0
WITH fill color := 255,255,255
WITH font := "System"
WITH justify IS center
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := result_in_major_modification
OF AB_general_rules
WITH location := 190,295,240,320

INSTANCE promptbox 7 ISA promptbox
WITH pen color := 255,0,0
WITH fill color := 255,255,255
WITH font := "System"
WITH justify IS center
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := rule_ignored OF
AB_general_rules
WITH location := 190,345,240,370

INSTANCE promptbox 8 ISA promptbox
WITH pen color := 128,0,0
WITH fill color := 255,255,255
WITH font := "System"
WITH justify IS center
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := new_name_of_menu_group OF
Menus_manipulation_data
WITH location := 185,300,335,325

INSTANCE promptbox 9 ISA promptbox
WITH font := "System"
WITH justify IS center
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := project_name
WITH location := 10,135,160,165

INSTANCE pushbutton 1 ISA pushbutton
WITH label := "Building Components"
WITH attribute attachment := Building Components
WITH location := 10,105,160,130

INSTANCE pushbutton 2 ISA pushbutton
WITH label := "EXIT"
WITH attribute attachment := exit OF application
WITH location := 10,185,160,215

INSTANCE pushbutton 3 ISA pushbutton
WITH label := "Delete"
WITH location := 215,100,290,125

INSTANCE pushbutton 4 ISA pushbutton
WITH label := "New Component"
WITH location := 290,100,410,125

INSTANCE pushbutton 5 ISA pushbutton
WITH label := "END"
WITH attribute attachment :=
back_to_current_project_display
WITH location := 425,5,500,35

INSTANCE pushbutton 6 ISA pushbutton
WITH label := ""
WITH location := 425,90,500,135
```

```
INSTANCE pushbutton 8 ISA pushbutton
  WITH label := "Return"
  WITH location := 175,250,395,275

INSTANCE pushbutton 10 invisible ISA pushbutton
  WITH label := "Done"
  WITH attribute attachment := done of new component
  WITH location := 0,0,0,0

INSTANCE pushbutton 11 invisible ISA pushbutton
  WITH label := "Cancel"
  WITH location := 0,0,0,0

INSTANCE pushbutton 12 invisible2 ISA pushbutton
  WITH label := "Done"
  WITH attribute attachment := done of new attribute
  WITH location := 0,0,0,0

INSTANCE pushbutton 13 invisible2 ISA pushbutton
  WITH label := "Next Attribute"
  WITH attribute attachment := next new attribute
  WITH location := 0,0,0,0

INSTANCE pushbutton 14 ISA pushbutton
  WITH label := "Delete"
  WITH location := 180,250,235,270

INSTANCE pushbutton 15 ISA pushbutton
  WITH label := "New"
  WITH location := 180,270,235,290

INSTANCE pushbutton 16 invisible2 ISA pushbutton
  WITH label := "OK"
  WITH attribute attachment := ok of attribute name
  WITH location := 0,0,0,0

INSTANCE pushbutton 17 ISA pushbutton
  WITH label := "General Rules"
  WITH attribute attachment := General Rules
  WITH location := 10,165,160,190

INSTANCE pushbutton 18 ISA pushbutton
  WITH label := "First"
  WITH attribute attachment := action OF rules
navigate 2 IS first
  WITH location := 400,240,490,265

INSTANCE pushbutton 19 ISA pushbutton
  WITH label := "Next"
  WITH attribute attachment := action OF navigate IS
next
  WITH location := 400,265,490,290

INSTANCE pushbutton 20 ISA pushbutton
  WITH label := "Previous"
  WITH attribute attachment := action OF navigate IS
previous
  WITH location := 400,290,490,315

INSTANCE pushbutton 21 ISA pushbutton
  WITH label := "Last"
  WITH attribute attachment := action OF navigate IS
last
  WITH location := 400,315,490,340

INSTANCE pushbutton 22 ISA pushbutton
  WITH label := "END"
  WITH attribute attachment :=
back_to_current_project_display
  WITH location := 280,400,480,425

INSTANCE pushbutton 23 ISA pushbutton
  WITH label := "Update Rule"
  WITH attribute attachment := update rule
  WITH location := 30,400,230,425

INSTANCE pushbutton 24 ISA pushbutton
  WITH label := "New Rule"
  WITH attribute attachment := new rule
  WITH location := 400,355,490,380

INSTANCE pushbutton 25 ISA pushbutton
  WITH location := 10,10,210,35

INSTANCE pushbutton 26 invisible2 ISA pushbutton
  WITH label := "Done"
  WITH attribute attachment := done of ID attribute
  WITH location := 0,0,0,0

INSTANCE pushbutton 26 ISA pushbutton
  WITH label := "Menus"
  WITH attribute attachment := Menus
  WITH location := 10,135,160,160

INSTANCE pushbutton 27 ISA pushbutton
  WITH label := "END"
  WITH attribute attachment :=
back_to_current_project_display
  WITH location := 345,360,500,415

INSTANCE pushbutton 28 ISA pushbutton
  WITH label := "Add to the Menu Group"
  WITH attribute attachment := add build comp OF
Menus_manipulation_data
  WITH location := 10,385,170,410

INSTANCE pushbutton 29 ISA pushbutton
  WITH label := "Del. Component"
  WITH attribute attachment := delete build comp OF
Menus_manipulation_data
  WITH location := 350,325,495,350

INSTANCE pushbutton 30 ISA pushbutton
  WITH label := "Add A Menu Group"
  WITH attribute attachment := add menu group OF
Menus_manipulation_data
  WITH location := 185,360,335,385

INSTANCE pushbutton 31 ISA pushbutton
  WITH label := "Delete Menu Group"
  WITH attribute attachment := delete menu group OF
Menus_manipulation_data
  WITH location := 185,260,335,285

INSTANCE pushbutton 32 ISA pushbutton
  WITH label := "Rename Menu Group"
  WITH attribute attachment := rename menu group OF
Menus_manipulation_data
  WITH location := 185,385,335,410

INSTANCE pushbutton 33 ISA pushbutton
  WITH label := "EXIT"
  WITH attribute attachment := exit OF application
  WITH location := 10,195,160,220

INSTANCE pushbutton 34 ISA pushbutton
  WITH label := "New Project"
  WITH attribute attachment := New_project
  WITH display attachment :=
NEW_project_start_display
  WITH location := 10,105,160,135

INSTANCE pushbutton 35 ISA pushbutton
  WITH label := "Existing Project"
  WITH attribute attachment := Current_project
  WITH display attachment :=
CURENT_project_start_display
  WITH location := 10,145,160,175

INSTANCE pushbutton 36 ISA pushbutton
  WITH label := "EXIT"
  WITH attribute attachment := exit OF application
  WITH location := 10,195,160,220

INSTANCE pushbutton 37 ISA pushbutton
  WITH label := "OK"
  WITH location := 10,170,160,195

INSTANCE pushbutton 38 ISA pushbutton
  WITH label := "OK"
  WITH location := 10,170,160,195

INSTANCE pushbutton 39 ISA pushbutton
  WITH label := "from Another Project"
  WITH display attachment := NEW from another
project display
  WITH location := 10,105,160,140

INSTANCE pushbutton 40 ISA pushbutton
  WITH label := "from Systems"
  WITH attribute attachment := from systems OF
NEW_to_make_a_new_project
  WITH location := 10,145,160,180

INSTANCE pushbutton 41 ISA pushbutton
  WITH label := "from Components"
  WITH attribute attachment := from components OF
NEW_to_make_a_new_project
  WITH location := 10,185,160,220

INSTANCE pushbutton 42 ISA pushbutton
  WITH label := "Modify components"
  WITH location := 10,120,160,145

INSTANCE pushbutton 43 ISA pushbutton
  WITH label := "Modify Gen. Rules"
  WITH location := 10,145,160,170

INSTANCE pushbutton 44 ISA pushbutton
  WITH label := "Config. Menus"
  WITH location := 10,170,160,195

INSTANCE pushbutton 45 ISA pushbutton
  WITH label := "Back"
  WITH display attachment :=
NEW_project_selection_display
  WITH location := 10,195,160,220

INSTANCE pushbutton 46 ISA pushbutton
  WITH label := "OK"
  WITH attribute attachment := from systems OF
NEW_to_make_a_new_project
  WITH location := 20,195,160,220

INSTANCE pushbutton 47 ISA pushbutton
  WITH label := "Add selected component to the new
project"
  WITH attribute attachment := add component to the
new project OF NEW_to_make_a_new_project
  WITH location := 20,355,335,380

INSTANCE pushbutton 48 ISA pushbutton
  WITH label := "Finish"
  WITH attribute attachment := finish components of
the new project OF NEW_to_make_a_new_project
  WITH location := 345,355,475,380

INSTANCE pushbutton 49 ISA pushbutton
  WITH label := "Add to the new project"
  WITH attribute attachment := add system to the new
project OF NEW_to_make_a_new_project
  WITH location := 255,330,475,355

INSTANCE pushbutton 50 ISA pushbutton
  WITH label := "Finish"
  WITH attribute attachment := finish systems of the
new project OF NEW_to_make_a_new_project
  WITH location := 255,360,475,385

INSTANCE pushbutton 51 ISA pushbutton
  WITH label := "Ignore highlighted compon."
  WITH attribute attachment := ignore highlighted
component OF NEW_to_make_a_new_project
  WITH location := 265,285,465,310

INSTANCE pushbutton 52 ISA pushbutton
  WITH label := " "
  WITH attribute attachment := get from general
database
  WITH location := 425,40,500,85

INSTANCE pushbutton 53 ISA pushbutton
  WITH label := "Add the Component"
  WITH attribute attachment := add component from
_get from general datab
  WITH location := 20,285,215,305

INSTANCE pushbutton 54 ISA pushbutton
  WITH label := "Return"
  WITH attribute attachment := return from _get from
general datab
  WITH location := 215,285,400,305

INSTANCE pushbutton 55 ISA pushbutton
  WITH label := "Add the Component and its related
General Rules "
  WITH attribute attachment := add component and
general rule
  WITH location := 20,305,400,325

INSTANCE radiobutton group 1 ISA radiobutton
group
  WITH pen color := 0,0,0
  WITH fill color := 192,192,192
  WITH frame := TRUE
  WITH group label := ""
  WITH show current := TRUE
  WITH attachment := discipline OF input data
  WITH location := 235,145,355,295

INSTANCE radiobutton group 2 ISA radiobutton
group
  WITH pen color := 0,0,0
```

```
 WITH fill color := 192,192,192
 WITH frame := TRUE
 WITH group label := "attribute type"
 WITH show current := TRUE
 WITH attachment := attribute type OF input data
 WITH location := 355,145,495,225

INSTANCE radiobutton group 3 ISA radiobutton
group
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH frame := TRUE
 WITH group label := ""
 WITH show current := TRUE
 WITH attachment := discipline OF input data
 WITH location := 260,220,395,385

INSTANCE table 1 ISA table
 WITH attachment := building_element_attribute
 WITH columns [1 ] := column 1
 WITH columns [2 ] := column 2
 WITH columns [3 ] := column 3
 WITH columns [4 ] := column 4
 WITH columns [5 ] := column 5
 WITH heading := TRUE
 WITH heading height := 50
 WITH fill color := 0,255,255
 WITH column lines := TRUE
 WITH row lines := TRUE
 WITH frame := TRUE
 WITH show current instance := TRUE
 WITH location := 10,45,590,240

INSTANCE textbox 1 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALSE
 WITH font size := 12
 WITH text := "CONFIGURATION
MODULE"
 WITH location := 10,30,155,80

INSTANCE textbox 2 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 12
 WITH frame := TRUE
 WITH text := "Configuration of Building Components
and Attributes"
 WITH location := 5,5,420,35

INSTANCE textbox 3 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "List of Building Components"
 WITH location := 15,50,205,70

INSTANCE textbox 4 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Building Components"
 WITH location := 215,50,410,70

INSTANCE textbox 5 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Building Component Attributes"
 WITH location := 15,150,220,170

INSTANCE textbox 6 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Attribute"
 WITH location := 15,240,130,260

INSTANCE textbox 7 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Select Linked Component"
 WITH location := 25,300,225,320

INSTANCE textbox 8 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Graph name"
 WITH location := 15,105,100,125

INSTANCE textbox 9 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Select Linked Attribute"
 WITH location := 25,345,185,365

INSTANCE textbox 10 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Linked Component"
 WITH location := 260,300,460,320

INSTANCE textbox 11 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Linked Attribute"
 WITH location := 260,345,420,365

INSTANCE textbox 12 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Type"
 WITH location := 355,225,445,250

INSTANCE textbox 13 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current
Discipline"
 WITH location := 355,250,425,290

INSTANCE textbox 14 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Review
Attributes"
 WITH location := 430,95,495,130

INSTANCE textbox 15 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 12
 WITH text := "Summary of Attributes of the Building
Component:"
 WITH location := 10,10,355,35

INSTANCE textbox 16 ISA textbox
 WITH pen color := 128,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "Times New Roman"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALSE
 WITH font size := 12
 WITH text := " "
 WITH location := 355,10,590,35

INSTANCE textbox 17 invisible ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Type the name of
building component"
 WITH location := 0,0,0,0

INSTANCE textbox 18 invisible2 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Type the attribute name of the
building component and press OK"
 WITH location := 0,0,0,0

INSTANCE textbox 19 invisible2 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Fill the rest of the attribute data
(discipline, type)"
 WITH location := 0,0,0,0

INSTANCE textbox 20 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 18
 WITH frame := TRUE
 WITH text := "GENERAL RULE
CONFIGURATION"
 WITH location := 5,5,500,45

INSTANCE textbox 23 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "then the discipline"
 WITH location := 15,170,140,190

INSTANCE textbox 24 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "If such a change results in major
redesign, please type YES"
 WITH location := 10,285,190,335

INSTANCE textbox 26 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Select a Building Component"
 WITH location := 270,60,465,80

INSTANCE textbox 27 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Select a Component Attribute"
 WITH location := 270,105,465,125

INSTANCE textbox 28 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "# of Current Related Rules:"
 WITH location := 275,155,455,175

INSTANCE textbox 29 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Related Rules #:"
 WITH location := 275,180,445,200

INSTANCE textbox 30 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
```

```
 WITH text := "of the following Building Component"
 WITH location := 10,125,245,145

INSTANCE textbox 31 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Related General Rule"
 WITH location := 405,205,495,240

INSTANCE textbox 32 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Affected Discipline"
 WITH location := 265,205,390,225

INSTANCE textbox 33 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "If you need this rule to be ignored,
please type YES"
 WITH location := 10,340,180,375

INSTANCE textbox 34 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 16
 WITH frame := TRUE
 WITH text := "Configuration of Menu of Building
Components"
 WITH location := 5,5,500,40

INSTANCE textbox 36 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Unclassified Building Components"
 WITH location := 15,55,160,90

INSTANCE textbox 37 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "List of Menu Groups"
 WITH location := 200,55,320,90

INSTANCE textbox 38 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Components of Current Menu Group"
 WITH location := 350,50,490,85

INSTANCE textbox 39 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Selected Menu Group"
 WITH location := 185,210,335,230

INSTANCE textbox 40 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Selected Building Component"
 WITH location := 15,320,165,355

INSTANCE temp invisible textbox 41 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Write the new name"
 WITH location := 0,0,0,0

INSTANCE textbox 41 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Type Added or Renamed Name above"
 WITH location := 185,325,335,360

INSTANCE textbox 42 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Selected Building Component"
 WITH location := 355,260,490,295

INSTANCE textbox 43 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Double click to select a project then
click OK"
 WITH location := 10,100,165,140

INSTANCE textbox 44 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 16
 WITH text := "Configure Existing Project"
 WITH location := 15,15,150,85

INSTANCE textbox 45 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 12
 WITH text := "What would you like to configure?"
 WITH location := 15,25,145,75

INSTANCE textbox 46 ISA textbox
 WITH justify IS left
 WITH font := "System"
 WITH text := "textbox 46"
 WITH location := 210,65,360,140

INSTANCE textbox 47 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 16
 WITH text := "Assemble New Project"
 WITH location := 10,20,155,75

INSTANCE textbox 48 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Type the project name then click OK"
 WITH location := 10,100,165,135

INSTANCE textbox 49 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 14
 WITH text := "Select an Assembly Method"
 WITH location := 20,15,145,80

INSTANCE textbox 50 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 12
 WITH text := "Assemble from another project"
 WITH location := 25,15,140,60

INSTANCE textbox 51 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Select project"
 WITH location := 40,75,140,95

INSTANCE textbox 52 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 12
 WITH text := "Select Participating Disciplines"
 WITH location := 15,10,155,55

INSTANCE textbox 53 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 14
 WITH frame := TRUE
 WITH text := "Assemble the New Project from the
Components"
 WITH location := 5,5,490,35

INSTANCE textbox 54 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Double click to select a building
component"
 WITH location := 105,65,395,85

INSTANCE textbox 55 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Selected Component"
 WITH location := 30,215,110,250

INSTANCE textbox 57 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Attributes
of the Component"
 WITH location := 35,270,115,325

INSTANCE textbox 58 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 14
 WITH frame := TRUE
 WITH text := "Assemble the New Project from
Building Systems"
 WITH location := 5,5,490,35

INSTANCE textbox 59 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Double click to select a building
system"
 WITH location := 50,115,215,150

INSTANCE textbox 60 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Selected Building System"
 WITH location := 280,115,450,135

INSTANCE textbox 61 ISA textbox
 WITH pen color := 0,0,0
```

```
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH text := "Components in the building system"
WITH location := 275,165,460,202

INSTANCE textbox 62 ISA textbox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH text := "Description of the highlighted building system"
WITH location := 40,275,225,312

INSTANCE textbox 63 ISA textbox
WITH pen color := 255,255,255
WITH fill color := 0,128,128
WITH justify IS center
WITH font := "System"
WITH text := "Double click to select a design discipline"
WITH location := 30,60,255,95

INSTANCE textbox 64 ISA textbox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH text := "From
General"
WITH location := 430,45,495,80

INSTANCE textbox 65 ISA textbox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH text := "Selected Component"
WITH location := 20,170,100,205

INSTANCE textbox 66 ISA textbox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH text := "Attributes
of the Component"
WITH location := 20,215,100,270

INSTANCE textbox 67 ISA textbox
WITH pen color := 255,255,255
WITH fill color := 128,0,0
WITH justify IS center
WITH font := "Times New Roman"
WITH font style IS bold, italic CF FALSE, underline CF FALSE, strikeout CF FALSE
WITH font size := 14
WITH frame := TRUE
WITH text := "Components in the General Database"
WITH location := 5,5,415,35

INSTANCE textbox 68 ISA textbox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH text := "Double Click to Select a Component"
WITH location := 90,55,330,75

INSTANCE textbox 69 ISA textbox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH text := "If a change of          % occurs
to the following attribute"
WITH location := 15,65,245,100

INSTANCE textbox 70 ISA textbox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH text := "need to be notified because it may affect "
WITH location := 15,193,245,230

INSTANCE valuebox 1 ISA valuebox
WITH pen color := 128,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := building_element OF current_data
WITH location := 215,70,410,95

INSTANCE valuebox 2 ISA valuebox
WITH pen color := 128,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := attribute_of_building_element OF current_data
WITH location := 15,260,170,285

INSTANCE valuebox 3 ISA valuebox
WITH pen color := 128,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := linked_building_element OF current_data
WITH location := 260,320,480,345

INSTANCE valuebox 4 ISA valuebox
WITH pen color := 128,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment :=
linked_attribute_of_building_element OF current_data
WITH location := 260,365,480,390

INSTANCE valuebox 5 ISA valuebox
WITH pen color := 128,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := designing_discipline OF current_data
WITH location := 435,260,490,285

INSTANCE valuebox 6 ISA valuebox
WITH pen color := 128,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := attribute_type OF current_data
WITH location := 465,225,490,250

INSTANCE valuebox 7 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := building_element OF Current_rule_data
WITH location := 15,145,240,165

INSTANCE valuebox 8 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := attribute_of_building_element OF Current_rule_data
WITH location := 15,100,240,120

INSTANCE valuebox 9 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := number instances OF rules navigate 2
WITH location := 455,155,490,175

INSTANCE valuebox 10 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := instance number OF rules navigate 2
WITH location := 455,180,490,200

INSTANCE valuebox 11 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := affected_discipline OF AB_general_rules
WITH location := 155,170,240,190

INSTANCE valuebox 13 ISA valuebox
WITH pen color := 128,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := current_menu_B_comp OF Menus_manipulation_data
WITH location := 10,355,170,380

INSTANCE valuebox 14 ISA valuebox
WITH pen color := 128,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := current_menu_B_comp OF Menus_manipulation_data
WITH location := 350,295,495,320

INSTANCE valuebox 15 ISA valuebox
WITH pen color := 128,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := current_menu_group OF Menus_manipulation_data
WITH location := 185,230,335,255

INSTANCE valuebox 16 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := building_element OF NEW_to_make_a_new_project
WITH location := 115,215,460,245

INSTANCE valuebox 17 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := building_system OF NEW_to_make_a_new_project
WITH location := 265,135,465,160

INSTANCE valuebox 18 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := description OF NEW_building_systems
WITH location := 35,315,230,370
```

```
INSTANCE valuebox 17 ISA valuebox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := building_system OF
NEW_to_make_a_new_project
 WITH location := 265,135,465,160

INSTANCE valuebox 18 ISA valuebox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := description OF
NEW_building_systems
 WITH location := 35,315,230,370

INSTANCE valuebox 19 ISA valuebox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment :=
GENERAL_Building_component
 WITH location := 110,170,400,200

INSTANCE main window ISA window
 WITH location := 207,160,381,413
 WITH menus [1 ] := UNDETERMINED
 WITH style IS moveable, sizeable, closeable
 WITH title := ""
 WITH visible := TRUE

INSTANCE configuration window ISA window
 WITH location := 61,11,578,464
 WITH menus [1 ] := UNDETERMINED
 WITH style IS moveable, sizeable, closeable CF
FALSE
 WITH title := ""
 WITH visible := FALSE

INSTANCE attribute window ISA window
 WITH location := 22,62,627,371
 WITH menus [1 ] := UNDETERMINED
 WITH style IS moveable, sizeable, closeable
 WITH title := " "
 WITH visible := FALSE

INSTANCE get from general database window ISA
window
 WITH location := 192,114,617,490
 WITH menus [1 ] := UNDETERMINED
 WITH style IS moveable, sizeable, closeable
 WITH title := " "
 WITH visible := FALSE

! DEMON GROUP: affected_discipline OF
AB_general_rules

DEMON 11
IF CONF(affected_discipline OF AB_general_rules)
>= 0
THEN FORGET discipline OF input data

! DEMON GROUP: button selected OF message box

DEMON 5
IF button selected OF message box 1 IS yes
THEN delete a component := TRUE

DEMON 10
IF button selected OF message box 3 IS yes
THEN delete of attribute := TRUE

! DEMON GROUP: selected OF pushbutton

DEMON 1
IF selected OF pushbutton 6
THEN text OF textbox 16 := building_element OF
current_data
AND output OF attribute window := attributes table
display
AND visible OF attribute window := TRUE

DEMON 2
IF selected OF pushbutton 8
THEN visible OF attribute window := FALSE

DEMON 4
IF selected OF pushbutton 3
THEN put up OF message box 1 := TRUE

DEMON 6
IF selected OF pushbutton 4
THEN location OF border 6 invisible := 15,50,410,95
AND location OF textbox 17 invisible := 25,55,160,90
AND location OF promptbox 2 invisible :=
170,60,340,85
AND location OF pushbutton 10 invisible :=
355,50,410,70
AND location OF pushbutton 11 invisible :=
355,75,410,95
AND location OF pushbutton 12 invisible2 := 0,0,0,0
AND location OF promptbox 3 invisible2 := 0,0,0,0
AND location OF border 7 invisible2 := 0,0,0,0
AND location OF textbox 18 invisible2 := 0,0,0,0
AND location OF textbox 19 invisible2 := 0,0,0,0
AND location OF pushbutton 13 invisible2 := 0,0,0,0
AND FORGET current_data
AND FORGET building_element_attribute

DEMON 7
IF selected OF pushbutton 11 invisible
THEN location OF border 6 invisible := 0,0,0,0
AND location OF textbox 17 invisible := 0,0,0,0
AND location OF promptbox 2 invisible := 0,0,0,0
AND location OF pushbutton 10 invisible := 0,0,0,0
AND location OF pushbutton 11 invisible := 0,0,0,0

DEMON 8
IF selected OF pushbutton 15
THEN location OF pushbutton 16 invisible2 :=
180,195,220,220
AND location OF promptbox 3 invisible2 :=
25,195,220,220
AND location OF border 7 invisible2 :=
15,150,235,290
AND location OF textbox 18 invisible2 :=
25,155,220,190
AND location OF textbox 19 invisible2 :=
25,225,220,260
AND FORGET attribute_of_building_element OF
current_data
AND FORGET attribute_type OF current_data
AND FORGET designing_discipline OF current_data
AND FORGET linked_building_element OF
current_data
AND FORGET linked_attribute_of_building_element
OF current_data

DEMON 9
IF selected OF pushbutton 14
THEN put up OF message box 3 := TRUE

! DEMON GROUP: double clicked OF table

DEMON 3
IF double clicked OF table 1
THEN visible OF attribute window := FALSE
AND attribute_of_building_element OF current_data
:= attribute_of_building_element OF
building_element_attribute

END
```

C.3. MESSAGE MODULE

```
$VERSION3.5
□
$LOCATIONS ARE PIXELS
□

□
CLASS AB_general_rules
□
 WITH AB_general_rules_ID NUMERIC
□
 WITH building_element STRING
□
 WITH attribute_of_building_element STRING
□
 WITH affected_discipline STRING
 WITH percent_change NUMERIC
 WITH result_in_major_modification STRING
 WITH cause_of_the_effect STRING

CLASS AB_specific_rules
 WITH AB_specific_rules_id NUMERIC
 WITH building_element STRING
 WITH building_element_id STRING
 WITH attribute_of_building_element STRING
 WITH related_class STRING
 WITH related_instance_id STRING
 WITH related_attribute STRING
 WITH relationship STRING
 WITH writting_date STRING
 WITH relation COMPOUND
  Equal To,
  Less than,
  More than

CLASS border INHERITS add on, display item
 WITH style COMPOUND
  picture frame,
  edit control,
  group,
  shadow
  INIT picture frame
 WITH perspective COMPOUND
  in,
  out
  INIT in
 WITH border width NUMERIC
  INIT 1
 WITH background color COLOR
  INIT 192,192,192
 WITH fill color COLOR
  INIT 192,192,192
 WITH highlight color COLOR
  INIT 255,255,255
 WITH shadow color COLOR
  INIT 128,128,128

CLASS Current_projects
 WITH Project_name STRING

CLASS discipline_message
 WITH changed_attribute STRING
 WITH changed_class STRING
 WITH changed_instance_id STRING
 WITH old_value STRING
 WITH new_value STRING
 WITH affected_attribute STRING
 WITH affected_class STRING
 WITH affected_instance_id STRING
 WITH relationship STRING
 WITH writing_date TIME
 WITH reading_date TIME
 WITH been_read STRING
 WITH been_acted_upon STRING
 WITH id NUMERIC
 WITH discipline_to STRING
 WITH discipline_from STRING
 WITH sent_because_change_ID NUMERIC
 WITH general_specific STRING
 WITH rule_writting_date STRING
 WITH violated_rule_id NUMERIC
 WITH cause_of_the_effect STRING

CLASS lSodbc INHERITS add on
 WITH data source STRING
 WITH userid STRING
 WITH password STRING
 WITH connection string STRING
 WITH connection prompting SIMPLE
  INIT FALSE
 WITH auto commit SIMPLE
  INIT TRUE
 WITH action COMPOUND
  connect,
  disconnect
 WITH records NUMERIC
 WITH transaction COMPOUND
  commit,
  rollback
 WITH append SIMPLE
  INIT FALSE
 WITH status STRING
 WITH show error SIMPLE
 WITH default error handling SIMPLE
  INIT TRUE
 WITH error message STRING
 WITH native error NUMERIC
 WITH trace file STRING

CLASS message box INHERITS add on
 WITH title STRING
 WITH text STRING
 WITH variable text STRING
 WITH modal style COMPOUND
  app modal,
  sys modal,
  not modal
  INIT app modal
 WITH icon COMPOUND
  exclamation,
  information,
  question,
  stop sign
  INIT exclamation
 WITH button COMPOUND
  abort retry ignore,
  ok,
  ok cancel,
  retry cancel,
  yes no,
  yes no cancel
  INIT ok
 WITH default button COMPOUND
  one,
  two,
  three
  INIT one
 WITH button selected COMPOUND
  abort,
  cancel,
  ignore,
  no,
  ok,
  retry,
  yes
 WITH put up SIMPLE

CLASS navigate INHERITS add on
 WITH class attachment CLASS REFERENCE
 WITH action COMPOUND
  first,
  previous,
  next,
  last
  WHEN CHANGED
   BEGIN
    IF instance number OF navigate 1 <> 0 THEN
     BEGIN
!
! ****** define the message color
      IF been_read OF discipline_message = "Yes"
AND been_acted_upon OF discipline_message = "No"
THEN
       pen color OF valuebox 1 := 255,0,0
      IF been_read OF discipline_message = "No"
AND been_acted_upon OF discipline_message = "No"
THEN
       pen color OF valuebox 1 := 0,0,255
      IF been_read OF discipline_message = "Yes"
AND been_acted_upon OF discipline_message = "Yes"
THEN
       pen color OF valuebox 1 := 0,0,0
      attachment OF valuebox 1 := message builder
OF required_message
!
      IF (general_specific OF discipline_message =
"GENERAL") THEN
       BEGIN
        general rule message := TRUE
       END
!
      IF (general_specific OF discipline_message =
"SPECIFIC") THEN
       BEGIN
        specific rule message := TRUE
       END
     END
   END
 WITH instance number NUMERIC
 WITH number instances NUMERIC

CLASS required_message
 WITH discipline name COMPOUND
  Architecture,
  HVAC,
  Illumination,
  Envelope,
  Structure,
  Interior
 WITH message status COMPOUND
  All Messages,
  UnRead Yet,
  UnActed Upon
 WITH choosen_discipline STRING
 WITH message builder STRING

ATTRIBUTE No$ STRING
ATTRIBUTE Yes$ STRING
ATTRIBUTE helping SIMPLE
 WHEN CHANGED
  BEGIN
   visible OF helping window := TRUE
   output OF helping window := helping display
  END
ATTRIBUTE show rule SIMPLE
 WHEN CHANGED
  BEGIN
!
! **** in case of a Genreal rule
   IF (general_specific OF discipline_message =
"GENERAL") THEN
    BEGIN
     EXEC lSodbc 1 SQL select * from [AB-general-
rules] where AB_general_rules_ID =
:discipline_message.violated_rule_id
         END SQL INTO AB_general_rules
     visible OF helping window := TRUE
     output OF helping window := general rule
display
    END
!
! **** in case of a specific rule
   IF (general_specific OF discipline_message =
"SPECIFIC") THEN
    BEGIN
     EXEC lSodbc 1 SQL select * from [AB-specific-
rules] where AB_specific_rules_id =
:discipline_message.violated_rule_id
         END SQL INTO AB_specific_rules
     visible OF specific rule window := TRUE
     output OF specific rule window := specific rule
display
    END
!
! **** end of method
  END
ATTRIBUTE update of rule SIMPLE
 WHEN CHANGED
  BEGIN
!
```

```
! **** in case of a Genreal rule
   IF (general_specific OF discipline_message =
"GENERAL") THEN
     BEGIN
      IF (result_in_major_modification OF
AB_general_rules = "Yes" OR
result_in_major_modification OF AB_general_rules =
"No") THEN
        BEGIN
         EXEC lSodbc 1 SQL update [AB-general-
rules] set
              percent_change =
:AB_general_rules.percent_change,
result_in_major_modification =
:AB_general_rules.result_in_major_modification,
cause_of_the_effect =
:AB_general_rules.cause_of_the_effect
              where AB_general_rules_ID =
:AB_general_rules.AB_general_rules_ID
              END SQL
         visible OF helping window := FALSE
         FORGET  output OF helping window
        END
       ELSE
        BEGIN
         text OF message box 1 := "Last box value
should be Yes or No"
         put up OF message box 1 := TRUE
        END
      END
!
!
! **** in case of a specific rule
   IF (general_specific OF discipline_message =
"SPECIFIC") THEN
     BEGIN
      IF ( CONF(relation OF AB_specific_rules) >= 0)
THEN
       BEGIN
        relationship OF AB_specific_rules := TO
STRING( relation OF AB_specific_rules)
       END
      EXEC lSodbc 1 SQL update [AB-specific-rules]
set
             relationship =
:AB_specific_rules.relationship
             where AB_specific_rules_id =
:AB_specific_rules.AB_specific_rules_id
             END SQL
     END
!
! **** end of method
  END
ATTRIBUTE ignore rule SIMPLE
 WHEN CHANGED
  BEGIN
!
! **** in case of a Genreal rule
   IF (general_specific OF discipline_message =
"GENERAL") THEN
     BEGIN
      EXEC lSodbc 1 SQL update [AB-general-rules]
set
             rule_ignored = :domain.Yes$
             where AB_general_rules_ID =
:AB_general_rules.AB_general_rules_ID
             END SQL
      visible OF helping window := FALSE
      FORGET  output OF helping window
     END
!
! **** in case of a Specificl rule
   IF (general_specific OF discipline_message =
"SPECIFIC") THEN
     BEGIN
      EXEC lSodbc 1 SQL update [AB-specific-rules]
set
             rule_ignored = :domain.Yes$
             where AB_specific_rules_id =
:AB_specific_rules.AB_specific_rules_id
             END SQL
      visible OF specific rule window := FALSE
      FORGET  output OF specific rule window
     END
!
! **** end of method
  END
ATTRIBUTE start the module SIMPLE
 WHEN CHANGED
  BEGIN
     action OF lSodbc 1 IS connect := TRUE
     visible OF main window := FALSE
     visible OF message window := TRUE
     output OF message window := message display
   END
ATTRIBUTE general rule message SIMPLE
 WHEN CHANGED
  BEGIN
!
    IF ( CONF(cause_of_the_effect OF
discipline_message) < 0) THEN
      cause_of_the_effect OF discipline_message :=
"Undefined"
!
    message builder OF required_message :=
CONCAT( "The attribute ", changed_attribute OF
discipline_message, " of the building component ",
changed_class OF discipline_message, " (",
changed_instance_id OF discipline_message, ")
has been changed from the value (", old_value OF
discipline_message, ") to the value (", new_value OF
discipline_message, ").
Such a change may affect the design of the ",
discipline_to OF discipline_message, " system.
The possible cause of the effect is ",
cause_of_the_effect OF discipline_message, "

It is advisable to take some of the following steps:
 * Redesign the affected building system.
 * Negotiate the change with designing discipline.
 * Modefy the rule that caused this message.

If you need more information, please push the HELP
botton.

If you want to see and edit the rule that caused this
automated message
to be sent, please push the RULE botton")
  END
ATTRIBUTE specific rule message SIMPLE
 WHEN CHANGED
  BEGIN
    message builder OF required_message :=
CONCAT( "The attribute ", changed_attribute OF
discipline_message, " of the building component ",
changed_class OF discipline_message, " (",
changed_instance_id OF discipline_message, ")
has been changed from the value (", old_value OF
discipline_message, ") to the value (", new_value OF
discipline_message, ").
According to a previously define SPECIFIC rule, such
a change may affect the design of the attribute
", affected_attribute OF discipline_message, " of the
building component ", affected_class OF
discipline_message, " (", affected_instance_id OF
discipline_message, ")".

It is advisable to take some of the following steps:
 * Redesign the affected building component.
 * Negotiate the change with designing discipline.
 * Modefy the rule that caused this message.

If you need more information, please push the HELP
botton.

If you want to see and edit the rule that caused this
automated message
to be sent, please push the RULE botton")
  END
ATTRIBUTE go_ahead SIMPLE
 WHEN CHANGED
  BEGIN
!
   action OF lSodbc 2 GENERAL IS connect :=
TRUE
!
   EXEC lSodbc 2 GENERAL SQL SELECT
Project_name from Current_projects
      END SQL INTO Current_projects
(Project_name)
!
   visible OF main window := FALSE
   visible OF Select a project window := TRUE
   output OF Select a project window :=
select_project_display
  END
ATTRIBUTE project_name STRING
 WHEN CHANGED
  BEGIN
   data source OF lSodbc 1 := project_name
   title OF message window := CONCAT( "Reading
Automated Messages for Project : ", project_name)
   start the module := TRUE
  END
ATTRIBUTE include_initial_design SIMPLE
 WHEN CHANGED
  BEGIN
   FORGET  attachment OF valuebox 1
   FORGET  message status OF required_message
   IF include_initial_design = TRUE THEN
    include_initial_design_value := "* * *"
   ELSE
    include_initial_design_value := " "
  END
ATTRIBUTE include_initial_design_value STRING

INSTANCE border 1 ISA border
 WITH style IS shadow
 WITH perspective IS in
 WITH border width := 5
 WITH background color := 192,192,192
 WITH fill color := 0,0,128
 WITH highlight color := 255,255,255
 WITH shadow color := 0,0,0
 WITH location := 15,15,280,225

INSTANCE border 2 ISA border
 WITH style IS edit control
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 390,20,610,140

INSTANCE border 3 ISA border
 WITH style IS shadow
 WITH perspective IS in
 WITH border width := 5
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 10,235,615,385

INSTANCE border 4 ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,50,300,345

INSTANCE border 5 ISA border
 WITH style IS edit control
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,50,300,345

INSTANCE border 6 ISA border
 WITH style IS edit control
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,5,290,265

INSTANCE border 7 ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 10,10,240,195

INSTANCE border 8 ISA border
 WITH style IS shadow
 WITH perspective IS in
 WITH border width := 6
```

```
WITH background color := 192,192,192
WITH fill color := 0,0,128
WITH highlight color := 255,255,255
WITH shadow color := 0,0,0
WITH location := 25,20,220,140

INSTANCE the domain ISA domain
WITH No$ := "No"
WITH Yes$ := "Yes"
WITH include_initial_design := FALSE
WITH include_initial_design_value := " "

INSTANCE l5odbc 1 ISA l5odbc
WITH data source := "build"
WITH connection prompting := FALSE
WITH auto commit := TRUE
WITH append := FALSE
WITH default error handling := TRUE

INSTANCE l5odbc 2 GENERAL ISA l5odbc
WITH data source := "general"
WITH connection prompting := FALSE
WITH auto commit := TRUE
WITH append := FALSE
WITH default error handling := TRUE

INSTANCE message box 1 ISA message box
WITH title := "Input Error"
WITH modal style IS app modal
WITH icon IS stop sign
WITH button IS ok
WITH default button IS one

INSTANCE navigate 1 ISA navigate
WITH class attachment := discipline_message

INSTANCE the application ISA application
WITH unknowns fail := TRUE
WITH threshold := 50
WITH title display := opening display
WITH ignore breakpoints := FALSE
WITH reasoning on := FALSE
WITH numeric precision := 8
WITH demon strategy IS fire first

INSTANCE checkbox 1 ISA checkbox
WITH label := "Include initial designs messages"
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH show current := TRUE
WITH attachment := include_initial_design
WITH location := 380,200,615,230

INSTANCE opening display ISA display
WITH wait := TRUE
WITH delay changes := FALSE
WITH items [1 ] := border 6
WITH items [2 ] := border 1
WITH items [3 ] := textbox 1
WITH items [4 ] := UNDETERMINED
WITH items [5 ] := OK botton
WITH items [6 ] := UNDETERMINED
WITH items [7 ] := UNDETERMINED
WITH items [8 ] := UNDETERMINED
WITH items [9 ] := UNDETERMINED
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE message display ISA display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 3
WITH items [2 ] := valuebox 1
WITH items [3 ] := radiobutton group 1
WITH items [4 ] := radiobutton group 2
WITH items [5 ] := textbox 4
WITH items [6 ] := valuebox 2
WITH items [7 ] := textbox 5
WITH items [8 ] := valuebox 3
WITH items [9 ] := border 2
WITH items [10 ] := pushbutton 3
WITH items [11 ] := pushbutton 4
WITH items [12 ] := pushbutton 5
WITH items [13 ] := pushbutton 6
WITH items [14 ] := message has been read botton
WITH items [15 ] := message has been acted upon
botton
WITH items [16 ] := pushbutton 9
WITH items [17 ] := textbox 6
WITH items [18 ] := textbox 7
WITH items [19 ] := textbox 8
WITH items [20 ] := textbox 9
WITH items [21 ] := UNDETERMINED
WITH items [22 ] := UNDETERMINED
WITH items [23 ] := UNDETERMINED
WITH items [24 ] := UNDETERMINED
WITH items [25 ] := pushbutton 10
WITH items [26 ] := textbox 10
WITH items [27 ] := pushbutton 13
WITH items [28 ] := textbox 13
WITH items [29 ] := UNDETERMINED
WITH items [30 ] := UNDETERMINED
WITH items [31 ] := UNDETERMINED
WITH items [32 ] := UNDETERMINED
WITH items [33 ] := checkbox 1
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE helping display ISA display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 4
WITH items [2 ] := textbox 11
WITH items [3 ] := textbox 12
WITH items [4 ] := UNDETERMINED
WITH items [5 ] := pushbutton 11
WITH items [6 ] := pushbutton 12
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE general rule display ISA display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := textbox 14
WITH items [2 ] := border 5
WITH items [3 ] := UNDETERMINED
WITH items [4 ] := UNDETERMINED
WITH items [5 ] := UNDETERMINED
WITH items [6 ] := UNDETERMINED
WITH items [7 ] := UNDETERMINED
WITH items [8 ] := textbox 15
WITH items [9 ] := textbox 16
WITH items [10 ] := UNDETERMINED
WITH items [11 ] := textbox 18
WITH items [12 ] := promptbox 1
WITH items [13 ] := UNDETERMINED
WITH items [14 ] := textbox 19
WITH items [15 ] := promptbox 2
WITH items [16 ] := pushbutton 14
WITH items [17 ] := pushbutton 15
WITH items [18 ] := pushbutton 16
WITH items [19 ] := textbox 27
WITH items [20 ] := promptbox 3
WITH items [21 ] := valuebox 4
WITH items [22 ] := valuebox 5
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE specific rule display ISA display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := textbox 17
WITH items [2 ] := valuebox 6
WITH items [3 ] := valuebox 7
WITH items [4 ] := valuebox 8
WITH items [5 ] := valuebox 9
WITH items [6 ] := valuebox 10
WITH items [7 ] := valuebox 11
WITH items [8 ] := valuebox 12
WITH items [9 ] := textbox 20
WITH items [10 ] := textbox 21
WITH items [11 ] := textbox 22
WITH items [12 ] := textbox 23
WITH items [13 ] := textbox 24
WITH items [14 ] := textbox 25
WITH items [15 ] := textbox 26
WITH items [16 ] := UNDETERMINED
WITH items [17 ] := pushbutton 17
WITH items [18 ] := UNDETERMINED
WITH items [19 ] := pushbutton 19
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE select_project_display ISA display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 7
WITH items [2 ] := border 8
WITH items [3 ] := textbox 28
WITH items [4 ] := listbox 1
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE listbox 1 ISA listbox
WITH show current instance := TRUE
WITH source := Project_name OF Current_projects
WITH destination := project_name
WITH location := 30,150,210,180

INSTANCE promptbox 1 ISA promptbox
WITH font := "System"
WITH justify IS center
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := percent_change OF
AB_general_rules
WITH location := 240,170,290,200

INSTANCE promptbox 2 ISA promptbox
WITH font := "System"
WITH justify IS left
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := result_in_major_modification
OF AB_general_rules
WITH location := 240,225,290,255

INSTANCE promptbox 3 ISA promptbox
WITH font := "System"
WITH justify IS left
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := cause_of_the_effect OF
AB_general_rules
WITH location := 15,285,290,335

INSTANCE OK botton ISA pushbutton
WITH label := "Go Ahead"
WITH attribute attachment := go_ahead
WITH location := 90,230,195,255

INSTANCE pushbutton 3 ISA pushbutton
WITH label := "Next"
WITH attribute attachment := action OF navigate 1 IS
next
WITH location := 400,70,460,100

INSTANCE pushbutton 4 ISA pushbutton
WITH label := "Prev."
WITH attribute attachment := action OF navigate 1 IS
previous
WITH location := 470,70,530,100

INSTANCE pushbutton 5 ISA pushbutton
WITH label := "Last"
WITH attribute attachment := action OF navigate 1 IS
last
WITH location := 540,70,600,100

INSTANCE pushbutton 6 ISA pushbutton
WITH label := "Read First Message"
WITH attribute attachment := action OF navigate 1 IS
first
WITH location := 400,30,600,62

INSTANCE message has been read botton ISA
pushbutton
WITH label := "Message has been read"
WITH location := 15,390,305,415

INSTANCE message has been acted upon botton ISA
pushbutton
WITH label := "Message has been read and acted
upon"
WITH location := 310,390,610,415

INSTANCE pushbutton 9 ISA pushbutton
WITH label := "EXIT"
WITH attribute attachment := exit OF application
WITH location := 300,20,370,65

INSTANCE pushbutton 10 ISA pushbutton
WITH label := ""
WITH attribute attachment := helping
WITH location := 300,75,370,105

INSTANCE pushbutton 11 ISA pushbutton
WITH label := "OK"
WITH location := 30,350,135,380
```

INSTANCE pushbutton 12 ISA pushbutton
 WITH label := "RULE"
 WITH attribute attachment := show rule
 WITH location := 165,350,270,380

INSTANCE pushbutton 13 ISA pushbutton
 WITH label := ""
 WITH attribute attachment := show rule
 WITH location := 300,110,370,140

INSTANCE pushbutton 14 ISA pushbutton
 WITH label := "Cancel"
 WITH location := 5,350,70,380

INSTANCE pushbutton 15 ISA pushbutton
 WITH label := "Update Rule"
 WITH attribute attachment := update of rule
 WITH location := 75,350,185,380

INSTANCE pushbutton 16 ISA pushbutton
 WITH label := "Ignore Rule"
 WITH attribute attachment := ignore rule
 WITH location := 190,350,298,380

INSTANCE pushbutton 17 ISA pushbutton
 WITH label := "Cancel"
 WITH location := 215,340,425,370

INSTANCE pushbutton 19 ISA pushbutton
 WITH label := "Ignore Rule"
 WITH attribute attachment := ignore rule
 WITH location := 10,340,210,370

INSTANCE radiobutton group 1 ISA radiobutton group
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH frame := TRUE
 WITH group label := "Discipline"
 WITH show current := TRUE
 WITH attachment := discipline name OF required_message
 WITH location := 5,15,140,230

INSTANCE radiobutton group 2 ISA radiobutton group
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH frame := TRUE
 WITH group label := "Message status"
 WITH show current := TRUE
 WITH attachment := message status OF required_message
 WITH location := 140,15,290,150

INSTANCE textbox 1 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic, underline CF FALSE, strikeout CF FALSE
 WITH font size := 20
 WITH text := "MODULE FOR READING AUTOMATED MESSAGES"
 WITH location := 25,55,265,185

INSTANCE textbox 4 ISA textbox
 WITH pen color := 255,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "# of Messages"
 WITH location := 390,150,510,180

INSTANCE textbox 5 ISA textbox
 WITH pen color := 255,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "# of Current Message"
 WITH location := 390,175,570,203

INSTANCE textbox 6 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS bold CF FALSE, italic CF FALSE, underline CF FALSE, strikeout CF FALSE
 WITH frame := TRUE
 WITH text := "Read and Acted Upon Message"
 WITH location := 145,150,370,172

INSTANCE textbox 7 ISA textbox
 WITH pen color := 255,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH frame := TRUE
 WITH text := "Read but Un Acted Upon Message"
 WITH location := 145,200,370,220

INSTANCE textbox 8 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS bold CF FALSE, italic CF FALSE, underline CF FALSE, strikeout CF FALSE
 WITH frame := TRUE
 WITH text := "Un Read and Un Acted Upon Message"
 WITH location := 145,175,370,195

INSTANCE textbox 9 ISA textbox
 WITH pen color := 0,0,128
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Select Message"
 WITH location := 440,110,580,130

INSTANCE textbox 10 ISA textbox
 WITH pen color := 255,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "HELP"
 WITH location := 315,80,355,100

INSTANCE textbox 11 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline CF FALSE, strikeout CF FALSE
 WITH font size := 18
 WITH frame := TRUE
 WITH text := "HELP DISPLAY"
 WITH location := 5,5,300,45

INSTANCE textbox 12 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "This automated message has been sent by the system to inform you about a specific design change.

Such a change has violated a GENERAL or SPECIFIC rule that is built in the system. The components of that rule can be seen if you click on the RULE botton.

If you feel that this rule does not reflect your building system design requirement, you may modify the rule."
 WITH location := 25,60,280,340

INSTANCE textbox 13 ISA textbox
 WITH pen color := 0,0,128
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS italic
 WITH text := "RULE"
 WITH location := 310,115,360,135

INSTANCE textbox 14 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline CF FALSE, strikeout CF FALSE
 WITH font size := 18
 WITH frame := TRUE
 WITH text := "GENERAL RULE"
 WITH location = 5,5,300,45

INSTANCE textbox 15 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Changed Building Component"
 WITH location := 15,55,140,90

INSTANCE textbox 16 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Changed Component Attribute"
 WITH location := 15,95,160,130

INSTANCE textbox 18 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Percent change in value that requires design change from the affected discipline: (i.e. 0.3)"
 WITH location := 15,140,230,195

INSTANCE textbox 19 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Will there be major modifications with such a design change (Yes/No)"
 WITH location := 15,205,205,270

INSTANCE textbox 17 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline CF FALSE, strikeout CF FALSE
 WITH font size := 18
 WITH frame := TRUE
 WITH text := "Specific Rule"
 WITH location := 5,5,425,45

INSTANCE textbox 20 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Building Component:"
 WITH location := 10,55,170,80

INSTANCE textbox 21 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Building Component ID:"
 WITH location := 10,85,170,110

INSTANCE textbox 22 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Component Attribute:"
 WITH location := 10,115,170,140

INSTANCE textbox 23 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Related Building Component:"
 WITH location := 10,165,220,190

INSTANCE textbox 24 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Related Component ID:"
 WITH location := 10,195,220,220

INSTANCE textbox 25 ISA textbox

```
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH text := "Related Component Attribute:"
WITH location := 10,226,235,250

INSTANCE textbox 26 ISA textbox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH text := "Current Relationship:"
WITH location := 10,255,155,275

INSTANCE textbox 27 ISA textbox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH text := "Effect on the building system"
WITH location := 15,265,280,285

INSTANCE textbox 28 ISA textbox
WITH pen color := 255,255,255
WITH fill color := 0,0,128
WITH justify IS center
WITH font := "Times New Roman"
WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
WITH font size := 18
WITH text := "Select a Project from the List"
WITH location := 40,45,205,110

INSTANCE valuebox 1 ISA valuebox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "Times New Roman"
WITH font style IS bold CF FALSE, italic CF
FALSE, underline CF FALSE, strikeout CF FALSE
WITH font size := 12
WITH frame := FALSE
WITH clipped := TRUE
WITH scroll := TRUE
WITH horizontal scroll := TRUE
WITH location := 20,245,600,370

INSTANCE valuebox 2 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := number instances OF navigate 1
WITH location := 565,150,595,170

INSTANCE valuebox 3 ISA valuebox
WITH pen color := 0,0,128
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := instance number OF navigate 1
WITH location := 565,175,595,195

INSTANCE valuebox 4 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := building_element OF
AB_general_rules
WITH location := 100,75,290,95

INSTANCE valuebox 5 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := attribute_of_building_element
OF AB_general_rules
WITH location := 100,115,290,135

INSTANCE valuebox 6 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := building_element OF
AB_specific_rules
WITH location := 235,55,425,80

INSTANCE valuebox 7 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := building_element_id OF
AB_specific_rules
WITH location := 235,85,425,110

INSTANCE valuebox 8 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := attribute_of_building_element
OF AB_specific_rules
WITH location := 235,115,425,140

INSTANCE valuebox 9 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := related_class OF
AB_specific_rules
WITH location := 235,165,425,190

INSTANCE valuebox 10 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := related_instance_id OF
AB_specific_rules
WITH location := 235,195,425,220

INSTANCE valuebox 11 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := related_attribute OF
AB_specific_rules
WITH location := 235,225,425,250

INSTANCE valuebox 12 ISA valuebox
WITH pen color := 0,0,255
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := relationship OF
AB_specific_rules
WITH location := 10,275,425,330

INSTANCE main window ISA window
WITH location := 150,107,454,406
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := "Automated Messages Module"
WITH visible := TRUE

INSTANCE expand window ISA window
WITH location := 13,8,633,458
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := "(Untitled)"
WITH visible := FALSE

INSTANCE message window ISA window
WITH location := 5,8,634,460
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable CF
FALSE
WITH title := "Reading Automated Messages"
WITH visible := FALSE

INSTANCE helping window ISA window
WITH location := 149,43,463,459
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := ""
WITH visible := FALSE

INSTANCE specific rule window ISA window
WITH location := 97,37,543,447
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := ""
WITH visible := FALSE

INSTANCE Select a project window ISA window
WITH location := 151,149,407,383
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := "(Untitled)"
WITH visible := FALSE

! DEMON GROUP: discipline name OF
required_message

DEMON 1
IF discipline name OF required_message IS
Architecture
THEN choosen_discipline OF required_message :=
"arch"
AND FORGET attachment OF valuebox 1
AND FORGET message status OF required_message

DEMON 2
IF discipline name OF required_message IS HVAC
THEN choosen_discipline OF required_message :=
"hvac"
AND FORGET attachment OF valuebox 1
AND FORGET message status OF required_message

DEMON 3
IF discipline name OF required_message IS
Illumination
THEN choosen_discipline OF required_message :=
"illu"
AND FORGET attachment OF valuebox 1
AND FORGET message status OF required_message

DEMON 4
IF discipline name OF required_message IS Envelope
THEN choosen_discipline OF required_message :=
"enve"
AND FORGET attachment OF valuebox 1
AND FORGET message status OF required_message

DEMON 10
IF discipline name OF required_message IS Structure
THEN choosen_discipline OF required_message :=
"stru"
AND FORGET attachment OF valuebox 1
AND FORGET message status OF required_message

DEMON 13
IF discipline name OF required_message IS Interior
THEN choosen_discipline OF required_message :=
"inte"
AND FORGET attachment OF valuebox 1
AND FORGET message status OF required_message

! DEMON GROUP: message status OF
required_message

DEMON 5
IF message status OF required_message IS All
Messages
AND choosen_discipline OF required_message <>
"UNDETERMINED"
THEN EXEC ISodbc 1 SQL select * from
message_elements
where discipline_to =
:required_message.choosen_discipline
AND rule_ignored = :domain.NoS
```

```
AND old_value <>
:domain.include_initial_design_value
END SQL INTO discipline_message
AND FORGET attachment OF valuebox 1

DEMON 6
IF message status OF required_message IS UnRead Yet
AND choosen_discipline OF required_message <>
"UNDETERMINED"
THEN EXEC lSodbc 1 SQL select * from
message_elements
where discipline_to =
:required_message.choosen_discipline
AND been_read = :NoS
AND rule_ignored = :domain.NoS
 END SQL INTO discipline_message
AND FORGET attachment OF valuebox 1

DEMON 7
IF message status OF required_message IS UnActed
Upon
AND choosen_discipline OF required_message <>
"UNDETERMINED"
THEN EXEC lSodbc 1 SQL select * from
message_elements
where discipline_to =
:required_message.choosen_discipline
AND been_read = :YesS
AND been_acted_upon = :NoS
AND rule_ignored = :domain.NoS
 END SQL INTO discipline_message
AND FORGET attachment OF valuebox 1

! DEMON GROUP: selected OF pushbutton

DEMON 17
IF selected OF message has been read botton
THEN EXEC lSodbc 1 SQL update message_elements
set
been_read = :YesS
where id = :discipline_message.id
 END SQL

DEMON 18
IF selected OF message has been acted upon botton
THEN EXEC lSodbc 1 SQL update message_elements
set
been_acted_upon = :YesS, been_read = :YesS
where id = :discipline_message.id
 END SQL

DEMON 8
IF selected OF pushbutton 9
THEN action OF lSodbc 1 IS disconnect

DEMON 9
IF selected OF pushbutton 11
THEN visible OF helping window := FALSE
AND FORGET output OF helping window

DEMON 11
IF selected OF pushbutton 14
THEN visible OF helping window := FALSE
AND FORGET output OF helping window

DEMON 12
IF selected OF pushbutton 17
THEN visible OF specific rule window := FALSE
AND FORGET output OF specific rule window

END
```

C.4. TRACKING MODULE

```
$VERSION035
$LOCATIONS ARE PIXELS

CLASS A_attributes_of_monitored_object
  WITH name STRING

CLASS A_change_monitoring_results

  WITH Change_ID STRING
  WITH date_time STRING
  WITH discipline STRING
  WITH object STRING
  WITH object_ID STRING
  WITH attribute STRING
  WITH old_value STRING
  WITH new_value STRING
  WITH preceeding_change_ID STRING

CLASS A_monitored_object_input
  WITH object STRING
  WITH object_ID STRING
  WITH attribute STRING
  WITH start_time STRING
  WITH end_time STRING
  WITH select_discipline COMPOUND
    Architecture,
    Structure,
    Envelope,
    HVAC,
    Illumination,
    Interior
    WHEN CHANGED
     BEGIN
!
     IF select_discipline OF A_monitored_object_input
IS Architecture THEN
         BEGIN
          discipline OF A_monitored_object_input :=
"arch"
!------ reset all the other query data
          object OF A_monitored_object_input := ""
          object_ID OF A_monitored_object_input := ""
          attribute OF A_monitored_object_input := ""
          FORGET  source OF listbox 1
          FORGET  source OF listbox 2
          Change_ID OF A_monitored_object_input := ""
         END
!
     IF select_discipline OF A_monitored_object_input
IS Structure THEN
         BEGIN
          discipline OF A_monitored_object_input :=
"stru"
!------ reset all the other query data
          object OF A_monitored_object_input := ""
          object_ID OF A_monitored_object_input := ""
          attribute OF A_monitored_object_input := ""
          FORGET  source OF listbox 1
          FORGET  source OF listbox 2
          Change_ID OF A_monitored_object_input := ""
         END
!
     IF select_discipline OF A_monitored_object_input
IS Envelope THEN
         BEGIN
          discipline OF A_monitored_object_input :=
"enve"
!------ reset all the other query data
          object OF A_monitored_object_input := ""
          object_ID OF A_monitored_object_input := ""
          attribute OF A_monitored_object_input := ""
          FORGET  source OF listbox 1
          FORGET  source OF listbox 2
          Change_ID OF A_monitored_object_input := ""
         END
!
     IF select_discipline OF A_monitored_object_input
IS HVAC THEN
         BEGIN
          discipline OF A_monitored_object_input :=
"hvac"
!------ reset all the other query data
          object OF A_monitored_object_input := ""
          object_ID OF A_monitored_object_input := ""
          attribute OF A_monitored_object_input := ""
          FORGET  source OF listbox 1
          FORGET  source OF listbox 2
          Change_ID OF A_monitored_object_input := ""
         END
!
     IF select_discipline OF A_monitored_object_input
IS Illumination THEN
         BEGIN
          discipline OF A_monitored_object_input :=
"illu"
!------ reset all the other query data
          object OF A_monitored_object_input := ""
          object_ID OF A_monitored_object_input := ""
          attribute OF A_monitored_object_input := ""
          FORGET  source OF listbox 1
          FORGET  source OF listbox 2
          Change_ID OF A_monitored_object_input := ""
         END
!
     IF select_discipline OF A_monitored_object_input
IS Interior THEN
         BEGIN
          discipline OF A_monitored_object_input :=
"inte"
!------ reset all the other query data
          object OF A_monitored_object_input := ""
          object_ID OF A_monitored_object_input := ""
          attribute OF A_monitored_object_input := ""
          FORGET  source OF listbox 1
          FORGET  source OF listbox 2
          Change_ID OF A_monitored_object_input := ""
         END
!
     IF select_discipline OF A_monitored_object_input
= FALSE THEN
         BEGIN
          discipline OF A_monitored_object_input := ""
         END
!
!***** end of method
     END
  WITH discipline STRING
  WITH selection_statement STRING
  WITH Change_ID STRING
   WHEN CHANGED
    BEGIN
!***** reset all the other query data
     IF Change_ID OF A_monitored_object_input <>
"" THEN
         BEGIN
          discipline OF A_monitored_object_input := ""
          object OF A_monitored_object_input := ""
          object_ID OF A_monitored_object_input := ""
          attribute OF A_monitored_object_input := ""
          FORGET  source OF listbox 1
          FORGET  source OF listbox 2
          select_discipline OF A_monitored_object_input
:= UNDETERMINED
         END
!
    END

CLASS A_object_ID_of_monitored_object
  WITH ID STRING

CLASS border INHERITS add on, display item
  WITH style COMPOUND
   picture frame,
   edit control,
   group,
   shadow
   INIT picture frame
  WITH perspective COMPOUND
   in,
   out
   INIT in
  WITH border width NUMERIC
   INIT 1
  WITH background color COLOR
   INIT 192,192,192
  WITH fill color COLOR
   INIT 192,192,192
  WITH highlight color COLOR
   INIT 255,255,255
  WITH shadow color COLOR
   INIT 128,128,128

CLASS combobox INHERITS add on, display item
  WITH attachment ATTRIBUTE REFERENCE
  WITH selected SIMPLE
  WITH enabled SIMPLE
   INIT TRUE
  WITH sort SIMPLE
   INIT FALSE
  WITH update with current instance SIMPLE
   INIT TRUE

CLASS Current_projects
  WITH Project_name STRING

CLASS discipline_message
  WITH changed_attribute STRING
  WITH changed_class STRING
  WITH changed_instance_id STRING
  WITH old_value STRING
  WITH new_value STRING
  WITH affected_attribute STRING
  WITH affected_class STRING
  WITH affected_instance_id STRING
  WITH relationship STRING
  WITH writing_date TIME
  WITH reading_date TIME
  WITH been_read STRING
  WITH been_acted_upon STRING
  WITH id NUMERIC
  WITH discipline_to STRING
  WITH discipline_from STRING
  WITH sent_because_change_ID NUMERIC
  WITH general_specific STRING
  WITH rule_writting_date STRING
  WITH violated_rule_id NUMERIC
  WITH cause_of_the_effect STRING

CLASS I5odbc INHERITS add on
  WITH data source STRING
  WITH userid STRING
  WITH password STRING
  WITH connection string STRING
  WITH connection prompting SIMPLE
   INIT FALSE
  WITH auto commit SIMPLE
   INIT TRUE
  WITH action COMPOUND
   connect,
   disconnect
  WITH records NUMERIC
  WITH transaction COMPOUND
   commit,
   rollback
  WITH append SIMPLE
   INIT FALSE
  WITH status STRING
  WITH show error SIMPLE
  WITH default error handling SIMPLE
   INIT TRUE
  WITH error message STRING
  WITH native error NUMERIC
  WITH trace file STRING

CLASS message box INHERITS add on
  WITH title STRING
  WITH text STRING
  WITH variable text STRING
  WITH modal style COMPOUND
   app modal,
   sys modal,
   not modal
   INIT app modal
  WITH icon COMPOUND
   exclamation,
   information,
   question,
   stop sign
   INIT exclamation
  WITH button COMPOUND
   abort retry ignore,
   ok,
```

```
   ok cancel,
   retry cancel,
   yes no,
   yes no cancel
   INIT ok
  WITH default button COMPOUND
   one,
   two,
   three
   INIT one
  WITH button selected COMPOUND
   abort,
   cancel,
   ignore,
   no,
   ok,
   retry,
   yes,
   cancell
  WITH put up SIMPLE

CLASS navigate INHERITS add on
  WITH class attachment CLASS REFERENCE
  WITH action COMPOUND
   first,
   previous,
   next,
   last
   WHEN CHANGED
    BEGIN
     IF instance number OF navigate 1 <> 0 THEN
      BEGIN
!
! **** attach the discipline to the value box
        attachment OF valuebox 16 := discipline_to OF
discipline_message
!
! ****** Show the message on the screen
        IF been_read OF discipline_message = "Yes"
AND been_acted_upon OF discipline_message = "No"
THEN
          pen color OF valuebox 15 := 255,0,0
        IF been_read OF discipline_message = "No"
AND been_acted_upon OF discipline_message = "No"
THEN
          pen color OF valuebox 15 := 0,0,255
        IF been_read OF discipline_message = "Yes"
AND been_acted_upon OF discipline_message = "Yes"
THEN
          pen color OF valuebox 15 := 0,0,0
          attachment OF valuebox 15 := message builder
OF required_message
!
        IF general_specific OF discipline_message =
"GENERAL" THEN
          general rule := TRUE
!
        IF general_specific OF discipline_message =
"SPECIFIC" THEN
          specific rule := TRUE
!
      END
    END
  WITH instance number NUMERIC
  WITH number instances NUMERIC

CLASS relations building
  WITH current class STRING
  WITH current instance id STRING
  WITH current attribute name STRING
  WITH current display INSTANCE REFERENCE
  WITH related class STRING
  WITH related attribute name STRING
  WITH related instance id STRING
  WITH Relationship types COMPOUND
   Equal to,
   More than,
   Less than,
   Exist with,
   Between values
  WITH Chosen Relationship type STRING
  WITH columns headings STRING
   ARRAY SIZE 1
  WITH all id of related class STRING
   ARRAY SIZE 1
  WITH current class id attribute name STRING
  WITH related class id attribute name STRING
  WITH current attribute designer STRING
  WITH old value STRING
  WITH new value STRING
  WITH related attribute designer STRING
  WITH designers of related class attributes STRING
   ARRAY SIZE 1

CLASS required_message
  WITH discipline name COMPOUND
   Architecture,
   HVAC,
   Illumination,
   Envelope,
   Structure,
   Interior
  WITH message status COMPOUND
   All Messages,
   UnRead Yet,
   UnActed Upon
  WITH choosen_discipline STRING
  WITH message builder STRING

CLASS temp_current_menu_items
  WITH label STRING

ATTRIBUTE nn NUMERIC
ATTRIBUTE number of table columns NUMERIC
ATTRIBUTE show results SIMPLE
  WHEN CHANGED
   BEGIN
!
! ***** to test that there are input data
    IF ((object OF A_monitored_object_input <> "")
OR (discipline OF A_monitored_object_input <> "")
OR (start_time OF A_monitored_object_input <> "")
OR (end_time OF A_monitored_object_input <> "")
OR (Change_ID OF A_monitored_object_input <> ""))
THEN
     BEGIN
!
! ***** to test if end time is bigger than start time if
there is an end time
       IF end_time OF A_monitored_object_input <> ""
AND end_time OF A_monitored_object_input <
start_time OF A_monitored_object_input THEN
        BEGIN
         put up OF message box 2 := TRUE
        END
       ELSE
        BEGIN
!
!***** Start of SELECT statement
         selection_statement OF
A_monitored_object_input := "SELECT * FROM [A-
change-monitoring-data] WHERE "
!
!***** To select based on the discipline
         IF discipline OF A_monitored_object_input
<> "" THEN
          BEGIN
           selection_statement OF
A_monitored_object_input := CONCAT(
selection_statement OF A_monitored_object_input,
"discipline = :A_monitored_object_input.discipline")
          END
!
!***** To select based on the ID
         IF Change_ID OF A_monitored_object_input
<> "" THEN
          BEGIN
           numeric_Change_ID := TO NUMERIC(
Change_ID OF A_monitored_object_input)
           selection_statement OF
A_monitored_object_input := CONCAT(
selection_statement OF A_monitored_object_input,
"Change_ID = :numeric_Change_ID ")
          END
!
!***** To select based on object data
         IF object OF A_monitored_object_input <> ""
THEN
          BEGIN
           selection_statement OF
A_monitored_object_input := CONCAT(
selection_statement OF A_monitored_object_input,
"object = :A_monitored_object_input.object")
           IF object_ID OF A_monitored_object_input
<> "" THEN
            selection_statement OF
A_monitored_object_input := CONCAT(
selection_statement OF A_monitored_object_input, "
AND object_ID =
:A_monitored_object_input.object_ID")
           IF attribute OF A_monitored_object_input
<> "" THEN
            selection_statement OF
A_monitored_object_input := CONCAT(
selection_statement OF A_monitored_object_input, "
AND attribute = :A_monitored_object_input.attribute")
          END
!
!***** To select based on time period
!------- Case of start time alone
         IF start_time OF A_monitored_object_input
<> "" THEN
          BEGIN
           IF LENGTH(selection_statement OF
A_monitored_object_input) > 47 THEN
            selection_statement OF
A_monitored_object_input := CONCAT(
selection_statement OF A_monitored_object_input, "
AND")
           selection_statement OF
A_monitored_object_input := CONCAT(
selection_statement OF A_monitored_object_input, "
date_time >= :A_monitored_object_input.start_time")
          END
!------- Case of end time with or without start time
         IF end_time OF A_monitored_object_input <>
"" THEN
          BEGIN
           IF LENGTH(selection_statement OF
A_monitored_object_input) > 47 THEN
            selection_statement OF
A_monitored_object_input := CONCAT(
selection_statement OF A_monitored_object_input, "
AND")
           selection_statement OF
A_monitored_object_input := CONCAT(
selection_statement OF A_monitored_object_input, "
date_time <= :A_monitored_object_input.end_time")
          END
!
!****** Running the select statement
         EXEC !Sodbc 1 SQL WITH
selection_statement OF A_monitored_object_input
END SQL INTO A_change_monitoring_results
!
!

         output OF expand window := Results
         visible OF expand window := TRUE
         visible OF Query window := FALSE
         visible OF main window := FALSE
!
!***** end of second IF (check start abd end time)
        END
!***** end of IF (check that there are inputs
     END
    ELSE
     BEGIN
      put up OF message box 1 := TRUE
     END
! ***** end of method
   END
ATTRIBUTE numeric_Change_ID NUMERIC
ATTRIBUTE return to query screen SIMPLE
  WHEN CHANGED
   BEGIN
    visible OF Query window := TRUE
    visible OF expand window := FALSE
   END
ATTRIBUTE return to results screen SIMPLE
  WHEN CHANGED
   BEGIN
    FORGET attachment OF valuebox 16
    FORGET discipline_message
    FORGET required_message
    output OF expand window := Results
    visible OF expand window := TRUE
    visible OF messages window := FALSE
   END
ATTRIBUTE go to message screen SIMPLE
  WHEN CHANGED
   BEGIN
    output OF messages window := messages
    visible OF messages window := TRUE
    visible OF expand window := FALSE
   END
ATTRIBUTE sample time STRING
ATTRIBUTE complete as monitored object SIMPLE
  WHEN CHANGED
   BEGIN
!
!****** reset all the other query data
    Change_ID OF A_monitored_object_input := ""
    discipline OF A_monitored_object_input := ""
```

```
    select_discipline OF A_monitored_object_input :=
UNDETERMINED
    object_ID OF A_monitored_object_input := ""
    attribute OF A_monitored_object_input := ""
!
! **** get the ID of the object from the database
    general_statement_of_selection := CONCAT(
"select ", object OF A_monitored_object_input, "_id
from ", object OF A_monitored_object_input)
    EXEC lSodbc 1 SQL WITH
general_statement_of_selection END SQL INTO
A_object_ID_of_monitored_object (ID)
!
    source OF listbox 1 := ID OF
A_object_ID_of_monitored_object
!
! **** get the attributes of the object from the database
    EXEC lSodbc 1 SQL select
attribute_of_building_element from [AB-attribute-
designer] where building_element =
:A_monitored_object_input.object
                END SQL INTO
A_attributes_of_monitored_object (name)
!
    source OF listbox 2 := name OF
A_attributes_of_monitored_object
!
!**** end of method
  END
ATTRIBUTE general_statement_of_selection STRING
ATTRIBUTE start the module SIMPLE
 WHEN CHANGED
  BEGIN
!
    action OF lSodbc 1 IS connect := TRUE
!
! ***** Load the menus in the screens
!
    EXEC lSodbc 1 SQL SELECT
DISTINCT(main_menu_label) from [AB-menu_item]
      END SQL INTO menu (label)
!
    EXEC lSodbc 1 SQL SELECT label from [AB-
menu_item]
      END SQL INTO menu item
!
    IF (number instances OF navigate menu > 0) THEN
     BEGIN
!
      RESIZE menus OF Query window := number
instances OF navigate menu
!
!
      FOR (nn := 1 TO number instances OF
navigate menu)
       BEGIN
        instance number OF navigate menu := nn
!
! ***** load the menu items in every menu
      EXEC lSodbc 1 SQL SELECT label from
[AB-menu_item] WHERE (main_menu_label) =
:menu.label
                    END SQL INTO
temp_current_menu_items (label)
        RESIZE items OF menu := number instances
OF navigate temp_current_menu_items
        FOR (%nnn := 1 TO number instances OF
navigate temp_current_menu_items)
         BEGIN
          instance number OF navigate
temp_current_menu_items := %nnn
          FIND menu item
           WHERE label OF menu item = label OF
temp_current_menu_items
           FIND END
          items[ %nnn] OF menu := menu item
         END
!
       menus[ nn] OF Query window := menu
      END
!
    END
!
    visible OF Query window := TRUE
    visible OF main window := FALSE
!
! *** end of method
  END
ATTRIBUTE general rule SIMPLE
 WHEN CHANGED
  BEGIN
!
    IF ( CONF(cause_of_the_effect OF
discipline_message) < 0) THEN
      cause_of_the_effect OF discipline_message :=
"Undefined"
!
    message builder OF required_message :=
CONCAT( "The attribute "", changed_attribute OF
discipline_message, "" of the building component "",
changed_class OF discipline_message, " (",
changed_instance_id OF discipline_message, ")'
has been changed from the value (", old_value OF
discipline_message, ") to the value (", new_value OF
discipline_message, ").
Such a change may affect the design of the ",
discipline_to OF discipline_message, " system.
The possible cause of the effect is "",
cause_of_the_effect OF discipline_message, ""

It is advisable to take some of the following steps:
  * Redesign the affected building system.
  * Negotiate the change with designing discipline.
  * Modefy the rule that caused this message.

If you need more information, please push the HELP
botton.

If you want to see and edit the rule that caused this
automated message
to be sent, please push the RULE botton. ")
  END
ATTRIBUTE specific rule SIMPLE
 WHEN CHANGED
  BEGIN
    message builder OF required_message :=
CONCAT( "The attribute "", changed_attribute OF
discipline_message, "" of the building component "",
changed_class OF discipline_message, " (",
changed_instance_id OF discipline_message, ")'
has been changed from the value (", old_value OF
discipline_message, ") to the value (", new_value OF
discipline_message, ").
According to a previously define SPECIFIC rule, such
a change may affect the design of the attribute
", affected_attribute OF discipline_message, "" of the
building component "", affected_class OF
discipline_message, " (", affected_instance_id OF
discipline_message, ")'.

It is advisable to take some of the following steps:
  * Redesign the affected building system.
  * Negotiate the change with designing discipline.
  * Modefy the rule that caused this message.

If you need more information, please push the HELP
botton.

If you want to see and edit the rule that caused this
automated message
to be sent, please push the RULE botton.")
  END
ATTRIBUTE effect of menu item SIMPLE
 WHEN CHANGED
  BEGIN
!
    object OF A_monitored_object_input := label OF
menu item
    complete as monitored object := TRUE
!
! *** end of method
  END
ATTRIBUTE %nnn NUMERIC
ATTRIBUTE go_ahead SIMPLE
 WHEN CHANGED
  BEGIN
    !
    action OF lSodbc 2 GENERAL IS connect :=
TRUE
!
    EXEC lSodbc 2 GENERAL SQL SELECT
Project_name from Current_projects
      END SQL INTO Current_projects
(Project_name)
!
    visible OF main window := FALSE
    visible OF Select a project window := TRUE
    output OF Select a project window :=
select_project_display
!
  END
ATTRIBUTE project_name STRING
 WHEN CHANGED
  BEGIN
   data source OF lSodbc 1 := project_name
   title OF Query window := CONCAT( "Change
Monitoring for Project : ", project_name)
   start the module := TRUE
  END

INSTANCE A_monitored_object_input 1 ISA
A_monitored_object_input

INSTANCE border 1 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 10,60,145,155

INSTANCE border 2 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 10,165,320,385

INSTANCE border 3 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 330,245,550,385

INSTANCE border 4 ISA border
 WITH style IS edit control
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,50,555,175

INSTANCE border 5 ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 6
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,180,555,355

INSTANCE border 6 ISA border
 WITH style IS shadow
 WITH perspective IS in
 WITH border width := 6
 WITH background color := 192,192,192
 WITH fill color := 0,0,128
 WITH highlight color := 255,255,255
 WITH shadow color := 0,0,0
 WITH location := 15,15,190,150

INSTANCE border 7 ISA border
 WITH style IS picture frame
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 340,65,545,165

INSTANCE border 8 ISA border
 WITH style IS shadow
 WITH perspective IS in
 WITH border width := 4
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 10,220,545,372
```

```
INSTANCE border 9 ISA border
  WITH style IS edit control
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 5,5,200,200

INSTANCE border 10 ISA border
  WITH style IS picture frame
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 465,65,550,80

INSTANCE border 11 ISA border
  WITH style IS picture frame
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 465,220,550,235

INSTANCE border 12 ISA border
  WITH style IS picture frame
  WITH perspective IS in
  WITH border width := 1
  WITH background color := 192,192,192
  WITH fill color := 192,192,192
  WITH highlight color := 255,255,255
  WITH shadow color := 128,128,128
  WITH location := 10,10,240,195

INSTANCE border 13 ISA border
  WITH style IS shadow
  WITH perspective IS in
  WITH border width := 6
  WITH background color := 192,192,192
  WITH fill color := 0,0,128
  WITH highlight color := 255,255,255
  WITH shadow color := 0,0,0
  WITH location := 25,25,225,135

INSTANCE combobox 1 ISA combobox
  WITH enabled := TRUE
  WITH sort := FALSE
  WITH update with current instance := TRUE
  WITH location := 155,245,295,265

INSTANCE the domain ISA domain
  WITH sample time := "1996/01/20 14:00"

INSTANCE l5odbc 1 ISA l5odbc
  WITH data source := "build"
  WITH connection prompting := FALSE
  WITH auto commit := TRUE
  WITH append := FALSE
  WITH default error handling := TRUE

INSTANCE l5odbc 2 GENERAL ISA l5odbc
  WITH data source := "general"
  WITH connection prompting := FALSE
  WITH auto commit := TRUE
  WITH append := FALSE
  WITH default error handling := TRUE

INSTANCE message box 1 ISA message box
  WITH title := "INPUT ERROR"
  WITH text := "You need to input query data"
  WITH modal style IS app modal
  WITH icon IS stop sign
  WITH button IS ok
  WITH default button IS one

INSTANCE message box 2 ISA message box
  WITH title := "INPUT ERROR"
  WITH text := "End Time must be bigger than Start
Time"
  WITH modal style IS app modal
  WITH icon IS stop sign
  WITH button IS ok
  WITH default button IS one

INSTANCE navigate 1 ISA navigate
  WITH class attachment := discipline_message

INSTANCE navigate menu ISA navigate
  WITH class attachment := menu

INSTANCE navigate temp_current_menu_items ISA
navigate
  WITH class attachment := temp_current_menu_items

INSTANCE the application ISA application
  WITH unknowns fail := TRUE
  WITH threshold := 50
  WITH title display := Starting Display
  WITH ignore breakpoints := FALSE
  WITH reasoning on := FALSE
  WITH numeric precision := 8
  WITH demon strategy IS fire first

INSTANCE column 1 ISA column
  WITH attachment := Change_ID OF
A_change_monitoring_results
  WITH width := 55
  WITH justify IS center
  WITH wordwrap := TRUE
  WITH heading label := "Change
ID"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE column 2 ISA column
  WITH attachment := date_time OF
A_change_monitoring_results
  WITH width := 120
  WITH justify IS center
  WITH wordwrap := TRUE
  WITH heading label := "Date/Time"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE column 3 ISA column
  WITH attachment := discipline OF
A_change_monitoring_results
  WITH width := 40
  WITH justify IS center
  WITH wordwrap := TRUE
  WITH heading label := "Dspl."
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE column 4 ISA column
  WITH attachment := object OF
A_change_monitoring_results
  WITH width := 100
  WITH justify IS center
  WITH wordwrap := TRUE
  WITH heading label := "component"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE column 5 ISA column
  WITH attachment := object_ID OF
A_change_monitoring_results
  WITH width := 70
  WITH justify IS center
  WITH wordwrap := TRUE
  WITH heading label := "Comp.ID"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE column 6 ISA column
  WITH attachment := attribute OF
A_change_monitoring_results
  WITH width := 120
  WITH justify IS center
  WITH wordwrap := TRUE
  WITH heading label := "Attribute"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE column 7 ISA column
  WITH attachment := old_value OF
A_change_monitoring_results
  WITH width := 100
  WITH justify IS center
  WITH wordwrap := TRUE
  WITH heading label := "Old
Value"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE column 8 ISA column
  WITH attachment := new_value OF
A_change_monitoring_results
  WITH width := 100
  WITH justify IS center
  WITH wordwrap := TRUE
  WITH heading label := "New
Value"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE column 9 ISA column
  WITH attachment := preceeding_change_ID OF
A_change_monitoring_results
  WITH width := 65
  WITH justify IS left
  WITH wordwrap := TRUE
  WITH heading label := "Prev.
ChangeID"
  WITH heading justify IS heading center
  WITH heading wordwrap := TRUE

INSTANCE Starting Display ISA display
  WITH wait := TRUE
  WITH delay changes := FALSE
  WITH items [1 ] := border 9
  WITH items [2 ] := border 6
  WITH items [3 ] := textbox 1
  WITH items [4 ] := UNDETERMINED
  WITH items [5 ] := pushbutton 6
  WITH items [6 ] := UNDETERMINED
  WITH items [7 ] := UNDETERMINED
  WITH fill color := 192,192,192
  WITH menus [1 ] := UNDETERMINED

INSTANCE query ISA display
  WITH wait := TRUE
  WITH delay changes := FALSE
  WITH items [1 ] := radiobutton group 1
  WITH items [2 ] := UNDETERMINED
  WITH items [3 ] := border 3
  WITH items [4 ] := border 2
  WITH items [5 ] := textbox 2
  WITH items [6 ] := border 1
  WITH items [7 ] := UNDETERMINED
  WITH items [8 ] := textbox 4
  WITH items [9 ] := textbox 5
  WITH items [10 ] := textbox 6
  WITH items [11 ] := UNDETERMINED
  WITH items [12 ] := UNDETERMINED
  WITH items [13 ] := UNDETERMINED
  WITH items [14 ] := valuebox 3
  WITH items [15 ] := textbox 7
  WITH items [16 ] := UNDETERMINED
  WITH items [17 ] := UNDETERMINED
  WITH items [18 ] := UNDETERMINED
  WITH items [19 ] := UNDETERMINED
  WITH items [20 ] := promptbox 1
  WITH items [21 ] := textbox 9
  WITH items [22 ] := textbox 10
  WITH items [23 ] := textbox 11
  WITH items [24 ] := UNDETERMINED
  WITH items [25 ] := promptbox 2
  WITH items [26 ] := UNDETERMINED
  WITH items [27 ] := UNDETERMINED
  WITH items [28 ] := UNDETERMINED
  WITH items [29 ] := UNDETERMINED
  WITH items [30 ] := pushbutton 2
  WITH items [31 ] := pushbutton 3
  WITH items [32 ] := UNDETERMINED
  WITH items [33 ] := UNDETERMINED
  WITH items [34 ] := UNDETERMINED
  WITH items [35 ] := UNDETERMINED
  WITH items [36 ] := UNDETERMINED
  WITH items [37 ] := UNDETERMINED
  WITH items [38 ] := textbox 28
  WITH items [39 ] := promptbox 5
  WITH items [40 ] := UNDETERMINED
  WITH items [41 ] := UNDETERMINED
  WITH items [42 ] := UNDETERMINED
  WITH items [43 ] := textbox 33
  WITH items [44 ] := textbox 34
  WITH items [45 ] := UNDETERMINED
  WITH items [46 ] := UNDETERMINED
  WITH items [47 ] := textbox 35
  WITH items [48 ] := UNDETERMINED
  WITH items [49 ] := textbox 37
  WITH items [50 ] := textbox 38
  WITH items [51 ] := UNDETERMINED
  WITH items [52 ] := textbox 40
  WITH items [53 ] := promptbox 7
  WITH items [54 ] := listbox 1
```

```
WITH items [55 ] := listbox 2
WITH items [56 ] := textbox 36
WITH items [57 ] := valuebox 17
WITH items [58 ] := valuebox 18
WITH items [59 ] := border 10
WITH items [60 ] := border 11
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE Results ISA display
WITH wait := TRUE
WITH delay changes := FALSE
WITH items [1 ] := border 4
WITH items [2 ] := textbox 13
WITH items [3 ] := textbox 14
WITH items [4 ] := textbox 15
WITH items [5 ] := textbox 16
WITH items [6 ] := textbox 17
WITH items [7 ] := UNDETERMINED
WITH items [8 ] := UNDETERMINED
WITH items [9 ] := valuebox 8
WITH items [10 ] := UNDETERMINED
WITH items [11 ] := valuebox 7
WITH items [12 ] := valuebox 9
WITH items [13 ] := valuebox 10
WITH items [14 ] := textbox 18
WITH items [15 ] := UNDETERMINED
WITH items [16 ] := textbox 19
WITH items [17 ] := textbox 20
WITH items [18 ] := valuebox 11
WITH items [19 ] := valuebox 12
WITH items [20 ] := UNDETERMINED
WITH items [21 ] := border 5
WITH items [22 ] := table 2
WITH items [23 ] := UNDETERMINED
WITH items [24 ] := UNDETERMINED
WITH items [25 ] := UNDETERMINED
WITH items [26 ] := pushbutton 15
WITH items [27 ] := UNDETERMINED
WITH items [28 ] := textbox 29
WITH items [29 ] := textbox 31
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE messages ISA display
WITH wait := TRUE
WITH delay changes := FALSE
WITH items [1 ] := border 8
WITH items [2 ] := border 7
WITH items [3 ] := textbox 21
WITH items [4 ] := UNDETERMINED
WITH items [5 ] := UNDETERMINED
WITH items [6 ] := pushbutton 7
WITH items [7 ] := pushbutton 8
WITH items [8 ] := pushbutton 9
WITH items [9 ] := pushbutton 10
WITH items [10 ] := textbox 22
WITH items [11 ] := textbox 23
WITH items [12 ] := textbox 24
WITH items [13 ] := textbox 25
WITH items [14 ] := textbox 26
WITH items [15 ] := textbox 27
WITH items [16 ] := valuebox 13
WITH items [17 ] := valuebox 14
WITH items [18 ] := valuebox 15
WITH items [19 ] := UNDETERMINED
WITH items [20 ] := UNDETERMINED
WITH items [21 ] := UNDETERMINED
WITH items [22 ] := pushbutton 11
WITH items [23 ] := textbox 39
WITH items [24 ] := valuebox 16
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE select_project_display ISA display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 12
WITH items [2 ] := border 13
WITH items [3 ] := textbox 41
WITH items [4 ] := listbox 3
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE listbox 1 ISA listbox
WITH show current instance := TRUE
WITH destination := object_ID OF
A_monitored_object_input
WITH location := 150,235,310,260

INSTANCE listbox 2 ISA listbox
WITH show current instance := TRUE
WITH destination := attribute OF
A_monitored_object_input
WITH location := 150,315,310,342

INSTANCE listbox 3 ISA listbox
WITH show current instance := TRUE
WITH source := Project_name OF Current_projects
WITH destination := project_name
WITH location := 30,150,215,180

INSTANCE promptbox 1 ISA promptbox
WITH font := "System"
WITH justify IS center
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := start_time OF
A_monitored_object_input
WITH location := 385,295,540,320

INSTANCE promptbox 2 ISA promptbox
WITH font := "System"
WITH justify IS center
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := end_time OF
A_monitored_object_input
WITH location := 385,325,540,350

INSTANCE promptbox 5 ISA promptbox
WITH font := "System"
WITH justify IS center
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := Change_ID OF
A_monitored_object_input
WITH location := 20,115,135,140

INSTANCE promptbox 7 ISA promptbox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH font := "System"
WITH justify IS center
WITH frame := FALSE
WITH show default := TRUE
WITH show current := TRUE
WITH attachment := sample time
WITH location := 400,355,540,380

INSTANCE pushbutton 2 ISA pushbutton
WITH label := "SHOW RESULTS"
WITH attribute attachment := show results
WITH location := 155,60,320,105

INSTANCE pushbutton 3 ISA pushbutton
WITH label := "END"
WITH attribute attachment := exit OF the application
WITH location := 155,110,320,155

INSTANCE pushbutton 6 ISA pushbutton
WITH label := "Go Ahead"
WITH attribute attachment := go_ahead
WITH location := 25,160,175,192

INSTANCE pushbutton 7 ISA pushbutton
WITH label := "Read First Message"
WITH attribute attachment := action OF navigate 1 IS
first
WITH location := 350,70,535,105

INSTANCE pushbutton 8 ISA pushbutton
WITH label := "Next"
WITH attribute attachment := action OF navigate 1 IS
next
WITH location := 350,105,410,135

INSTANCE pushbutton 9 ISA pushbutton
WITH label := "Prev."
WITH attribute attachment := action OF navigate 1 IS
previous
WITH location := 410,105,470,135

INSTANCE pushbutton 10 ISA pushbutton
WITH label := "Last"
WITH attribute attachment := action OF navigate 1 IS
last
WITH location := 470,105,533,135

INSTANCE pushbutton 15 ISA pushbutton
WITH label := "OK"
WITH attribute attachment := return to query screen
WITH location := 415,360,550,400

INSTANCE pushbutton 14 ISA pushbutton
WITH label := "END"
WITH attribute attachment := exit OF the application
WITH location := 215,40,365,78

INSTANCE pushbutton 11 ISA pushbutton
WITH label := "OK"
WITH attribute attachment := return to results screen
WITH location := 340,170,545,210

INSTANCE radiobutton group 1 ISA radiobutton
group
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH frame := TRUE
WITH group label := "Discipline"
WITH show current := TRUE
WITH attachment := select_discipline OF
A_monitored_object_input
WITH location := 320,55,465,245

INSTANCE table 2 ISA table
WITH attachment := A_change_monitoring_results
WITH columns [1 ] := column 1
WITH columns [2 ] := column 2
WITH columns [3 ] := column 3
WITH columns [4 ] := column 4
WITH columns [5 ] := column 5
WITH columns [6 ] := column 6
WITH columns [7 ] := column 7
WITH columns [8 ] := column 8
WITH columns [9 ] := column 9
WITH heading := TRUE
WITH heading height := 40
WITH fill color := 0,255,255
WITH column lines := TRUE
WITH row lines := TRUE
WITH frame := TRUE
WITH show current instance := TRUE
WITH location := 10,185,550,350

INSTANCE text style 1 ISA text style
WITH font := "Times New Roman"
WITH size := 10
WITH font style IS bold CF FALSE, italic CF
FALSE, underline CF FALSE, strikeout CF FALSE

INSTANCE textbox 1 ISA textbox
WITH pen color := 255,255,255
WITH fill color := 0,0,128
WITH justify IS center
WITH font := "Times New Roman"
WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
WITH font size := 14
WITH frame := FALSE
WITH text := "
CHANGE TRACKING MODULE"
WITH location := 25,25,170,130

INSTANCE textbox 2 ISA textbox
WITH pen color := 255,255,255
WITH fill color := 128,0,0
WITH justify IS center
WITH font := "Times New Roman"
WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
WITH font size := 18
WITH frame := TRUE
WITH text := "SELECTION OF DESIGN
CHANGES"
WITH location := 10,10,550,50

INSTANCE textbox 4 ISA textbox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH text := "Building Comp.:"
WITH location := 15,180,155,200

INSTANCE textbox 5 ISA textbox
WITH pen color := 0,0,0
WITH fill color := 192,192,192
WITH justify IS left
WITH font := "System"
WITH text := "Building Comp. ID:"
WITH location := 20,240,180,260
```

```
INSTANCE textbox 6 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALSE
 WITH font size := 5
 WITH text := "Define from the upper Menu"
 WITH location := 20,205,210,225

INSTANCE textbox 7 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Comp. Attribute:"
 WITH location := 20,315,165,340

INSTANCE textbox 9 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS italic
 WITH text := "Time Period"
 WITH location := 340,250,430,270

INSTANCE textbox 10 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "From"
 WITH location := 340,300,380,320

INSTANCE textbox 11 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "To"
 WITH location := 340,330,375,350

INSTANCE textbox 13 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 18
 WITH frame := TRUE
 WITH text := "QUERY RESULTS"
 WITH location := 5,5,555,45

INSTANCE textbox 14 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Discipline"
 WITH location := 20,60,90,85

INSTANCE textbox 15 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Building Component"
 WITH location := 100,60,240,80

INSTANCE textbox 16 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Component ID"
 WITH location := 255,60,350,85

INSTANCE textbox 17 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Component Attribute"
 WITH location := 395,60,530,85

INSTANCE textbox 18 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Time Period:"
 WITH location := 20,115,125,140

INSTANCE textbox 19 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "From:"
 WITH location := 275,115,335,140

INSTANCE textbox 20 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "To:"
 WITH location := 275,140,305,165

INSTANCE textbox 21 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 18
 WITH frame := TRUE
 WITH text := "RELATED MESSAGES"
 WITH location := 10,10,545,50

INSTANCE textbox 22 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Select Message"
 WITH location := 390,140,500,160

INSTANCE textbox 23 ISA textbox
 WITH justify IS left
 WITH font := "System"
 WITH frame := TRUE
 WITH text := " Read and Acted Upon Message (Black
Color)"
 WITH location := 10,95,330,120

INSTANCE textbox 24 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 255,255,255
 WITH justify IS left
 WITH font := "System"
 WITH frame := TRUE
 WITH text := " Un Read and Un Acted Upon Message
(Green)"
 WITH location := 10,125,330,150

INSTANCE textbox 25 ISA textbox
 WITH pen color := 255,0,0
 WITH fill color := 255,255,255
 WITH justify IS left
 WITH font := "System"
 WITH frame := TRUE
 WITH text := " Read but Un Acted Upon Message
(Red)"
 WITH location := 10,155,330,180

INSTANCE textbox 26 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "# of Messages"
 WITH location := 10,185,140,210

INSTANCE textbox 27 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "# of Current Message"
 WITH location := 155,185,300,210

INSTANCE textbox 28 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Change ID:"
 WITH location := 40,70,120,90

INSTANCE textbox 29 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "From project start time     OR"
 WITH location := 20,140,270,160

INSTANCE textbox 31 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 0,255,255
 WITH justify IS center
 WITH font := "System"
 WITH font style IS bold
 WITH frame := TRUE
 WITH text := "Double click to retreive the massages
sent
by the system as a response to a design change"
 WITH location := 5,360,410,400

INSTANCE textbox 32 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 255,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 36
 WITH frame := TRUE
 WITH text := "END OF MONITORING MODULE"
 WITH location := 77,87,548,307

INSTANCE textbox 33 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "From Project Start Time"
 WITH location := 340,270,500,290

INSTANCE textbox 34 ISA textbox
 WITH pen color := 255,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "OR"
 WITH location := 515,270,540,295

INSTANCE textbox 35 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALSE
 WITH font size := 5
 WITH text := "Select
by double click"
 WITH location := 20,260,175,305

INSTANCE textbox 37 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALSE
 WITH font size := 5
 WITH text := "Input"
 WITH location := 40,90,90,110

INSTANCE textbox 38 ISA textbox
 WITH pen color := 0,0,128
 WITH fill color := 0,255,255
 WITH justify IS left
 WITH font := "Times New Roman"
 WITH font style IS bold CF FALSE, italic CF
FALSE, underline CF FALSE, strikeout CF FALSE
 WITH font size := 10
 WITH frame := TRUE
 WITH text := "
 Select either:

 - Discipline
 - Change ID
  OR
 - Component"
 WITH location := 465,90,550,210
```

```
INSTANCE textbox 39 ISA textbox
  WITH pen color := 0,0,255
  WITH fill color := 192,192,192
  WITH justify IS left
  WITH font := "System"
  WITH text := "Discipline which received the
message:"
  WITH location := 10,65,335,90

INSTANCE textbox 40 ISA textbox
  WITH pen color := 0,0,0
  WITH fill color := 192,192,192
  WITH justify IS left
  WITH font := "System"
  WITH text := "Sample:"
  WITH location := 340,360,405,380

INSTANCE textbox 36 ISA textbox
  WITH pen color := 0,0,255
  WITH fill color := 192,192,192
  WITH justify IS left
  WITH font := "System"
  WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALSE
  WITH font size := 5
  WITH text := "Select
by double click"
  WITH location := 20,335,135,375

INSTANCE textbox 41 ISA textbox
  WITH pen color := 255,255,255
  WITH fill color := 0,0,128
  WITH justify IS center
  WITH font := "Times New Roman"
  WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
  WITH font size := 18
  WITH text := "Select a Project from the List"
  WITH location := 35,50,210,115

INSTANCE valuebox 2 ISA valuebox
  WITH justify IS left
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH location := 160,170,290,203

INSTANCE valuebox 3 ISA valuebox
  WITH pen color := 0,0,128
  WITH fill color := 192,192,192
  WITH justify IS center
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH attachment := object OF
A_monitored_object_input
  WITH location := 150,175,310,200

INSTANCE valuebox 8 ISA valuebox
  WITH pen color := 0,0,255
  WITH fill color := 192,192,192
  WITH justify IS center
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH attachment := object_ID OF
A_monitored_object_input
  WITH location := 240,80,370,105

INSTANCE valuebox 7 ISA valuebox
  WITH pen color := 0,0,255
  WITH fill color := 192,192,192
  WITH justify IS center
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH attachment := attribute OF
A_monitored_object_input
  WITH location := 375,80,545,105

INSTANCE valuebox 9 ISA valuebox
  WITH pen color := 0,0,255
  WITH fill color := 192,192,192
  WITH justify IS center
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH attachment := object OF
A_monitored_object_input
  WITH location := 95,80,235,105

INSTANCE valuebox 10 ISA valuebox
  WITH pen color := 0,0,255
  WITH fill color := 192,192,192
  WITH justify IS center
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH attachment := discipline OF
A_monitored_object_input
  WITH location := 20,80,90,105

INSTANCE valuebox 11 ISA valuebox
  WITH pen color := 255,0,0
  WITH fill color := 192,192,192
  WITH justify IS left
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH attachment := end_time OF
A_monitored_object_input
  WITH location := 350,140,545,165

INSTANCE valuebox 12 ISA valuebox
  WITH pen color := 255,0,0
  WITH fill color := 192,192,192
  WITH justify IS left
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH attachment := start_time OF
A_monitored_object_input
  WITH location := 350,110,545,135

INSTANCE valuebox 13 ISA valuebox
  WITH pen color := 0,0,255
  WITH fill color := 192,192,192
  WITH justify IS center
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH attachment := number instances OF navigate 1
  WITH location := 115,185,145,210

INSTANCE valuebox 14 ISA valuebox
  WITH pen color := 0,0,255
  WITH fill color := 192,192,192
  WITH justify IS center
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH attachment := instance number OF navigate 1
  WITH location := 300,185,330,210

INSTANCE valuebox 15 ISA valuebox
  WITH pen color := 0,0,0
  WITH fill color := 192,192,192
  WITH justify IS left
  WITH font := "System"
  WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
  WITH font size := 10
  WITH frame := FALSE
  WITH clipped := TRUE
  WITH scroll := TRUE
  WITH horizontal scroll := TRUE
  WITH location := 20,230,535,360

INSTANCE valuebox 16 ISA valuebox
  WITH justify IS center
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH location := 275,65,330,90

INSTANCE valuebox 17 ISA valuebox
  WITH pen color := 0,0,128
  WITH fill color := 192,192,192
  WITH justify IS center
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH attachment := object_ID OF
A_monitored_object_input
  WITH location := 150,265,310,290

INSTANCE valuebox 18 ISA valuebox
  WITH pen color := 0,0,128
  WITH fill color := 192,192,192
  WITH justify IS center
  WITH font := "System"
  WITH frame := TRUE
  WITH clipped := TRUE
  WITH attachment := attribute OF
A_monitored_object_input
  WITH location := 150,345,310,370

INSTANCE main window ISA window
  WITH location := 172,137,386,370
  WITH menus [1 ] := UNDETERMINED
  WITH style IS moveable, sizeable, closeable
  WITH title := "Change-Monitoring Module"
  WITH visible := TRUE

INSTANCE expand window ISA window
  WITH location := 33,15,604,454
  WITH menus [1 ] := UNDETERMINED
  WITH style IS moveable, sizeable, closeable CF
FALSE
  WITH title := "Change-Monitoring Module"
  WITH visible := FALSE

INSTANCE messages window ISA window
  WITH location := 41,43,601,448
  WITH menus [1 ] := UNDETERMINED
  WITH style IS moveable, sizeable, closeable CF
FALSE
  WITH title := "Change-Monitoring Module"
  WITH visible := FALSE

INSTANCE Query window ISA window
  WITH location := 33,15,604,454
  WITH menus [1 ] := UNDETERMINED
  WITH style IS moveable, sizeable, closeable CF
FALSE
  WITH title := "Change-Monitoring Module"
  WITH visible := FALSE
  WITH output := query

INSTANCE Select a project window ISA window
  WITH location := 151,149,407,383
  WITH menus [1 ] := UNDETERMINED
  WITH style IS moveable, sizeable, closeable
  WITH title := " "
  WITH visible := FALSE

! DEMON GROUP:  selected OF menu item

DEMON 1
IF selected OF menu item
THEN effect of menu item := TRUE

! DEMON GROUP:  double clicked OF table

DEMON 2
IF double clicked OF table 2
THEN numeric_Change_ID := TO NUMERIC(
Change_ID OF A_change_monitoring_results)
AND EXEC !Sodbc 1 SQL select * from
message_elements WHERE sent_because_change_ID
= :numeric_Change_ID
                                END SQL INTO
discipline_message
AND go to message screen := TRUE

END
```

C.5. VIRTUAL CHANGE MODULE

```
SVERSION35
SLOCATIONS ARE PIXELS

CLASS A_attributes_of_monitored_object
 WITH name STRING

CLASS A_change_data
 WITH CHANGE STRING
 WITH Required_man_hours NUMERIC
 WITH Difference_in_Build_Cost NUMERIC
 WITH Recommendation NUMERIC
 WITH Reason_for_recomm STRING
 WITH object STRING
 WITH object_ID STRING
  WHEN CHANGED
   BEGIN
    IF object_ID OF A_change_data <> "" AND
attribute OF A_change_da\
ta <> "" THEN
      BEGIN
       check existing data := TRUE
      END
   END
 WITH attribute STRING
  WHEN CHANGED
   BEGIN
    IF object_ID OF A_change_data <> "" AND
attribute OF A_change_da\
ta <> "" THEN
      BEGIN
       check existing data := TRUE
      END
   END
 WITH sending_time STRING
 WITH old_value STRING
 WITH new_value STRING
 WITH Case_ID NUMERIC
 WITH PREDECESSOR STRING
 WITH DURATION NUMERIC
 WITH alternative_CHANGE STRING
 WITH date_time STRING

CLASS A_change_data_retrieved
 WITH CHANGE STRING
 WITH Required_man_hours NUMERIC
 WITH Difference_in_Build_Cost NUMERIC
 WITH Recommendation NUMERIC
 WITH Reason_for_recomm STRING
 WITH object STRING
 WITH object_ID STRING
 WITH attribute STRING
 WITH DURATION NUMERIC
 WITH CASE_ID NUMERIC
 WITH date_time STRING
 WITH old_value STRING
 WITH new_value STRING

CLASS A_message_components
 WITH changed_attribute STRING
 WITH changed_class STRING
 WITH changed_instance_id STRING
 WITH old_value STRING
 WITH new_value STRING
 WITH affected_attribute STRING
 WITH affected_class STRING
 WITH affected_instance_id STRING
 WITH relationship STRING
 WITH writting_date STRING
 WITH discipline_to STRING
 WITH discipline_from STRING
 WITH general_specific STRING
 WITH rule_writting_date STRING
 WITH violated_rule_id NUMERIC
 WITH Case_ID NUMERIC
 WITH sent_because_change_ID STRING
 WITH cause_of_the_effect STRING

CLASS A_object_ID_of_monitored_object
 WITH ID STRING

CLASS A_Responding_Data
 WITH discipline STRING
 WITH select_discipline COMPOUND
  Architecture,
  Structure,
  Envelope,
  HVAC,
  Illumination,
  Interior
  WHEN CHANGED
   BEGIN
!
! **** reset for accepting a first change
    CONF(yes for second alternative) := -1
    CONF(first_alternative_value) := -1
!
    IF select_discipline OF A_Responding_Data IS
Architecture THEN
     BEGIN
      discipline OF A_Responding_Data := "arch"
     END
!
    IF select_discipline OF A_Responding_Data IS
Structure THEN
     BEGIN
      discipline OF A_Responding_Data := "stru"
     END
!
    IF select_discipline OF A_Responding_Data IS
Envelope THEN
     BEGIN
      discipline OF A_Responding_Data := "enve"
     END
!
    IF select_discipline OF A_Responding_Data IS
HVAC THEN
     BEGIN
      discipline OF A_Responding_Data := "hvac"
     END
!
    IF select_discipline OF A_Responding_Data IS
Illumination THEN
     BEGIN
      discipline OF A_Responding_Data := "illu"
     END
!
    IF select_discipline OF A_Responding_Data IS
Interior THEN
     BEGIN
      discipline OF A_Responding_Data := "inte"
     END
!
    IF select_discipline OF A_Responding_Data =
FALSE THEN
     BEGIN
      discipline OF A_Responding_Data := ""
     END
!
! **** retrieve the messages from
[A_virtual_message_elements] table
    EXEC lSodbc 1 SQL select * from
A_virtual_message_elements wher\
e discipline_to = :A_Responding_Data.discipline AND
been_acted_upon = :d\
omain.SNo
           END SQL INTO discipline_message
!
! **** put the first message as default
    action OF navigate 1 IS first := TRUE
!
!***** end of method
  END
 WITH CASE_ID NUMERIC
 WITH PREDECESSOR STRING

CLASS A_Violated_GENERAL_rule
 WITH percent_change NUMERIC
 WITH affected_discipline STRING
 WITH cause_of_the_effect STRING

CLASS A_Violated_SPECIFIC_rule
 WITH related_class STRING
 WITH related_instance_id STRING
 WITH related_attribute STRING
 WITH relationship STRING
 WITH writting_date STRING
 WITH building_element STRING
 WITH building_element_id STRING
 WITH attribute_of_building_element STRING
 WITH affected_discipline STRING
 WITH statement_of_selection STRING
 WITH AB_specific_rules_id NUMERIC

CLASS border INHERITS add on, display item
 WITH style COMPOUND
  picture frame,
  edit control,
  group,
  shadow
  INIT picture frame
 WITH perspective COMPOUND
  in,
  out
  INIT in
 WITH border width NUMERIC
  INIT 1
 WITH background color COLOR
  INIT 192,192,192
 WITH fill color COLOR
  INIT 192,192,192
 WITH highlight color COLOR
  INIT 255,255,255
 WITH shadow color COLOR
  INIT 128,128,128

CLASS combobox INHERITS add on, display item
 WITH attachment ATTRIBUTE REFERENCE
 WITH selected SIMPLE
 WITH enabled SIMPLE
  INIT TRUE
 WITH sort SIMPLE
  INIT FALSE
 WITH update with current instance SIMPLE
  INIT TRUE

CLASS Current_projects
 WITH Project_name STRING

CLASS discipline_message
 WITH changed_attribute STRING
 WITH changed_class STRING
 WITH changed_instance_id STRING
 WITH old_value STRING
 WITH new_value STRING
 WITH affected_attribute STRING
 WITH affected_class STRING
 WITH affected_instance_id STRING
 WITH relationship STRING
 WITH writing_date TIME
 WITH reading_date TIME
 WITH been_read STRING
 WITH been_acted_upon STRING
 WITH id NUMERIC
 WITH discipline_to STRING
 WITH discipline_from STRING
 WITH rule_writting_date STRING
 WITH violated_rule_id NUMERIC
 WITH general_specific STRING
 WITH Case_ID NUMERIC
 WITH sent_because_change_ID STRING
 WITH cause_of_the_effect STRING

CLASS lSodbc INHERITS add on
 WITH data source STRING
 WITH userid STRING
 WITH password STRING
 WITH connection string STRING
 WITH connection prompting SIMPLE
  INIT FALSE
 WITH auto commit SIMPLE
  INIT TRUE
 WITH action COMPOUND
  connect,
  disconnect
 WITH records NUMERIC
 WITH transaction COMPOUND
  commit,
  rollback
 WITH append SIMPLE
  INIT FALSE
 WITH status STRING
 WITH show error SIMPLE
```

```
 WITH default error handling SIMPLE
  INIT TRUE
 WITH error message STRING
 WITH native error NUMERIC
 WITH trace file STRING

CLASS message box INHERITS add on
 WITH title STRING
 WITH text STRING
 WITH variable text STRING
 WITH modal style COMPOUND
  app modal,
  sys modal,
  not modal
  INIT app modal
 WITH icon COMPOUND
  exclamation,
  information,
  question,
  stop sign
  INIT exclamation
 WITH button COMPOUND
  abort retry ignore,
  ok,
  ok cancel,
  retry cancel,
  yes no,
  yes no cancel
  INIT ok
 WITH default button COMPOUND
  one,
  two,
  three
  INIT one
 WITH button selected COMPOUND
  abort,
  cancel,
  ignore,
  no,
  ok,
  retry,
  yes,
  cancell
 WITH put up SIMPLE

CLASS navigate INHERITS add on
 WITH class attachment CLASS REFERENCE
 WITH action COMPOUND
  first,
  previous,
  next,
  last
  WHEN CHANGED
   BEGIN
    IF instance number OF navigate 1 <> 0 THEN
     BEGIN
!
! ***** reset for accepting a first alternative
       CONF(yes for second alternative) := -1
       CONF(first_alternative_value) := -1
!
       IF general_specific OF discipline_message =
"GENERAL" THEN
        general message := TRUE
!
       IF general_specific OF discipline_message =
"SPECIFIC" THEN
        specific message := TRUE
!
     END
   END
 WITH instance number NUMERIC
 WITH number instances NUMERIC

CLASS relations building
 WITH current class STRING
 WITH current instance id STRING
 WITH current attribute name STRING
 WITH current display INSTANCE REFERENCE
 WITH related class STRING
 WITH related attribute name STRING
 WITH related instance id STRING
 WITH Relationship types COMPOUND
  Equal to,
  More than,
  Less than,
  Exist with,
  Between values
 WITH Chosen Relationship type STRING
 WITH columns headings STRING
  ARRAY SIZE 1
 WITH all id of related class STRING
  ARRAY SIZE 1
 WITH current class id attribute name STRING
 WITH related class id attribute name STRING
 WITH current attribute designer STRING
 WITH old value STRING
 WITH new value STRING
 WITH related attribute designer STRING
 WITH designers of related class attributes STRING
  ARRAY SIZE 1

CLASS required_message
 WITH discipline name COMPOUND
  Architecture,
  HVAC,
  Illumination,
  Envelope,
  Structure
 WITH message status COMPOUND
  All Messages,
  UnRead Yet,
  UnActed Upon
 WITH choosen_discipline STRING
 WITH message builder STRING

CLASS temp_current_menu_items
 WITH label STRING

ATTRIBUTE nn NUMERIC
ATTRIBUTE complete as monitored object SIMPLE
 WHEN CHANGED
  BEGIN
!
   %yyy := 0
! **** in case of (RESPONDING) check that a
discipline has been selected
   IF (new case or responding = "responding") THEN
    BEGIN
     IF ( CONF(discipline OF A_Responding_Data)
< 0) THEN
      BEGIN
       text OF message box 2 := "Select a discipline
first"
       put up OF message box 2 := TRUE
       %yyy := 1
      END
    END
!
!
   IF (%yyy = 0) THEN
    BEGIN
! **** get the ID of the object from the database
      general_statement_of_selection := CONCAT(
"select ", object OF\
 A_change_data, "_id from ", object OF
A_change_data)
      EXEC lSodbc 1 SQL WITH
general_statement_of_selection END SQL \
INTO A_object_ID_of_monitored_object (ID)
!
      source OF listbox 1 := ID OF
A_object_ID_of_monitored_object
      source OF listbox 3 := ID OF
A_object_ID_of_monitored_object
!
! **** get the attributes of the object from the database
      EXEC lSodbc 1 SQL select
attribute_of_building_element from [A\
B-attribute-designer] where building_element =
:A_change_data.object
                  END SQL INTO
A_attributes_of_monitore\
d_object (name)
!
      source OF listbox 2 := name OF
A_attributes_of_monitored_objec\
t
      source OF listbox 4 := name OF
A_attributes_of_monitored_objec\
t
!
!
      Case_ID OF A_change_data := Case_ID
    END
!**** end of method
  END
ATTRIBUTE general_statement_of_selection STRING
ATTRIBUTE start new case SIMPLE
 WHEN CHANGED
  BEGIN
!
    action OF lSodbc 1 IS connect := TRUE
!
!
! ***** Load the menus in the screens
!
    EXEC lSodbc 1 SQL SELECT
DISTINCT(main_menu_label) from [AB-menu_i\
tem]
       END SQL INTO menu (label)
!
    EXEC lSodbc 1 SQL SELECT label from [AB-
menu_item]
       END SQL INTO menu item
!
    IF (number instances OF navigate menu > 0) THEN
     BEGIN
!
      RESIZE menus OF new case window := number
instances OF navigat\
e menu
!
!
      FOR (nn := 1 TO number instances OF
navigate menu)
       BEGIN
        instance number OF navigate menu := nn
!
! ***** load the menu items in every menu
        EXEC lSodbc 1 SQL SELECT label from
[AB-menu_item] WHERE \
(main_menu_label) = :menu.label
                  END SQL INTO
temp_current_me\
nu_items (label)
        RESIZE items OF menu := number instances
OF navigate temp_\
current_menu_items
        FOR (%nnn := 1 TO number instances OF
navigate temp_cur\
rent_menu_items)
         BEGIN
          instance number OF navigate
temp_current_menu_items :=\
%nnn
          FIND menu item
           WHERE label OF menu item = label OF
temp_current_me\
nu_items
          FIND END
          items[ %nnn] OF menu := menu item
         END
!
        menus[ nn] OF new case window := menu
       END
!
     END
!
    visible OF Select a project window := FALSE
    visible OF new case window := TRUE
!
    new case or responding := "NEW"
!
! **** get the latest case id number and increase it by
one
    EXEC lSodbc 1 SQL select MAX (CASE_ID) from
[A-CPM-Alternatives]
               END SQL INTO domain
(Case_ID)
    IF CONF(Case_ID) < 0 THEN
     Case_ID := 0
    Case_ID := Case_ID + 1
!
! *** end of method
  END
ATTRIBUTE responding to change SIMPLE
 WHEN CHANGED
  BEGIN
!
    action OF lSodbc 1 IS connect := TRUE
!
!
! ***** Load the menus in the screens
!
    EXEC lSodbc 1 SQL SELECT
DISTINCT(main_menu_label) from [AB-menu_i\
tem]
       END SQL INTO menu (label)
!
    EXEC lSodbc 1 SQL SELECT label from [AB-
menu_item]
       END SQL INTO menu item
```

```
!
    IF (number instances OF navigate menu > 0) THEN
     BEGIN
!
       RESIZE menus OF responding window :=
number instances OF navig\
ate menu
!
!
      FOR (nn := 1 TO number instances OF
navigate menu)
        BEGIN
         instance number OF navigate menu := nn
!
! ***** load the menu items in every menu
         EXEC ISodbc 1 SQL SELECT label from
[AB-menu_item] WHERE \
(main_menu_label) = :menu.label
                           END SQL INTO
temp_current_me\
nu_items (label)
         RESIZE items OF menu := number instances
OF navigate temp_\
current_menu_items
         FOR (%ann := 1 TO number instances OF
navigate temp_cur\
rent_menu_items)
          BEGIN
           instance number OF navigate
temp_current_menu_items :=\
%ann
            FIND menu item
             WHERE label OF menu item = label OF
temp_current_me\
nu_items
             FIND END
            items[ %ann] OF menu := menu item
          END
!
        menus[ nn] OF responding window := menu
       END
!
     END
!
    visible OF Select a project window := FALSE
    visible OF responding window := TRUE
!
    new case or responding := "responding"
!
! *** end of method
   END
ATTRIBUTE another change in new case SIMPLE
ATTRIBUTE close change data display SIMPLE
 WHEN CHANGED
   BEGIN
!
    IF CONF(Required_man_hours OF
A_change_data) > -1 AND CONF( Diffe\
rence_in_Build_Cost OF A_change_data) > -1 AND
CONF( Recommendation OF A\
_change_data) > -1 AND CONF( DURATION OF
A_change_data) > -1 AND CONF( n\
ew_value OF A_change_data) > -1 THEN
     BEGIN
      IF (0 <= Recommendation OF A_change_data
AND Recommendation OF\
 A_change_data <= 4) THEN
       BEGIN
         IF NOT (Recommendation OF A_change_data
= 0 AND CONF( Reas\
on_for_recomm OF A_change_data) = -1) THEN
          BEGIN
!
! **** define the CHANGE OF A_change_data
(combine the "discipline lette\
r" with "ID of A-change-data"
         EXEC ISodbc 1 SQL select MAX(ID) from
[A-change-data]
                    END SQL INTO domain (nn)
           nn := nn + 1
         EXEC ISodbc 1 SQL select
designing_discipline from [AB\
-attribute-designer] where building_element =
:A_change_data.object AND \
attribute_of_building_element =
:A_change_data.attribute
                    END SQL INTO domain (tt)
         CHANGE OF A_change_data :=
CONCAT( tt, TO STRING( nn))
!
! ****** put the time in a format that can be stored in
the database (te\
xt format)
           current_time := NOW
           #year := YEAR( current_time)
           #month := MONTH( current_time)
           #day := DAY( current_time)
           #hour := HOUR( current_time)
           #minute := MINUTE( current_time)
           date_time OF A_change_data := CONCAT(
TO STRING( #year\
), "/")
       ! ---- to add zero before the number for months
less than \
10
         IF #month < 10 THEN
           date_time OF A_change_data :=
CONCAT( date_time OF A\
_change_data, "0", TO STRING( #month), "/", TO
STRING( #day), " ", TO ST\
RING( #hour), ":", TO STRING( #minute))
          ELSE
           date_time OF A_change_data :=
CONCAT( date_time OF A\
_change_data, TO STRING( #month), "/", TO
STRING( #day), " ", TO STRING(\
 #hour), ":", TO STRING( #minute))
!
         IF (new case or responding = "responding")
THEN
          BEGIN
           Case_ID OF A_change_data :=
CASE_ID OF A_Respondin\
g_Data
          END
!
! **** input the data in [A-change-data] table
!
         IF ( CONF(Reason_for_recomm OF
A_change_data) < 0) THE\
N
          Reason_for_recomm OF A_change_data
:= " "
         EXEC ISodbc 1 SQL insert into [A-change-
data] (CASE_ID\
,CHANGE, object, object_ID, attribute,
Required_man_hours, Difference_in\
_Build_Cost, Recommendation, Reason_for_recomm,
DURATION, date_time, old\
_value, new_value) VALUES
     ( :A_change_data.CASE_ID,
:A_change_data.CHANGE, :A_change_data.ob\
ject, :A_change_data.object_ID,
:A_change_data.attribute, :A_change_data\
.Required_man_hours,
:A_change_data.Difference_in_Build_Cost,
:A_change_\
data.Recommendation,
:A_change_data.Reason_for_recomm,
:A_change_data.DU\
RATION, :A_change_data.date_time,
:A_change_data.old_value, :A_change_da\
ta.new_value)
                    END SQL
!
! **** input the data in [A-CPM-Alternatives] table
        IF (new case or responding = "NEW")
THEN
          BEGIN
           PREDECESSOR OF A_change_data :=
"NULL"
           EXEC ISodbc 1 SQL insert into [A-CPM-
Alternatives]\
(CASE_ID, PREDECESSOR, CHANGE) values
    ( :A_change_data.CASE_ID,
:A_change_data.PREDECESSOR, :A_change_da\
ta.CHANGE)
                    END SQL
          END
!
         IF (new case or responding = "responding")
THEN
          BEGIN
           PREDECESSOR OF A_change_data :=
PREDECESSOR OF A_R\
esponding_Data
            IF (yes for second alternative = "YES")
THEN
             BEGIN
              EXEC ISodbc 1 SQL update [A-CPM-
Alternatives] \
set alternative_CHANGE = :A_change_data.CHANGE
where
               PREDECESSOR =
:A_change_data.PREDECESSOR A\
ND CHANGE = :domain.first_alternative_value
                   END SQL
             CONF(first_alternative_value) := -1
             END
            ELSE
             BEGIN
              EXEC ISodbc 1 SQL insert into [A-
CPM-Alternati\
ves] (CASE_ID, PREDECESSOR, CHANGE) values
    ( :A_change_data.CASE_ID,
:A_change_data.PREDECESSOR, :A_change_da\
ta.CHANGE)
                   END SQL
             END
           END
!
!
! **** send the messages and later close the data
display
           FORGET
A_attributes_of_monitored_object
           FORGET
A_object_ID_of_monitored_object
          send message components := TRUE
         END
        ELSE
         BEGIN
          text OF message box 2 := "Please tell why
you set the \
recommendation level to ZERO"
          put up OF message box 2 := TRUE
         END
       END
      ELSE
       BEGIN
        text OF message box 2 := "Recommendation
level should be
between 0 and 4"
        put up OF message box 2 := TRUE
       END
     END
    ELSE
     BEGIN
      text OF message box 2 := "Some Data are
Missing"
      put up OF message box 2 := TRUE
     END
!
!**** end of method
   END
ATTRIBUTE check existing data SIMPLE
 WHEN CHANGED
   BEGIN
!
! ------ load the current value of the attribute to be
changed
 ! ---- check the attribute type first ("n" for numeric or
"t" for text)
    EXEC ISodbc 1 SQL select attribute_type from
[AB-attribute-designe\
r] where building_element = :A_change_data.object
and attribute_of_build\
ing_element = :A_change_data.attribute
                    END SQL INTO domain (Sttt)
    general_statement_of_selection := CONCAT(
"select ", attribute OF \
A_change_data, " from ", object OF A_change_data, "
where ", object OF A\
_change_data, "_id = :A_change_data.object_ID ")
    IF Sttt = "t" THEN
     BEGIN
      EXEC ISodbc 1 SQL WITH
general_statement_of_selection END SQL \
INTO domain (tt)
      old_value OF A_change_data := (tt)
     END
    ELSE
     BEGIN
      EXEC ISodbc 1 SQL WITH
general_statement_of_selection END SQL \
INTO domain (nn)
      old_value OF A_change_data := TO STRING(
nn)
     END
!
!
! **** make sure that the change has not been made
before
```

```
! —— if it has been made before retrieve the previously
used data
    EXEC lSodbc 1 SQL select * from [A-change-data]
WHERE object = :A_\
change_data.object AND object_ID =
:A_change_data.object_ID AND attribut\
e = :A_change_data.attribute
                    END SQL INTO
A_change_data_retrieved
!
    IF number instances OF navigate retrieved data > 0
THEN
      BEGIN
!
        output OF existing design data window :=
existing data for a d\
esign change display
        visible OF existing design data window := TRUE
!
      END
    ELSE
      BEGIN
!
! ***** if there is no previous similar change then ask
for the change d\
ata
!
        visible OF design data window := TRUE
        output OF design data window := data for a
design change displ\
ay
      END
!
! ****** end of method
  END
ATTRIBUTE tt STRING
ATTRIBUTE new case or responding STRING
ATTRIBUTE Case_ID NUMERIC
ATTRIBUTE current_time TIME
ATTRIBUTE #year NUMERIC
ATTRIBUTE #month NUMERIC
ATTRIBUTE #day NUMERIC
ATTRIBUTE #hour NUMERIC
ATTRIBUTE #minute NUMERIC
ATTRIBUTE $tt STRING
ATTRIBUTE cancel current change SIMPLE
 WHEN CHANGED
  BEGIN
   visible OF design data window := FALSE
   FORGET  output OF design data window
   visible OF existing design data window := FALSE
   FORGET  output OF existing design data window
   FORGET A_attributes_of_monitored_object
   FORGET A_object_ID_of_monitored_object
   FORGET A_change_data
  END
ATTRIBUTE send message components SIMPLE
 WHEN CHANGED
  BEGIN
!
! ****** get the discipline who is responsible for the
changed attribute\
 (from the database)
    EXEC lSodbc 1 SQL select designing_discipline
from [AB-attribute-d\
esigner] where building_element =
:A_change_data.object and attribute_of\
_building_element = :A_change_data.attribute
                    END SQL INTO domain
($discipline_from)
!
!————————————————————————————————————————
——\
————————————————————————————————
!
!—(1)———————————————————————————————————
———\
————————————————————————————
! ****** to check if there is any violation of General
rules and send me\
ssage if there is
    EXEC lSodbc 1 SQL select * from [AB-general-
rules] where building_\
element = :A_change_data.object AND
attribute_of_building_element = :A_c\
hange_data.attribute  AND rule_ignored =
:domain.$No END SQL INTO A_Viol\
ated_GENERAL_rule
!
    %annOld := TO NUMERIC( old_value OF
A_change_data)
```

```
    %annNew := TO NUMERIC( new_value OF
A_change_data)
!
    FOR (nn := 1 TO number instances OF navigate
A_Violated_GENERAL\
_rule)
      BEGIN
        instance number OF navigate
A_Violated_GENERAL_rule := nn
        %ann := percent_change OF
A_Violated_GENERAL_rule
        IF (%ann = 0) OR (%annOld * (1 - %ann) >
%annNew) OR (%annOld \
* (1 + %ann) < %annNew) THEN
          BEGIN
            MAKE A_message_components
              WITH changed_attribute := attribute OF
A_change_data
              WITH changed_class := object OF
A_change_data
              WITH changed_instance id := object_ID OF
A_change_data
              WITH old_value := old_value OF
A_change_data
              WITH new_value := new_value OF
A_change_data
              WITH writting_date := date_time OF
A_change_data
              WITH discipline_to := affected_discipline
OF A_Violated\
_GENERAL_rule
              WITH discipline_from := $discipline_from
              WITH sent_because_change_ID :=
CHANGE OF A_change_data
              WITH sent_because_change_ID :=
CHANGE OF A_change_data
              WITH Case_ID := Case_ID OF
A_change_data
              WITH general_specific := "GENERAL"
              WITH cause_of_the_effect :=
cause_of_the_effect OF A_Vi\
olated_GENERAL_rule
            EXEC lSodbc 1 SQL insert into
[A_virtual_message_elements]\
 (changed_attribute,
  changed_class, changed_instance_id, old_value,
new_value, writting_d\
ate, discipline_to,
  discipline_from, sent_because_change_ID,
general_specific, Case_ID, \
cause_of_the_effect ) values
  ( :A_message_components.changed_attribute,
:A_message_components.cha\
nged_class,
  :A_message_components.changed_instance_id,
:A_message_components.old\
_value,
  :A_message_components.new_value,
:A_message_components.writting_date\
,
  :A_message_components.discipline_to,
:A_message_components.disciplin\
e_from,
  :A_message_components.sent_because_change_ID,
:A_message_components.\
general_specific, :A_message_components.Case_ID,
  :A_message_components.cause_of_the_effect
  )
                                  END SQL
          END
        END
!————————————————————————————————————————
——\
————————————————————————————
!
!—(2)———————————————————————————————————
———\
————————————————————————————
! ****** to check if there is any violation of specific
rules and send m\
essage if there is
! ——— note: the changed attribute is considered the
related attribute a\
t the database table
    EXEC lSodbc 1 SQL select * from [AB-specific-
rules] where related_\
class = :A_change_data.object AND
related_instance_id = :A_change_data.o\
bject_ID AND related_attribute =
:A_change_data.attribute  AND rule_igno\
red = :domain.$No END SQL INTO
```

```
A_Violated_SPECIFIC_rule
!
    FOR (nn := 1 TO number instances OF navigate
A_Violated_SPECIFI\
C_rule)
      BEGIN
        instance number OF navigate
A_Violated_SPECIFIC_rule := nn
!
! ——— get the affected discipline by the change
        EXEC lSodbc 1 SQL select designing_discipline
from [AB-attribu\
te-designer] where building_element =
:A_Violated_SPECIFIC_rule.building\
_element and attribute_of_building_element =
:A_Violated_SPECIFIC_rule.a\
ttribute_of_building_element  END SQL INTO domain
($tt)
        affected_discipline OF
A_Violated_SPECIFIC_rule := $tt
!
! ——— get the value of the affected attribute
! —— check the attribute type first ("n" for numeric or
"t" for text)
        EXEC lSodbc 1 SQL select attribute_type from
[AB-attribute-des\
igner] where building_element =
:A_Violated_SPECIFIC_rule.building_eleme\
nt and attribute_of_building_element =
:A_Violated_SPECIFIC_rule.attribu\
te_of_building_element  END SQL INTO domain
($tt)
!!
        statement_of_selection OF
A_Violated_SPECIFIC_rule := CONCAT( \
"Select ", building_element OF
A_Violated_SPECIFIC_rule, ".", attribute_\
of_building_element OF A_Violated_SPECIFIC_rule,
" from ", building_elem\
ent OF A_Violated_SPECIFIC_rule, ", ", related_class
OF A_Violated_SPECI\
FIC_rule, " where ( ", building_element OF
A_Violated_SPECIFIC_rule, ".\
, building_element OF A_Violated_SPECIFIC_rule,
"_id = ", building_elem\
ent_id OF A_Violated_SPECIFIC_rule, ") AND (",
related_class OF A_Viola\
ted_SPECIFIC_rule, ".", related_class OF
A_Violated_SPECIFIC_rule, "_id \
= ", related_instance_id OF
A_Violated_SPECIFIC_rule, ") AND (")
        statement_of_selection OF
A_Violated_SPECIFIC_rule := CONCAT( \
statement_of_selection OF
A_Violated_SPECIFIC_rule, relationship OF A_Vi\
olated_SPECIFIC_rule, ")")
!!
        FORGET  $affected_attribute_value
        FORGET  %affected_attribute_value
!!
        IF $tt = "t" THEN
          BEGIN
            EXEC lSodbc 1 SQL WITH
statement_of_selection OF A_Violate\
d_SPECIFIC_rule END SQL INTO domain
($affected_attribute_value)
          END
        ELSE
          BEGIN
            EXEC lSodbc 1 SQL WITH
statement_of_selection OF A_Violate\
d_SPECIFIC_rule END SQL INTO domain
(%affected_attribute_value)
            %annNew := TO NUMERIC( new_value OF
A_change_data)
          END
!
!
! ——— if there is a violation then send a message
        IF (( CONF($affected_attribute_value) < 0)
AND ( CONF(%affecte\
d_attribute_value) < 0)) THEN
          BEGIN
            MAKE A_message_components
              WITH changed_attribute := attribute OF
A_change_data
              WITH changed_class := object OF
A_change_data
              WITH changed_instance_id := object_ID OF
A_change_data
              WITH old_value := old_value OF
```

```
A_change_data
        WITH new_value := new_value OF
A_change_data
        WITH affected_attribute :=
attribute_of_building_elemen\
t OF A_Violated_SPECIFIC_rule
        WITH affected_class := building_element
OF A_Violated_S\
PECIFIC_rule
        WITH affected_instance_id :=
building_element_id OF A_V\
iolated_SPECIFIC_rule
        WITH relationship := relationship OF
A_Violated_SPECIFI\
C_rule
        WITH writting_date := date_time OF
A_change_data
        WITH discipline_to := affected_discipline
OF A_Violated\
_SPECIFIC_rule
        WITH discipline_from := $discipline_from
        WITH sent_because_change_ID :=
CHANGE OF A_change_data
        WITH general_specific := "SPECIFIC"
        WITH rule_writting_date := writting_date
OF A_Violated_\
SPECIFIC_rule
        WITH violated_rule_id :=
AB_specific_rules_id OF A_Viol\
ated_SPECIFIC_rule
        WITH Case_ID := Case_ID OF
A_change_data
      EXEC l5odbc 1 SQL insert into
[A_virtual_message_elements]\
 (changed_attribute,
  changed_class, changed_instance_id, old_value,
new_value, affected_a\
ttribute, affected_class,
  affected_instance_id, relationship, writting_date,
discipline_to, di\
scipline_from,
  sent_because_change_ID, general_specific,
rule_writting_date, violat\
ed_rule_id, Case_ID) values
   ( :A_message_components.changed_attribute,
  :A_message_components.changed_class,
:A_message_components.changed_i\
nstance_id,
   :A_message_components.old_value,
:A_message_components.new_value,
   :A_message_components.affected_attribute,
:A_message_components.affe\
cted_class,
   :A_message_components.affected_instance_id,
:A_message_components.r\
elationship,
   :A_message_components.writting_date,
:A_message_components.disciplin\
e_to,
   :A_message_components.discipline_from,
:A_message_components.sent_b\
ecause_change_ID,
   :A_message_components.general_specific,
   :A_message_components.rule_writting_date,
:A_message_components.vio\
lated_rule_id,
   :A_message_components.Case_ID)
        END SQL
      END
    END
!-----------------------------------------------------
----\
-----------------------------------
!
! **** to indicate the the original message has been
acted upon (in case\
 of "responding"
   IF (new case or responding = "responding") THEN
    BEGIN
     tt := "Yes"
     EXEC l5odbc 1 SQL update
A_virtual_message_elements set been_a\
cted_upon = :domain.tt
                  where id = :discipline_message.id
                  END SQL
    END
!
   first_alternative_value := CHANGE OF
A_change_data
   FORGET A_change_data
   FORGET A_message_components
   visible OF design data window := FALSE
   FORGET output OF design data window
! **** end of method
  END
ATTRIBUTE %nnn NUMERIC
ATTRIBUTE %nnnOld NUMERIC
ATTRIBUTE %nnnNew NUMERIC
ATTRIBUTE $discipline_from STRING
ATTRIBUTE $affected_attribute_value STRING
ATTRIBUTE %affected_attribute_value NUMERIC
ATTRIBUTE %yyy NUMERIC
ATTRIBUTE close existing data display SIMPLE
 WHEN CHANGED
  BEGIN
   Required_man_hours OF A_change_data :=
Required_man_hours OF A_cha\
nge_data_retrieved
   DURATION OF A_change_data := DURATION
OF A_change_data_retrieved
   Difference_in_Build_Cost OF A_change_data :=
Difference_in_Build_C\
ost OF A_change_data_retrieved
   Recommendation OF A_change_data :=
Recommendation OF A_change_data\
_retrieved
   Reason_for_recomm OF A_change_data :=
Reason_for_recomm OF A_chang\
e_data_retrieved
   visible OF design data window := TRUE
   output OF design data window := data for a design
change display
   visible OF existing design data window := FALSE
   FORGET output OF existing design data window
  END
ATTRIBUTE second alternative SIMPLE
 WHEN CHANGED
  BEGIN
!
   IF ( CONF(first_alternative_value) >= 0) THEN
    BEGIN
     put up OF message box 3 := TRUE
!
     IF button selected OF message box 3 IS yes
THEN
      BEGIN
       put up OF message box 3 := FALSE
       yes for second alternative := "YES"
      END
!
     IF button selected OF message box 3 IS no
THEN
      BEGIN
       put up OF message box 3 := FALSE
      END
    END
   ELSE
    BEGIN
     text OF message box 1 := "No first alternative
was given"
     put up OF message box 1 := TRUE
    END
!
!***** end of method
  END
ATTRIBUTE yes for second alternative STRING
ATTRIBUTE first_alternative_value STRING
ATTRIBUTE $Yes STRING
ATTRIBUTE $No STRING
ATTRIBUTE general message SIMPLE
 WHEN CHANGED
  BEGIN
!
   IF ( CONF(cause_of_the_effect OF
discipline_message) < 0) THEN
     cause_of_the_effect OF discipline_message :=
"Undefined"
!
   message builder OF required_message :=
CONCAT( "In VIRTUAL MODE, T\
he attribute ", changed_attribute OF
discipline_message, " of the buil\
ding component ", changed_class OF
discipline_message, " (", changed_in\
stance_id OF discipline_message, ")"
has been changed from the value (", old_value OF
discipline_message, ") \
to the value (", new_value OF discipline_message, ").
Such a change may affect the design of the ",
discipline_to OF discipli\
ne_message, " system.
The possible cause of the effect is ",
cause_of_the_effect OF disciplin\
e_message, "

Please indicate the expected modifications in the
building components. "\
)
!
   attachment OF valuebox 15 := message builder OF
required_message
!
  END
ATTRIBUTE specific message SIMPLE
 WHEN CHANGED
  BEGIN
   message builder OF required_message :=
CONCAT( "In VIRTUAL MODE, T\
he attribute ", changed_attribute OF
discipline_message, " of the buil\
ding component ", changed_class OF
discipline_message, " (", changed_in\
stance_id OF discipline_message, ")"
has been changed from the value (", old_value OF
discipline_message, ") \
to the value (", new_value OF discipline_message, ").
According to a previously define SPECIFIC rule, such
a change may affect\
 the design of the attribute
", affected_attribute OF discipline_message, " of the
building compon\
ent ", affected_class OF discipline_message, " (",
affected_instance_id\
 OF discipline_message, ")".
Please indicate the expected modifications to the
affected building comp\
onents.")
!
   attachment OF valuebox 15 := message builder OF
required_message
!
  END
ATTRIBUTE effect of menu item SIMPLE
 WHEN CHANGED
  BEGIN
!
   object OF A_change_data := label OF menu item
   complete as monitored object := TRUE
!
! *** end of method
  END
ATTRIBUTE project_name STRING
 WHEN CHANGED
  BEGIN
   data source OF l5odbc 1 := project_name
   title OF new case window := CONCAT( "New
Case for Project : ", pro\
ject_name)
   title OF responding window := CONCAT(
"Responding for Project : ",\
project_name)
   output OF Select a project window :=
select_new_or_responding_disp\
lay
  END
ATTRIBUTE go_ahead SIMPLE
 WHEN CHANGED
  BEGIN
   !
   action OF l5odbc 2 GENERAL IS connect :=
TRUE
!
   EXEC l5odbc 2 GENERAL SQL SELECT
Project_name from Current_project\
s
       END SQL INTO Current_projects
(Project_name)
!
   visible OF main window := FALSE
   visible OF Select a project window := TRUE
   output OF Select a project window :=
select_project_display
!
  END

INSTANCE border 1 ISA border
 WITH style IS group
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
```

```
WITH shadow color := 128,128,128
WITH location := 295,60,420,125

INSTANCE border 2 ISA border
WITH style IS group
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 10,60,290,125

INSTANCE border 6 ISA border
WITH style IS shadow
WITH perspective IS in
WITH border width := 6
WITH background color := 192,192,192
WITH fill color := 0,0,128
WITH highlight color := 255,255,255
WITH shadow color := 0,0,0
WITH location := 15,15,195,140

INSTANCE border 7 ISA border
WITH style IS picture frame
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 425,65,630,165

INSTANCE border 8 ISA border
WITH style IS shadow
WITH perspective IS in
WITH border width := 4
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 20,220,634,372

INSTANCE border 9 ISA border
WITH style IS group
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 5,175,350,400

INSTANCE border 11 ISA border
WITH style IS picture frame
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 5,5,395,330

INSTANCE border 12 ISA border
WITH style IS picture frame
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 10,10,390,325

INSTANCE border 13 ISA border
WITH style IS picture frame
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 5,5,395,375

INSTANCE border 14 ISA border
WITH style IS picture frame
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 10,180,390,370

INSTANCE border 15 ISA border
WITH style IS group
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 10,130,290,210

INSTANCE border 16 ISA border
WITH style IS group
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 295,130,570,210

INSTANCE border 17 ISA border
WITH style IS picture frame
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 10,40,390,175

INSTANCE border 18 ISA border
WITH style IS picture frame
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 490,180,580,255

INSTANCE border 19 ISA border
WITH style IS edit control
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 5,5,205,215

INSTANCE border 20 ISA border
WITH style IS picture frame
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 10,10,240,195

INSTANCE border 21 ISA border
WITH style IS shadow
WITH perspective IS in
WITH border width := 6
WITH background color := 192,192,192
WITH fill color := 0,0,128
WITH highlight color := 255,255,255
WITH shadow color := 0,0,0
WITH location := 25,20,225,135

INSTANCE border 22 ISA border
WITH style IS picture frame
WITH perspective IS in
WITH border width := 1
WITH background color := 192,192,192
WITH fill color := 192,192,192
WITH highlight color := 255,255,255
WITH shadow color := 128,128,128
WITH location := 10,10,240,195

INSTANCE border 23 ISA border
WITH style IS shadow
WITH perspective IS in
WITH border width := 6
WITH background color := 192,192,192
WITH fill color := 0,0,128
WITH highlight color := 255,255,255
WITH shadow color := 0,0,0
WITH location := 25,25,230,130

INSTANCE combobox 1 ISA combobox
WITH enabled := TRUE
WITH sort := FALSE
WITH update with current instance := TRUE
WITH location := 155,245,295,265

INSTANCE the domain ISA domain
WITH $Yes := "Yes"
WITH $No := "No"

INSTANCE l5odbc 1 ISA l5odbc
WITH data source := "build"
WITH connection prompting := FALSE
WITH auto commit := TRUE
WITH append := FALSE
WITH default error handling := TRUE

INSTANCE l5odbc 2 GENERAL ISA l5odbc
WITH data source := "general"
WITH connection prompting := FALSE
WITH auto commit := TRUE
WITH append := FALSE
WITH default error handling := TRUE

INSTANCE message box 1 ISA message box
WITH title := "INPUT ERROR"
WITH text := "You need to input query data"
WITH modal style IS app modal
WITH icon IS stop sign
WITH button IS ok
WITH default button IS one

INSTANCE message box 2 ISA message box
WITH title := "INPUT ERROR"
WITH modal style IS app modal
WITH icon IS stop sign
WITH button IS ok
WITH default button IS one

INSTANCE message box 3 ISA message box
WITH text := "You are creating a second alternative
change
Would you like to do so ?"
WITH modal style IS app modal
WITH icon IS information
WITH button IS yes no
WITH default button IS one

INSTANCE navigate 1 ISA navigate
WITH class attachment := discipline_message

INSTANCE navigate retrieved data ISA navigate
WITH class attachment := A_change_data_retrieved

INSTANCE navigate A_Violated_GENERAL_rule
ISA navigate
WITH class attachment :=
A_Violated_GENERAL_rule

INSTANCE navigate A_Violated_SPECIFIC_rule ISA
navigate
WITH class attachment :=
A_Violated_SPECIFIC_rule

INSTANCE navigate temp_current_menu_items ISA
navigate
WITH class attachment := temp_current_menu_items

INSTANCE navigate menu ISA navigate
WITH class attachment := menu

INSTANCE the application ISA application
WITH unknowns fail := TRUE
WITH threshold := 50
WITH title display := Starting display
WITH ignore breakpoints := FALSE
WITH reasoning on := FALSE
WITH numeric precision := 8
WITH demon strategy IS fire first

INSTANCE Starting display ISA display
WITH wait := TRUE
WITH delay changes := FALSE
WITH items [1 ] := border 19
WITH items [2 ] := border 6
WITH items [3 ] := textbox 1
WITH items [4 ] := UNDETERMINED
WITH items [5 ] := UNDETERMINED
WITH items [6 ] := UNDETERMINED
WITH items [7 ] := pushbutton 25
```

```
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE New Case display ISA display
WITH wait := TRUE
WITH delay changes := FALSE
WITH items [1 ] := border 16
WITH items [2 ] := border 15
WITH items [3 ] := UNDETERMINED
WITH items [4 ] := border 2
WITH items [5 ] := textbox 2
WITH items [6 ] := border 1
WITH items [7 ] := textbox 4
WITH items [8 ] := textbox 5
WITH items [9 ] := textbox 6
WITH items [10 ] := valuebox 3
WITH items [11 ] := textbox 7
WITH items [12 ] := pushbutton 3
WITH items [13 ] := textbox 28
WITH items [14 ] := UNDETERMINED
WITH items [15 ] := textbox 35
WITH items [16 ] := listbox 1
WITH items [17 ] := listbox 2
WITH items [18 ] := textbox 36
WITH items [19 ] := valuebox 17
WITH items [20 ] := valuebox 18
WITH items [21 ] := UNDETERMINED
WITH items [22 ] := valuebox 26
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE responding display ISA display
WITH wait := TRUE
WITH delay changes := FALSE
WITH items [1 ] := border 18
WITH items [2 ] := UNDETERMINED
WITH items [3 ] := border 9
WITH items [4 ] := UNDETERMINED
WITH items [5 ] := UNDETERMINED
WITH items [6 ] := UNDETERMINED
WITH items [7 ] := UNDETERMINED
WITH items [8 ] := UNDETERMINED
WITH items [9 ] := UNDETERMINED
WITH items [10 ] := UNDETERMINED
WITH items [11 ] := UNDETERMINED
WITH items [12 ] := UNDETERMINED
WITH items [13 ] := UNDETERMINED
WITH items [14 ] := UNDETERMINED
WITH items [15 ] := UNDETERMINED
WITH items [16 ] := UNDETERMINED
WITH items [17 ] := UNDETERMINED
WITH items [18 ] := UNDETERMINED
WITH items [19 ] := UNDETERMINED
WITH items [20 ] := UNDETERMINED
WITH items [21 ] := UNDETERMINED
WITH items [22 ] := UNDETERMINED
WITH items [23 ] := UNDETERMINED
WITH items [24 ] := valuebox 15
WITH items [25 ] := valuebox 13
WITH items [26 ] := valuebox 14
WITH items [27 ] := UNDETERMINED
WITH items [28 ] := textbox 26
WITH items [29 ] := pushbutton 7
WITH items [30 ] := pushbutton 8
WITH items [31 ] := pushbutton 9
WITH items [32 ] := pushbutton 10
WITH items [33 ] := textbox 27
WITH items [34 ] := pushbutton 13
WITH items [35 ] := radiobutton group 2
WITH items [36 ] := valuebox 9
WITH items [37 ] := listbox 3
WITH items [38 ] := valuebox 10
WITH items [39 ] := listbox 4
WITH items [40 ] := valuebox 11
WITH items [41 ] := textbox 20
WITH items [42 ] := textbox 29
WITH items [43 ] := textbox 30
WITH items [44 ] := textbox 31
WITH items [45 ] := textbox 33
WITH items [46 ] := textbox 34
WITH items [47 ] := UNDETERMINED
WITH items [48 ] := textbox 37
WITH items [49 ] := pushbutton 15
WITH items [50 ] := UNDETERMINED
WITH items [51 ] := textbox 38
WITH items [52 ] := UNDETERMINED
WITH items [53 ] := valuebox 27
WITH items [54 ] := textbox 61
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE data for a design change display ISA
display
WITH wait := TRUE
WITH delay changes := FALSE
WITH items [1 ] := border 11
WITH items [2 ] := border 12
WITH items [3 ] := textbox 40
WITH items [4 ] := textbox 41
WITH items [5 ] := textbox 42
WITH items [6 ] := textbox 43
WITH items [7 ] := textbox 44
WITH items [8 ] := textbox 45
WITH items [9 ] := promptbox 3
WITH items [10 ] := promptbox 4
WITH items [11 ] := promptbox 6
WITH items [12 ] := UNDETERMINED
WITH items [13 ] := promptbox 8
WITH items [14 ] := pushbutton 18
WITH items [15 ] := UNDETERMINED
WITH items [16 ] := UNDETERMINED
WITH items [17 ] := UNDETERMINED
WITH items [18 ] := UNDETERMINED
WITH items [19 ] := UNDETERMINED
WITH items [20 ] := UNDETERMINED
WITH items [21 ] := UNDETERMINED
WITH items [22 ] := UNDETERMINED
WITH items [23 ] := UNDETERMINED
WITH items [24 ] := UNDETERMINED
WITH items [25 ] := UNDETERMINED
WITH items [26 ] := UNDETERMINED
WITH items [27 ] := pushbutton 17
WITH items [28 ] := textbox 53
WITH items [29 ] := textbox 54
WITH items [30 ] := promptbox 14
WITH items [31 ] := valuebox 12
WITH items [32 ] := promptbox 15
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE existing data for a design change display
ISA display
WITH wait := TRUE
WITH delay changes := FALSE
WITH items [1 ] := border 13
WITH items [2 ] := border 14
WITH items [3 ] := border 17
WITH items [4 ] := promptbox 9
WITH items [5 ] := promptbox 10
WITH items [6 ] := promptbox 11
WITH items [7 ] := promptbox 12
WITH items [8 ] := promptbox 13
WITH items [9 ] := textbox 46
WITH items [10 ] := UNDETERMINED
WITH items [11 ] := textbox 48
WITH items [12 ] := textbox 49
WITH items [13 ] := textbox 50
WITH items [14 ] := textbox 51
WITH items [15 ] := textbox 52
WITH items [16 ] := pushbutton 19
WITH items [17 ] := pushbutton 20
WITH items [18 ] := textbox 55
WITH items [19 ] := textbox 56
WITH items [20 ] := textbox 57
WITH items [21 ] := textbox 58
WITH items [22 ] := UNDETERMINED
WITH items [23 ] := UNDETERMINED
WITH items [24 ] := UNDETERMINED
WITH items [25 ] := UNDETERMINED
WITH items [26 ] := textbox 59
WITH items [27 ] := UNDETERMINED
WITH items [28 ] := textbox 47
WITH items [29 ] := textbox 60
WITH items [30 ] := UNDETERMINED
WITH items [31 ] := valuebox 19
WITH items [32 ] := valuebox 20
WITH items [33 ] := valuebox 21
WITH items [34 ] := valuebox 22
WITH items [35 ] := valuebox 23
WITH items [36 ] := valuebox 24
WITH items [37 ] := valuebox 25
WITH items [38 ] := pushbutton 21
WITH items [39 ] := pushbutton 22
WITH items [40 ] := pushbutton 23
WITH items [41 ] := pushbutton 24
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE select_project_display ISA display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 20
WITH items [2 ] := border 21
WITH items [3 ] := textbox 62
WITH items [4 ] := listbox 5
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE select_new_or_responding_display ISA
display
WITH wait := FALSE
WITH delay changes := FALSE
WITH items [1 ] := border 22
WITH items [2 ] := border 23
WITH items [3 ] := textbox 63
WITH items [4 ] := pushbutton 6
WITH items [5 ] := pushbutton 12
WITH fill color := 192,192,192
WITH menus [1 ] := UNDETERMINED

INSTANCE listbox 1 ISA listbox
WITH show current instance := TRUE
WITH destination := object_ID OF A_change_data
WITH location := 156,141,280,165

INSTANCE listbox 2 ISA listbox
WITH show current instance := TRUE
WITH destination := attribute OF A_change_data
WITH location := 415,140,560,165

INSTANCE listbox 3 ISA listbox
WITH show current instance := TRUE
WITH destination := object_ID OF A_change_data
WITH location := 170,256,339,280

INSTANCE listbox 4 ISA listbox
WITH show current instance := TRUE
WITH destination := attribute OF A_change_data
WITH location := 170,331,337,355

INSTANCE listbox 5 ISA listbox
WITH show current instance := TRUE
WITH source := Project_name OF Current_projects
WITH destination := project_name
WITH location := 25,150,225,185

INSTANCE promptbox 3 ISA promptbox
WITH font := "System"
WITH justify IS left
WITH frame := TRUE
WITH show current := TRUE
WITH format := "#"
WITH attachment := Recommendation OF
A_change_data
WITH location := 335,100,375,130

INSTANCE promptbox 4 ISA promptbox
WITH font := "System"
WITH justify IS left
WITH frame := TRUE
WITH scroll := TRUE
WITH show current := TRUE
WITH attachment := Reason_for_recomm OF
A_change_data
WITH location := 20,155,375,210

INSTANCE promptbox 6 ISA promptbox
WITH font := "System"
WITH justify IS left
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := Difference_in_Build_Cost OF
A_change_data
WITH location := 290,215,375,245

INSTANCE promptbox 8 ISA promptbox
WITH font := "System"
WITH justify IS left
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := DURATION OF A_change_data
WITH location := 230,251,280,281

INSTANCE promptbox 9 ISA promptbox
WITH font := "System"
WITH justify IS left
WITH frame := TRUE
WITH show current := TRUE
WITH attachment := Recommendation OF
A_change_data_retrieved
WITH location := 335,185,375,215

INSTANCE promptbox 10 ISA promptbox
```

```
 WITH font := "System"
 WITH justify IS left
 WITH frame := TRUE
 WITH show current := TRUE
 WITH attachment := Difference_in_Build_Cost OF
A_change_data_retrieved
 WITH location := 290,270,375,300

INSTANCE promptbox 11 ISA promptbox
 WITH font := "System"
 WITH justify IS left
 WITH frame := TRUE
 WITH show current := TRUE
 WITH attachment := DURATION OF
A_change_data_retrieved
 WITH location := 240,305,280,335

INSTANCE promptbox 12 ISA promptbox
 WITH font := "System"
 WITH justify IS left
 WITH frame := TRUE
 WITH show current := TRUE
 WITH attachment := Required_man_hours OF
A_change_data_retrieved
 WITH location := 240,335,280,365

INSTANCE promptbox 13 ISA promptbox
 WITH font := "System"
 WITH justify IS left
 WITH frame := TRUE
 WITH scroll := TRUE
 WITH show current := TRUE
 WITH attachment := Reason_for_recomm OF
A_change_data_retrieved
 WITH location := 20,230,375,265

INSTANCE promptbox 14 ISA promptbox
 WITH font := "System"
 WITH justify IS center
 WITH frame := TRUE
 WITH show current := TRUE
 WITH attachment := new_value OF A_change_data
 WITH location := 170,45,375,75

INSTANCE promptbox 15 ISA promptbox
 WITH font := "System"
 WITH justify IS left
 WITH frame := TRUE
 WITH show current := TRUE
 WITH attachment := Required_man_hours OF
A_change_data
 WITH location := 230,284,280,314

INSTANCE pushbutton 3 ISA pushbutton
 WITH label := "END"
 WITH attribute attachment := exit OF application
 WITH location := 425,60,570,125

INSTANCE pushbutton 6 ISA pushbutton
 WITH label := "New Case"
 WITH attribute attachment := start new case
 WITH location := 30,145,125,175

INSTANCE pushbutton 7 ISA pushbutton
 WITH label := "First"
 WITH attribute attachment := action OF navigate 1 IS
first
 WITH location := 345,140,430,165

INSTANCE pushbutton 8 ISA pushbutton
 WITH label := "Next"
 WITH attribute attachment := action OF navigate 1 IS
next
 WITH location := 430,140,480,165

INSTANCE pushbutton 9 ISA pushbutton
 WITH label := "Prev."
 WITH attribute attachment := action OF navigate 1 IS
previous
 WITH location := 480,140,530,165

INSTANCE pushbutton 10 ISA pushbutton
 WITH label := "Last"
 WITH attribute attachment := action OF navigate 1 IS
last
 WITH location := 530,140,580,165

INSTANCE pushbutton 14 ISA pushbutton
 WITH label := "END"
 WITH attribute attachment := exit OF the application
 WITH location := 215,40,365,78

INSTANCE pushbutton 12 ISA pushbutton
 WITH label := "Responding"
 WITH attribute attachment := responding to change
 WITH display attachment := responding display
 WITH location := 130,145,225,175

INSTANCE pushbutton 13 ISA pushbutton
 WITH label := "END"
 WITH attribute attachment := exit OF the application
 WITH location := 490,360,580,395

INSTANCE pushbutton 15 ISA pushbutton
 WITH label := ""
 WITH attribute attachment := second alternative
 WITH location := 490,265,580,350

INSTANCE pushbutton 18 ISA pushbutton
 WITH label := "OK"
 WITH attribute attachment := close change data
display
 WITH location := 290,250,375,280

INSTANCE pushbutton 17 ISA pushbutton
 WITH label := "CANCEL"
 WITH attribute attachment := cancel current change
 WITH location := 290,285,375,315

INSTANCE pushbutton 19 ISA pushbutton
 WITH label := "OK"
 WITH attribute attachment := close existing data
display
 WITH location := 290,305,375,335

INSTANCE pushbutton 20 ISA pushbutton
 WITH label := "CANCEL"
 WITH attribute attachment := cancel current change
 WITH location := 290,335,375,365

INSTANCE pushbutton 21 ISA pushbutton
 WITH label := "First"
 WITH attribute attachment := action OF navigate
retrieved data IS firs\
t
 WITH location := 200,85,255,110

INSTANCE pushbutton 22 ISA pushbutton
 WITH label := "N"
 WITH attribute attachment := action OF navigate
retrieved data IS next
 WITH location := 260,85,285,110

INSTANCE pushbutton 23 ISA pushbutton
 WITH label := "P"
 WITH attribute attachment := action OF navigate
retrieved data IS prev\
ious
 WITH location := 285,85,310,110

INSTANCE pushbutton 24 ISA pushbutton
 WITH label := "Last"
 WITH attribute attachment := action OF navigate
retrieved data IS last
 WITH location := 315,85,381,110

INSTANCE pushbutton 25 ISA pushbutton
 WITH label := "Go Ahead"
 WITH attribute attachment := go_ahead
 WITH location := 35,160,180,195

INSTANCE radiobutton group 2 ISA radiobutton
group
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH frame := TRUE
 WITH group label := "select discipline"
 WITH show current := TRUE
 WITH attachment := select_discipline OF
A_Responding_Data
 WITH location := 350,165,490,405

INSTANCE text style 1 ISA text style
 WITH font := "System"

INSTANCE textbox 1 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALS\
E
 WITH font size := 20
 WITH frame := FALSE
 WITH text := "VIRTUAL CHANGE
MODULE
"
 WITH location := 35,25,165,120

INSTANCE textbox 2 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeou\
t CF FALSE
 WITH font size := 18
 WITH frame := TRUE
 WITH text := "DEFINE WHAT YOU WANT TO
CHANGE"
 WITH location := 10,10,570,50

INSTANCE textbox 4 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Building Comp.:"
 WITH location := 20,65,160,85

INSTANCE textbox 5 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Building Comp. ID:"
 WITH location := 20,140,155,160

INSTANCE textbox 6 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALS\
E
 WITH font size := 5
 WITH text := "From the upper Menu"
 WITH location := 135,65,285,85

INSTANCE textbox 7 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Comp. Attribute:"
 WITH location := 305,140,415,165

INSTANCE textbox 21 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 255,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeou\
t CF FALSE
 WITH font size := 18
 WITH frame := TRUE
 WITH text := "RELATED MESSAGES"
 WITH location := 10,10,630,50

INSTANCE textbox 23 ISA textbox
 WITH justify IS left
 WITH font := "System"
 WITH frame := TRUE
 WITH text := "Read and Acted Upon Message (Black
Color)"
 WITH location := 20,95,410,120

INSTANCE textbox 24 ISA textbox
 WITH pen color := 0,128,0
 WITH fill color := 255,255,255
 WITH justify IS left
 WITH font := "System"
 WITH frame := TRUE
 WITH text := "Un Read and Un Acted Upon Message
(Green)"
 WITH location := 20,125,410,150

INSTANCE textbox 25 ISA textbox
 WITH pen color := 255,0,0
```

```
 WITH fill color := 255,255,255
 WITH justify IS left
 WITH font := "System"
 WITH frame := TRUE
 WITH text := "Read but Un Acted Upon Message
(Red)"
 WITH location := 20,155,410,180

INSTANCE textbox 26 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "# of Messages"
 WITH location := 5,140,105,165

INSTANCE textbox 27 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "# of Current Message"
 WITH location := 155,140,305,165

INSTANCE textbox 28 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Case ID:"
 WITH location := 325,65,385,85

INSTANCE textbox 32 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 255,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeou\
t CF FALSE
 WITH font size := 36
 WITH frame := TRUE
 WITH text := "END OF MONITORING MODULE"
 WITH location := 77,87,548,307

INSTANCE textbox 35 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALS\
E
 WITH font size := 5
 WITH text := "Select by
double clicking"
 WITH location := 20,165,175,205

INSTANCE textbox 39 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Discipline which received the
message:"
 WITH location := 20,65,345,90

INSTANCE textbox 36 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALS\
E
 WITH font size := 5
 WITH text := "Select by
double clicking"
 WITH location := 305,165,415,205

INSTANCE textbox 20 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Building Component:"
 WITH location := 15,195,155,215

INSTANCE textbox 29 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALS\
E
 WITH font size := 5
 WITH text := "Define from the
upper Menu"
 WITH location := 10,215,135,255

INSTANCE textbox 30 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Building Component ID:"
 WITH location := 15,255,171,280

INSTANCE textbox 31 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALS\
E
 WITH font size := 5
 WITH text := "Select by double click"
 WITH location := 10,275,165,305

INSTANCE textbox 33 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Component Attribute:"
 WITH location := 15,324,162,350

INSTANCE textbox 34 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALS\
E
 WITH font size := 5
 WITH text := "Select by double click"
 WITH location := 10,345,165,370

INSTANCE textbox 37 ISA textbox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Case ID"
 WITH location := 505,190,560,210

INSTANCE textbox 38 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeou\
t CF FALSE
 WITH font size := 18
 WITH frame := TRUE
 WITH text := "Read the Messages and Respond"
 WITH location := 5,5,580,45

INSTANCE textbox 40 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Level of Recommendation: (0 to 4)"
 WITH location := 20,80,290,100

INSTANCE textbox 41 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Reasons for the Recommendation
Level:"
 WITH location := 20,135,380,155

INSTANCE textbox 42 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Expected impact on building cost:"
 WITH location := 20,220,255,245

INSTANCE textbox 43 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Required design time [hours]:"
 WITH location := 20,255,220,275

INSTANCE textbox 44 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Required man hours:"
 WITH location := 20,285,165,305

INSTANCE textbox 45 ISA textbox
 WITH pen color := 0,0,128
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH font style IS italic
 WITH text := "(0 = Can not be done)
(4 = Highly recommended)"
 WITH location := 20,100,245,135

INSTANCE textbox 46 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Level of Recommendation: (0 to 4)"
 WITH location := 20,185,275,205

INSTANCE textbox 48 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Reasons for the Recommendation
Level:"
 WITH location := 20,210,330,230

INSTANCE textbox 49 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Expected impact on building cost:"
 WITH location := 20,275,255,295

INSTANCE textbox 50 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Required design time [hours]:"
 WITH location := 20,310,220,330

INSTANCE textbox 51 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Required man hours:"
 WITH location := 20,340,200,360

INSTANCE textbox 52 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 128,0,0
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeou\
t CF FALSE
 WITH font size := 14
 WITH frame := TRUE
 WITH text := "Such a Change has been done before"
 WITH location := 10,10,390,35

INSTANCE textbox 53 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current Value:"
```

```
WITH location := 20,20,120,40

INSTANCE textbox 54 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Proposed value:"
 WITH location := 20,50,147,70

INSTANCE textbox 55 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Number of times the change occured:"
 WITH location := 20,50,270,70

INSTANCE textbox 56 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Case ID:"
 WITH location := 20,120,80,140

INSTANCE textbox 57 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Date:"
 WITH location := 20,85,65,105

INSTANCE textbox 58 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Current #:"
 WITH location := 290,50,357,70

INSTANCE textbox 59 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Change Code:"
 WITH location := 200,120,300,140

INSTANCE textbox 47 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Original Value:"
 WITH location := 20,150,125,170

INSTANCE textbox 60 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH text := "Modefied Value"
 WITH location := 200,150,310,170

INSTANCE textbox 61 ISA textbox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH text := "Second
Alternative
Change"
 WITH location := 500,280,575,340

INSTANCE textbox 62 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeou\
t CF FALSE
 WITH font size := 18
 WITH text := "Select a Project from the List"
 WITH location := 35,40,210,100

INSTANCE textbox 63 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeou\
t CF FALSE
 WITH font size := 24
 WITH text := "Virtual Mode"
 WITH location := 65,35,185,110

INSTANCE valuebox 2 ISA valuebox
 WITH justify IS left
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH location := 160,170,290,203

INSTANCE valuebox 3 ISA valuebox
 WITH pen color := 0,0,128
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := object OF A_change_data
 WITH location := 20,90,280,115

INSTANCE valuebox 13 ISA valuebox
 WITH pen color := 255,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := number instances OF navigate 1
 WITH location := 110,140,140,165

INSTANCE valuebox 14 ISA valuebox
 WITH pen color := 255,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := instance number OF navigate 1
 WITH location := 305,140,335,165

INSTANCE valuebox 15 ISA valuebox
 WITH pen color := 0,0,0
 WITH fill color := 192,192,192
 WITH justify IS left
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH scroll := TRUE
 WITH horizontal scroll := TRUE
 WITH location := 5,50,580,135

INSTANCE valuebox 16 ISA valuebox
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := discipline_to OF
discipline_message
 WITH location := 340,65,410,90

INSTANCE valuebox 17 ISA valuebox
 WITH pen color := 0,0,128
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := object_ID OF A_change_data
 WITH location := 155,170,280,200

INSTANCE valuebox 18 ISA valuebox
 WITH pen color := 0,0,128
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := attribute OF A_change_data
 WITH location := 415,170,560,200

INSTANCE valuebox 9 ISA valuebox
 WITH pen color := 0,0,128
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := object OF A_change_data
 WITH location := 170,190,340,220

INSTANCE valuebox 10 ISA valuebox
 WITH pen color := 0,0,128
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := object_ID OF A_change_data
 WITH location := 170,285,340,315

INSTANCE valuebox 11 ISA valuebox
 WITH pen color := 0,0,128
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := attribute OF A_change_data
 WITH location := 170,360,340,390

INSTANCE valuebox 12 ISA valuebox
 WITH pen color := 255,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := old_value OF A_change_data
 WITH location := 170,15,375,40

INSTANCE valuebox 19 ISA valuebox
 WITH pen color := 128,0,0
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := instance number OF navigate
retrieved data
 WITH location := 360,45,380,70

INSTANCE valuebox 20 ISA valuebox
 WITH pen color := 0,0,128
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := number instances OF navigate
retrieved data
 WITH location := 265,45,285,70

INSTANCE valuebox 21 ISA valuebox
 WITH pen color := 0,0,255
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := date_time OF
A_change_data_retrieved
 WITH location := 60,85,195,110

INSTANCE valuebox 22 ISA valuebox
 WITH pen color := 0,0,128
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := CASE_ID OF
A_change_data_retrieved
 WITH location := 85,115,195,140

INSTANCE valuebox 23 ISA valuebox
 WITH pen color := 0,0,128
 WITH fill color := 192,192,192
 WITH justify IS center
 WITH font := "System"
 WITH frame := TRUE
 WITH clipped := TRUE
 WITH attachment := CHANGE OF
A_change_data_retrieved
 WITH location := 305,115,380,140

INSTANCE valuebox 24 ISA valuebox
```

```
WITH pen color := 0,0,128
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := old_value OF
A_change_data_retrieved
WITH location := 120,145,195,170

INSTANCE valuebox 25 ISA valuebox
WITH pen color := 0,0,128
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := new_value OF
A_change_data_retrieved
WITH location := 305,145,380,170

INSTANCE valuebox 26 ISA valuebox
WITH pen color := 255,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := Case_ID
WITH location := 315,90,400,115

INSTANCE valuebox 27 ISA valuebox
WITH pen color := 255,0,0
WITH fill color := 192,192,192
WITH justify IS center
WITH font := "System"
WITH frame := TRUE
WITH clipped := TRUE
WITH attachment := Case_ID OF discipline_message
WITH location := 505,215,565,245

INSTANCE main window ISA window
WITH location := 212,134,432,384
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := "Change-Monitoring"
WITH visible := TRUE

INSTANCE expand window ISA window
WITH location := 39,72,793,584
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := "Change-Monitoring Module"
WITH visible := FALSE

INSTANCE design data window ISA window
WITH location := 122,80,530,442
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable CF
FALSE
WITH title := "Data for A Design Change"
WITH visible := FALSE

INSTANCE existing design data window ISA window
WITH location := 114,44,522,450
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := "Similar Change Data"
WITH visible := FALSE

INSTANCE new case window ISA window
WITH location := 30,124,615,384
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := "New Case"
WITH visible := FALSE
WITH output := New Case display

INSTANCE responding window ISA window
WITH location := 20,5,615,455
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable CF
FALSE
WITH title := "Responding to Design Change"
WITH visible := FALSE
WITH output := responding display

INSTANCE Select a project window ISA window
WITH location := 151,149,407,383
WITH menus [1 ] := UNDETERMINED
WITH style IS moveable, sizeable, closeable
WITH title := ""
WITH visible := FALSE

! DEMON GROUP: action OF navigate

DEMON 1
IF action OF navigate 1
THEN CASE_ID OF A_Responding_Data := Case_ID
OF discipline_message
AND PREDECESSOR OF A_Responding_Data :=
sent_because_change_ID OF discip\
line_message

! DEMON GROUP: selected OF menu item

DEMON 2
IF selected OF menu item
THEN effect of menu item := TRUE

END
```

C.6. Planning and Scheduling Module

Part A

```
$VERSION$5
$LOCATIONS ARE PIXELS

CLASS available change case id
 WITH CASE_ID NUMERIC

CLASS border INHERITS add on, display item
 WITH style COMPOUND
  picture frame,
  edit control,
  group,
  shadow
  INIT picture frame
 WITH perspective COMPOUND
  in,
  out
  INIT in
 WITH border width NUMERIC
  INIT 1
 WITH background color COLOR
  INIT 192,192,192
 WITH fill color COLOR
  INIT 192,192,192
 WITH highlight color COLOR
  INIT 255,255,255
 WITH shadow color COLOR
  INIT 128,128,128

CLASS current
 WITH name STRING

CLASS Current_projects
 WITH Project_name STRING

CLASS data_elements
 WITH predecessor STRING
 WITH CHANGE STRING
 WITH alternative_CHANGE STRING
 WITH current_cpm_alternative# STRING
 WITH current_data_alternative_in_use STRING

CLASS finished
 WITH name STRING

CLASS l5odbc INHERITS add on
 WITH data source STRING
 WITH userid STRING
 WITH password STRING
 WITH connection string STRING
 WITH connection prompting SIMPLE
  INIT FALSE
 WITH auto commit SIMPLE
  INIT TRUE
 WITH action COMPOUND
  connect,
  disconnect
 WITH records NUMERIC
 WITH transaction COMPOUND
  commit,
  rollback
 WITH append SIMPLE
  INIT FALSE
 WITH status STRING
 WITH show error SIMPLE
 WITH default error handling SIMPLE
  INIT TRUE
 WITH error message STRING
 WITH native error NUMERIC
 WITH trace file STRING

CLASS last alternative data
 WITH name STRING

CLASS LastHighLavel

CLASS message box INHERITS add on
 WITH title STRING
 WITH text STRING
 WITH variable text STRING
 WITH modal style COMPOUND
  app modal,
  sys modal,
  not modal
  INIT app modal
 WITH icon COMPOUND
  exclamation,
  information,
  question,
  stop sign
  INIT exclamation
 WITH button COMPOUND
  abort retry ignore,
  ok,
  ok cancel,
  retry cancel,
  yes no,
  yes no cancel
  INIT ok
 WITH default button COMPOUND
  one,
  two,
  three
  INIT one
 WITH button selected COMPOUND
  abort,
  cancel,
  ignore,
  no,
  ok,
  retry,
  yes
 WITH put up SIMPLE

CLASS navigate INHERITS add on
 WITH class attachment CLASS REFERENCE
 WITH action COMPOUND
  first,
  previous,
  next,
  last
 WITH instance number NUMERIC
 WITH number instances NUMERIC

CLASS other alternatives
 WITH predecessor STRING
  ARRAY SIZE 1
 WITH alternative change STRING
  ARRAY SIZE 1

CLASS temporary current
 WITH name STRING

SHARED ATTRIBUTE CASE_ID NUMERIC
 WHEN CHANGED
  BEGIN
   delete A_CPMdata := TRUE
  END
SHARED ATTRIBUTE project_name STRING
 WHEN CHANGED
  BEGIN
   data source OF l5odbc 1 := project_name
   action OF l5odbc 1 IS connect := TRUE
   EXEC l5odbc 1 SQL select DISTINCT(CASE_ID)
from [A-CPM-Alternatives]
              END SQL INTO available change case id
   title OF main window := CONCAT( "Project : ",
project_name)
   output OF main window := select_case_display
  END
ATTRIBUTE i NUMERIC
ATTRIBUTE start calculations SIMPLE
 WHEN CHANGED
  BEGIN
   delete A_CPMdata := TRUE
  END
ATTRIBUTE ii NUMERIC
ATTRIBUTE yy NUMERIC
ATTRIBUTE $i STRING
ATTRIBUTE delete A_CPMdata SIMPLE
 WHEN CHANGED
  BEGIN
   EXEC l5odbc 1 SQL delete * FROM [A-CPMdata]
where CASE_ID = :domain.CASE_ID
    END SQL
!
   fill data elements := TRUE
  END
ATTRIBUTE fill data elements SIMPLE
 WHEN CHANGED
  BEGIN
!*** this is to create data elements that have each
predecessor and all
!*** it possible alternative (each predecessor and one
of its alternatives
!*** is considered as a separate element (instance)
   EXEC l5odbc 1 SQL select PREDECESSOR,
CHANGE, alternative_CHANGE from [A-CPM-
Alternatives]  where CASE_ID =:CASE_ID
              END SQL INTO data_elements
(predecessor, CHANGE, alternative_CHANGE)
!
!*** make current_data_alternative_in_use =
alternative#1(CHANGE)
   FOR (i :=  1 TO  number instances OF navigate
12)
     BEGIN
      instance number OF navigate 12 := i
      current_data_alternative_in_use OF
data_elements := CHANGE OF data_elements
     END
!
   make first alternative := TRUE
  END
ATTRIBUTE make first alternative SIMPLE
 WHEN CHANGED
  BEGIN
!***** Define the field ALTERNATIVE in A-
CPMdata table in the database
   alternative# := 1
!
!***** select the starting data elements
!***** also put alternative #1 as the
current_data_alternative_in_use OF data_elements
   FIND data_elements
     WHERE  predecessor OF data_elements =
"NULL"
     WHEN FOUND
      current_data_alternative_in_use OF
data_elements := CHANGE OF data_elements
      current_cpm_alternative# OF data_elements :=
CONCAT( "ALTERNATIVE#", TO STRING(
alternative#))
      MAKE current
       WITH name :=
current_data_alternative_in_use OF data_elements
      EXEC l5odbc 1 SQL insert into  [A-CPMdata] (
PREDECESSOR, CHANGE, ALTERNATIVE,
CASE_ID) values
       (:data_elements.predecessor ,
:data_elements.current_data_alternative_in_use ,
:data_elements.current_cpm_alternative# ,
:domain.CASE_ID )
                          END SQL
   FIND END
!
!***** Repeat to fill al the A-CPMdata table in the
data base
!***** select all the elements that come after the
previously used ones (called current)
!***** the assumption here is that any particular
change will always result in the same changes
```

```
!
    WHILE (name OF current <> "STOP")
     BEGIN
      FOR (i := 1 TO number instances OF navigate
1)
       BEGIN
        instance number OF navigate 1 := i
        FIND data_elements
         WHERE predecessor OF data_elements =
name OF current
         WHEN FOUND
          current_data_alternative_in_use OF
data_elements := CHANGE OF data_elements
          current_cpm_alternative# OF data_elements
:= CONCAT( "ALTERNATIVE#", TO STRING(
alternative#))
          MAKE temporary current
           WITH name := CHANGE OF
data_elements
          EXEC l5odbc 1 SQL insert into [A-
CPMdata] (PREDECESSOR, CHANGE,
ALTERNATIVE, CASE_ID) values
          ( :data_elements.predecessor,
:data_elements.current_data_alternative_in_use,
:data_elements.current_cpm_alternative#,
 :domain.CASE_ID )
                              END SQL
        FIND END
!**** end of FOR
       END
!**** make the temporary current as current after
making sure that it has not been used before
      FORGET current
      FOR (ii := 1 TO number instances OF navigate
6)
       BEGIN
        instance number OF navigate 6 := ii
        yy := 0
        FIND finished
         WHERE name OF finished = name OF
temporary current
         WHEN FOUND
          yy := 0
         WHEN NONE FOUND
          yy := 1
        FIND END
!
        IF (yy = 1) THEN
         BEGIN
          MAKE current
           WITH name := name OF temporary
current
          MAKE finished
           WITH name := name OF temporary
current
!**** end if
         END
!*** end for
       END
      FORGET temporary current
!**** end WHILE
     END
    FORGET finished
    FORGET current
    FORGET temporary current
!
!
    read the last alternative := TRUE
!**** end the method
   END
ATTRIBUTE make other alternatives SIMPLE
 WHEN CHANGED
  BEGIN
!*** find first instance "backward" in last alternative
data
    i := 1
    iii := 0
    yyy := 0
!
    DO
     BEGIN
      instance number OF navigate 11 := number
instances OF navigate 11 + 1 - i
      i := i + 1
      FIND data_elements
       WHERE predecessor OF data_elements =
name OF last alternative data
        AND alternative_CHANGE OF
data_elements <> ""
        AND current_data_alternative_in_use OF
data_elements = CHANGE OF data_elements
       WHEN FOUND
        iii := 1
        iiii := instance number OF navigate 11 + 1
      FIND END
!
      IF (iii = 1) THEN
       BEGIN
        current_data_alternative_in_use OF
data_elements := alternative_CHANGE OF
data_elements
        yyy := 1
        alternative# := alternative# + 1
!
!*** end of IF
       END
!
!*** end of DO
     END
    UNTIL (yyy = 1 OR i > number instances OF
navigate 11)
!
!
!*** to terminate the program if no more alternatives
are generate
!*** which occures when yyy reach here with the value
of "0"
    IF yyy = 0 THEN
     CHAIN "CPMLOGIC.app"
!
!
!**** to reset the elements that its two alternatives has
been used and has been passed
!**** by a higher level element
    FOR (i := iiii TO number instances OF navigate
11)
     BEGIN
      instance number OF navigate 11 := i
      FIND data_elements
       WHERE predecessor OF data_elements =
name OF last alternative data
        AND alternative_CHANGE OF
data_elements <> ""
       WHEN FOUND
        current_data_alternative_in_use OF
data_elements := CHANGE OF data_elements
      FIND END
     END
!
!*******************************************
!******* Start building the alternative *************
!*******************************************
!
!***** select the starting data elements
!***** also put the current_data_alternative_in_use
OF data_elements
    FIND data_elements
     WHERE predecessor OF data_elements =
"NULL"
     WHEN FOUND
      current_cpm_alternative# OF data_elements :=
CONCAT( "ALTERNATIVE#", TO STRING(
alternative#))
      MAKE current
       WITH name :=
current_data_alternative_in_use OF data_elements
      EXEC l5odbc 1 SQL insert into [A-CPMdata] (
PREDECESSOR, CHANGE, ALTERNATIVE,
CASE_ID) values
      (:data_elements.predecessor ,
:data_elements.current_data_alternative_in_use ,
:data_elements.current_cpm_alternative# ,
 :domain.CASE_ID )
                              END SQL
    FIND END
!
!***** Repeat to fill al the A-CPMdata table in the
data base
!***** select all the elements that come after the
previously used ones (called current)
!***** the assumption here is that any particular
change will always result in the same changes
!
    WHILE (name OF current <> "STOP")
     BEGIN
      FOR (i := 1 TO number instances OF navigate
1)
       BEGIN
        instance number OF navigate 1 := i
        FIND data_elements
         WHERE predecessor OF data_elements =
name OF current
         WHEN FOUND
          current_cpm_alternative# OF data_elements
:= CONCAT( "ALTERNATIVE#", TO STRING(
alternative#))
          MAKE temporary current
           WITH name :=
current_data_alternative_in_use OF data_elements
          EXEC l5odbc 1 SQL insert into [A-
CPMdata] ( PREDECESSOR, CHANGE,
ALTERNATIVE, CASE_ID) values
          (:data_elements.predecessor ,
:data_elements.current_data_alternative_in_use ,
:data_elements.current_cpm_alternative# ,
 :domain.CASE_ID )
                              END SQL
        FIND END
!**** end of FOR
       END
!**** make the temporary current as current after
making sure that it has not been used before
      FORGET current
      FOR (ii := 1 TO number instances OF navigate
6)
       BEGIN
        instance number OF navigate 6 := ii
        yy := 0
        FIND finished
         WHERE name OF finished = name OF
temporary current
         WHEN FOUND
          yy := 0
         WHEN NONE FOUND
          yy := 1
        FIND END
!
        IF (yy = 1) THEN
         BEGIN
          MAKE current
           WITH name := name OF temporary
current
          MAKE finished
           WITH name := name OF temporary
current
!**** end if
         END
!*** end for
       END
      FORGET temporary current
!**** end WHILE
     END
    FORGET finished
    FORGET current
    FORGET temporary current
!
!*** to continue the process
    read the last alternative := TRUE
!
!*** end of method
  END
ATTRIBUTE alternative# NUMERIC
ATTRIBUTE read the last alternative SIMPLE
 WHEN CHANGED
  BEGIN
!
!*** define last alternative
    current_cpm_alternative# := CONCAT(
"ALTERNATIVE#", TO STRING( alternative#))
!
!*** delete the existing last alternative data
    FORGET last alternative data
!
!*** read the data
    EXEC l5odbc 1 SQL select CHANGE from [A-
CPMdata]
  WHERE ALTERNATIVE =
:current_cpm_alternative#
    END SQL INTO last alternative data (name)
!
!*** to continue the process
    make other alternatives := TRUE
!
!** end of method
  END
ATTRIBUTE yyy NUMERIC
ATTRIBUTE current_cpm_alternative# STRING
ATTRIBUTE iii NUMERIC
ATTRIBUTE iiii NUMERIC
ATTRIBUTE go_ahead SIMPLE
 WHEN CHANGED
  BEGIN
   !
```

```
   action OF ISodbc 2 GENERAL IS connect :=
TRUE
!
   EXEC ISodbc 2 GENERAL SQL SELECT
Project_name from Current_projects
      END SQL INTO Current_projects
(Project_name)
!
   output OF main window := select_project_display
!
  END

INSTANCE border 1 ISA border
 WITH style IS shadow
 WITH perspective IS in
 WITH border width := 4
 WITH background color := 192,192,192
 WITH fill color := 0,0,128
 WITH highlight color := 255,255,255
 WITH shadow color := 0,0,0
 WITH location := 10,10,200,155

INSTANCE border 2 ISA border
 WITH style IS edit control
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,5,205,220

INSTANCE the domain ISA domain

INSTANCE ISodbc 1 ISA ISodbc
 WITH connection prompting := FALSE
 WITH auto commit := TRUE
 WITH append := FALSE
 WITH default error handling := TRUE

INSTANCE ISodbc 2 GENERAL ISA ISodbc
 WITH data source := "general"
 WITH connection prompting := FALSE
 WITH auto commit := TRUE
 WITH action IS connect
 WITH append := FALSE
 WITH default error handling := TRUE

INSTANCE navigate 1 ISA navigate
 WITH class attachment := current

INSTANCE navigate 4 ISA navigate
 WITH class attachment := finished

INSTANCE navigate 6 ISA navigate
 WITH class attachment := temporary current

INSTANCE navigate 11 ISA navigate
 WITH class attachment := last alternative data

INSTANCE navigate 12 ISA navigate
 WITH class attachment := data_elements

INSTANCE navigate 13 ISA navigate
 WITH class attachment := LastHighLavel

INSTANCE the application ISA application
 WITH unknowns fail := TRUE
 WITH threshold := 50
 WITH title display := starting display
 WITH ignore breakpoints := FALSE
 WITH reasoning on := FALSE
 WITH numeric precision := 8
 WITH demon strategy IS fire first

INSTANCE display 1 ISA display
 WITH wait := TRUE
 WITH delay changes := FALSE
 WITH items [1 ] := UNDETERMINED
 WITH items [2 ] := UNDETERMINED
 WITH items [3 ] := UNDETERMINED
 WITH items [4 ] := UNDETERMINED
 WITH items [5 ] := UNDETERMINED
 WITH items [6 ] := UNDETERMINED
 WITH items [7 ] := UNDETERMINED
 WITH items [8 ] := UNDETERMINED
 WITH items [9 ] := UNDETERMINED
 WITH items [10 ] := UNDETERMINED
 WITH items [11 ] := UNDETERMINED
 WITH items [12 ] := pushbutton 8
 WITH items [13 ] := pushbutton 9
 WITH items [14 ] := pushbutton 10
 WITH items [15 ] := pushbutton 11
 WITH items [16 ] := pushbutton 12
 WITH items [17 ] := pushbutton 6
 WITH items [18 ] := UNDETERMINED
 WITH items [19 ] := UNDETERMINED
 WITH items [20 ] := pushbutton 7
 WITH items [21 ] := UNDETERMINED
 WITH items [22 ] := UNDETERMINED
 WITH items [23 ] := UNDETERMINED
 WITH menus [1 ] := UNDETERMINED

INSTANCE starting display ISA display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 2
 WITH items [2 ] := border 1
 WITH items [3 ] := textbox 2
 WITH items [4 ] := UNDETERMINED
 WITH items [5 ] := UNDETERMINED
 WITH items [6 ] := UNDETERMINED
 WITH items [7 ] := UNDETERMINED
 WITH items [8 ] := UNDETERMINED
 WITH items [9 ] := UNDETERMINED
 WITH items [10 ] := UNDETERMINED
 WITH items [11 ] := pushbutton 13
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE select_project_display ISA display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 2
 WITH items [2 ] := border 1
 WITH items [3 ] := UNDETERMINED
 WITH items [4 ] := listbox 2
 WITH items [5 ] := textbox 4
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE select_case_display ISA display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 2
 WITH items [2 ] := border 1
 WITH items [3 ] := listbox 1
 WITH items [4 ] := textbox 3
 WITH items [5 ] := UNDETERMINED
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE dataFileOut ISA file
 WITH filename := "CPMin.dat"
 WITH shared := TRUE
 WITH default error handling := TRUE

INSTANCE events data in ISA file
 WITH filename := "cpmout.dat"
 WITH shared := TRUE
 WITH default error handling := TRUE

INSTANCE listbox 1 ISA listbox
 WITH show current instance := TRUE
 WITH source := CASE_ID OF available change case
id
 WITH destination := CASE_ID
 WITH location := 20,175,190,205

INSTANCE listbox 2 ISA listbox
 WITH show current instance := TRUE
 WITH source := Project_name OF Current_projects
 WITH destination := project_name
 WITH location := 15,170,195,205

INSTANCE pushbutton 8 ISA pushbutton
 WITH label := "delete A-CPMdata"
 WITH attribute attachment := delete A_CPMdata
 WITH location := 166,57,302,83

INSTANCE pushbutton 9 ISA pushbutton
 WITH label := "connect"
 WITH attribute attachment := action OF ISodbc IS
connect
 WITH location := 167,30,309,54

INSTANCE pushbutton 10 ISA pushbutton
 WITH label := "fill data elements"
 WITH attribute attachment := fill data elements
 WITH location := 170,87,307,114

INSTANCE pushbutton 11 ISA pushbutton
 WITH label := "make first alternative"
 WITH attribute attachment := make first alternative
 WITH location := 170,118,322,152

INSTANCE pushbutton 12 ISA pushbutton
 WITH label := "next alternatives"
 WITH attribute attachment := make other alternatives
 WITH location := 174,208,324,242

INSTANCE pushbutton 6 ISA pushbutton
 WITH label := "read last alternative in order"
 WITH attribute attachment := read the last alternative
 WITH location := 156,179,354,209

INSTANCE pushbutton 7 ISA pushbutton
 WITH label := "Start Calculations"
 WITH attribute attachment := start calculations
 WITH location := 368,55,502,90

INSTANCE pushbutton 13 ISA pushbutton
 WITH label := "Go Ahead"
 WITH attribute attachment := go_ahead
 WITH location := 30,170,180,205

INSTANCE textbox 2 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALSE
 WITH font size := 16
 WITH text := "PLANNING AND SCHEDULING
MODULE"
 WITH location := 16,42,190,123

INSTANCE textbox 3 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 18
 WITH text := "Select
Change Case ID"
 WITH location := 20,35,185,120

INSTANCE textbox 4 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 18
 WITH text := "Select a Project from the List"
 WITH location := 15,45,195,105

INSTANCE main window ISA window
 WITH location := 206,121,423,373
 WITH menus [1 ] := UNDETERMINED
 WITH style IS moveable, sizeable, closeable
 WITH title := ""
 WITH visible := TRUE

END
```

Part B

```
$VERSION35
$LOCATIONS ARE PIXELS

CLASS available change case id
 WITH CASE_ID NUMERIC

CLASS border INHERITS add on, display item
 WITH style COMPOUND
  picture frame,
  edit control,
  group,
  shadow
  INIT picture frame
 WITH perspective COMPOUND
  in,
  out
  INIT in
 WITH border width NUMERIC
  INIT 1
 WITH background color COLOR
  INIT 192,192,192
 WITH fill color COLOR
  INIT 192,192,192
 WITH highlight color COLOR
  INIT 255,255,255
 WITH shadow color COLOR
  INIT 128,128,128

CLASS current
 WITH name STRING

CLASS Current_projects
 WITH Project_name STRING

CLASS data_elements
 WITH predecessor STRING
 WITH CHANGE STRING
 WITH alternative_CHANGE STRING
 WITH current_cpm_alternative# STRING
 WITH current_data_alternative_in_use STRING

CLASS finished
 WITH name STRING

CLASS l5odbc INHERITS add on
 WITH data source STRING
 WITH userid STRING
 WITH password STRING
 WITH connection string STRING
 WITH connection prompting SIMPLE
  INIT FALSE
 WITH auto commit SIMPLE
  INIT TRUE
 WITH action COMPOUND
  connect,
  disconnect
 WITH records NUMERIC
 WITH transaction COMPOUND
  commit,
  rollback
 WITH append SIMPLE
  INIT FALSE
 WITH status STRING
 WITH show error SIMPLE
 WITH default error handling SIMPLE
  INIT TRUE
 WITH error message STRING
 WITH native error NUMERIC
 WITH trace file STRING

CLASS last alternative data
 WITH name STRING

CLASS LastHighLavel

CLASS message box INHERITS add on
 WITH title STRING
 WITH text STRING
 WITH variable text STRING
 WITH modal style COMPOUND
  app modal,
  sys modal,
  not modal
  INIT app modal
 WITH icon COMPOUND
  exclamation,
  information,
  question,
  stop sign
  INIT exclamation
 WITH button COMPOUND
  abort retry ignore,
  ok,
  ok cancel,
  retry cancel,
  yes no,
  yes no cancel
  INIT ok
 WITH default button COMPOUND
  one,
  two,
  three
  INIT one
 WITH button selected COMPOUND
  abort,
  cancel,
  ignore,
  no,
  ok,
  retry,
  yes
 WITH put up SIMPLE

CLASS navigate INHERITS add on
 WITH class attachment CLASS REFERENCE
 WITH action COMPOUND
  first,
  previous,
  next,
  last
 WITH instance number NUMERIC
 WITH number instances NUMERIC

CLASS other alternatives
 WITH predecessor STRING
  ARRAY SIZE 1
 WITH alternative change STRING
  ARRAY SIZE 1

CLASS temporary current
 WITH name STRING

SHARED ATTRIBUTE CASE_ID NUMERIC
 WHEN CHANGED
  BEGIN
   delete A_CPMdata := TRUE
  END
SHARED ATTRIBUTE project_name STRING
 WHEN CHANGED
  BEGIN
   data source OF l5odbc 1 := project_name
   action OF l5odbc 1 IS connect := TRUE
   EXEC l5odbc 1 SQL select DISTINCT(CASE_ID)
from [A-CPM-Alternatives]
            END SQL INTO available change case id
   title OF main window := CONCAT( "Project : ",
project_name)
   output OF main window := select_case_display
  END
ATTRIBUTE i NUMERIC
ATTRIBUTE start calculations SIMPLE
 WHEN CHANGED
  BEGIN
   delete A_CPMdata := TRUE
  END
ATTRIBUTE ii NUMERIC
ATTRIBUTE yy NUMERIC
ATTRIBUTE Si STRING
ATTRIBUTE delete A_CPMdata SIMPLE
 WHEN CHANGED
  BEGIN
   EXEC l5odbc 1 SQL delete * FROM [A-CPMdata]
where CASE_ID = :domain.CASE_ID
    END SQL
!
   fill data elements := TRUE
  END
ATTRIBUTE fill data elements SIMPLE
 WHEN CHANGED
  BEGIN
!*** this is to create data elements that have each
predecessor and all
!*** it possible alternative (each predecessor and one
of its alternatives
!*** is considered as a separate element (instance)
   EXEC l5odbc 1 SQL select PREDECESSOR,
CHANGE, alternative_CHANGE from [A-CPM-
Alternatives] where CASE_ID =:CASE_ID
            END SQL INTO data_elements
(predecessor, CHANGE, alternative_CHANGE)
!
!*** make current_data_alternative_in_use =
alternative#1(CHANGE)
  FOR (i := 1 TO number instances OF navigate
12)
   BEGIN
    instance number OF navigate 12 := i
    current_data_alternative_in_use OF
data_elements := CHANGE OF data_elements
   END
!
   make first alternative := TRUE
  END
ATTRIBUTE make first alternative SIMPLE
 WHEN CHANGED
  BEGIN
!***** Define the field ALTERNATIVE in A-
CPMdata table in the database
   alternative# := 1
!
!***** select the starting data elements
!***** also put alternative #1 as the
current_data_alternative_in_use OF data_elements
   FIND data_elements
    WHERE predecessor OF data_elements =
"NULL"
    WHEN FOUND
     current_data_alternative_in_use OF
data_elements := CHANGE OF data_elements
     current_cpm_alternative# OF data_elements :=
CONCAT( "ALTERNATIVE#", TO STRING(
alternative#))
     MAKE current
      WITH name :=
current_data_alternative_in_use OF data_elements
     EXEC l5odbc 1 SQL insert into [A-CPMdata] (
PREDECESSOR, CHANGE, ALTERNATIVE,
CASE_ID) values
      (:data_elements.predecessor ,
:data_elements.current_data_alternative_in_use ,
:data_elements.current_cpm_alternative# ,
:domain.CASE_ID )
                END SQL
   FIND END
!
!***** Repeat to fill al the A-CPMdata table in the
data base
!***** select all the elements that come after the
previously used ones (called current)
!***** the assumption here is that any particular
change will always result in the same changes
!
  WHILE (name OF current <> "STOP")
   BEGIN
    FOR (i := 1 TO number instances OF navigate
1)
     BEGIN
      instance number OF navigate 1 := i
      FIND data_elements
       WHERE predecessor OF data_elements =
name OF current
       WHEN FOUND
        current_data_alternative_in_use OF
data_elements := CHANGE OF data_elements
        current_cpm_alternative# OF data_elements
:= CONCAT( "ALTERNATIVE#", TO STRING(
alternative#))
        MAKE temporary current
         WITH name := CHANGE OF
data_elements
        EXEC l5odbc 1 SQL insert into [A-
CPMdata] (PREDECESSOR, CHANGE,
```

```
ALTERNATIVE, CASE_ID) values
        ( :data_elements.predecessor,
:data_elements.current_data_alternative_in_use,
:data_elements.current_cpm_alternative#,
  :domain.CASE_ID )
                                END SQL
        FIND END
!**** end of FOR
        END
!**** make the temporary current as current after
making sure that it has not been used before
        FORGET current
        FOR (ii := 1 TO number instances OF navigate
6)
          BEGIN
          instance number OF navigate 6 := ii
          yy := 0
          FIND finished
            WHERE name OF finished = name OF
temporary current
            WHEN FOUND
              yy := 0
            WHEN NONE FOUND
              yy := 1
          FIND END
!
          IF (yy = 1) THEN
           BEGIN
            MAKE current
              WITH name := name OF temporary
current
            MAKE finished
              WITH name := name OF temporary
current
!**** end if
           END
!*** end for
         END
        FORGET temporary current
!**** end WHILE
      END
    FORGET finished
    FORGET current
    FORGET temporary current
!
!
    read the last alternative := TRUE
!**** end the method
   END
ATTRIBUTE make other alternatives SIMPLE
 WHEN CHANGED
   BEGIN
!*** find first instance "backward" in last alternative
data
     i := 1
     iii := 0
     yyy := 0
!
    DO
     BEGIN
      instance number OF navigate 11 := number
instances OF navigate 11 + 1 - i
      i := i + 1
      FIND data_elements
        WHERE predecessor OF data_elements =
name OF last alternative data
          AND alternative_CHANGE OF
data_elements <> ""
          AND current_data_alternative_in_use OF
data_elements = CHANGE OF data_elements
        WHEN FOUND
          iii := 1
          iiii := instance number OF navigate 11 + 1
      FIND END
!
      IF (iii = 1) THEN
       BEGIN
        current_data_alternative_in_use OF
data_elements := alternative_CHANGE OF
data_elements
          yyy := 1
          alternative# := alternative# + 1
!
!*** end of IF
        END
!
!*** end of DO
     END
    UNTIL (yyy = 1 OR i > number instances OF
navigate 11)
!
!
!*** to terminate the program if no more alternatives
are generate
!*** which occures when yyy reach here with the value
of "0"
    IF yyy = 0 THEN
      CHAIN "CPMLOGIC.app"
!
!
!**** to reset the elements that its two alternatives has
been used and has been passed
!**** by a higher level element
    FOR (i := iiii TO number instances OF navigate
11)
      BEGIN
       instance number OF navigate 11 := i
       FIND data_elements
         WHERE predecessor OF data_elements =
name OF last alternative data
           AND alternative_CHANGE OF
data_elements <> ""
         WHEN FOUND
           current_data_alternative_in_use OF
data_elements := CHANGE OF data_elements
       FIND END
      END
!
!******************************************
!******* Start building the alternative ************
!******************************************
!
!***** select the starting data elements
!***** also put the current_data_alternative_in_use
OF data_elements
    FIND data_elements
     WHERE predecessor OF data_elements =
"NULL"
     WHEN FOUND
       current_cpm_alternative# OF data_elements :=
CONCAT( "ALTERNATIVE#", TO STRING(
alternative#))
       MAKE current
        WITH name :=
current_data_alternative_in_use OF data_elements
       EXEC ISodbc 1 SQL insert into [A-CPMdata] (
PREDECESSOR, CHANGE, ALTERNATIVE,
CASE_ID) values
        (:data_elements.predecessor ,
:data_elements.current_data_alternative_in_use ,
:data_elements.current_cpm_alternative# ,
  :domain.CASE_ID )
                                END SQL
    FIND END
!
!***** Repeat to fill al the A-CPMdata table in the
data base
!***** select all the elements that come after the
previously used ones (called current)
!***** the assumption here is that any particular
change will always result in the same changes
!
    WHILE (name OF current <> "STOP")
     BEGIN
      FOR (i := 1 TO number instances OF navigate
1)
       BEGIN
        instance number OF navigate 1 := i
        FIND data_elements
          WHERE predecessor OF data_elements =
name OF current
          WHEN FOUND
            current_cpm_alternative# OF data_elements
:= CONCAT( "ALTERNATIVE#", TO STRING(
alternative#))
            MAKE temporary current
              WITH name :=
current_data_alternative_in_use OF data_elements
            EXEC ISodbc 1 SQL insert into [A-
CPMdata] ( PREDECESSOR, CHANGE,
ALTERNATIVE, CASE_ID) values
        (:data_elements.predecessor ,
:data_elements.current_data_alternative_in_use ,
:data_elements.current_cpm_alternative# ,
  :domain.CASE_ID )
                                END SQL
        FIND END
!**** end of FOR
        END
!**** make the temporary current as current after
making sure that it has not been used before
        FORGET current
        FOR (ii := 1 TO number instances OF navigate
6)
          BEGIN
          instance number OF navigate 6 := ii
          yy := 0
          FIND finished
            WHERE name OF finished = name OF
temporary current
            WHEN FOUND
              yy := 0
            WHEN NONE FOUND
              yy := 1
          FIND END
!
          IF (yy = 1) THEN
           BEGIN
            MAKE current
              WITH name := name OF temporary
current
            MAKE finished
              WITH name := name OF temporary
current
!**** end if
           END
!*** end for
         END
        FORGET temporary current
!**** end WHILE
      END
    FORGET finished
    FORGET current
    FORGET temporary current
!
!*** to continue the process
    read the last alternative := TRUE
!
!*** end of method
   END
ATTRIBUTE alternative# NUMERIC
ATTRIBUTE read the last alternative SIMPLE
 WHEN CHANGED
   BEGIN
!
!*** define last alternative
    current_cpm_alternative# := CONCAT(
"ALTERNATIVE#", TO STRING( alternative#))
!
!*** delete the existing last alternative data
    FORGET last alternative data
!
!*** read the data
    EXEC ISodbc 1 SQL select CHANGE from [A-
CPMdata]
   WHERE ALTERNATIVE =
:current_cpm_alternative#
    END SQL INTO last alternative data (name)
!
!*** to continue the process
    make other alternatives := TRUE
!
!** end of method
   END
ATTRIBUTE yyy NUMERIC
ATTRIBUTE current_cpm_alternative# STRING
ATTRIBUTE iii NUMERIC
ATTRIBUTE iiii NUMERIC
ATTRIBUTE go_ahead SIMPLE
 WHEN CHANGED
  BEGIN
   !
   action OF ISodbc 2 GENERAL IS connect :=
TRUE
!
   EXEC ISodbc 2 GENERAL SQL SELECT
Project_name from Current_projects
      END SQL INTO Current_projects
(Project_name)
!
   output OF main window := select_project_display
!
  END

INSTANCE border 1 ISA border
 WITH style IS shadow
 WITH perspective IS in
 WITH border width := 4
 WITH background color := 192,192,192
 WITH fill color := 0,0,128
 WITH highlight color := 255,255,255
 WITH shadow color := 0,0,0
 WITH location := 10,10,200,155
```

```
INSTANCE border 2 ISA border
 WITH style IS edit control
 WITH perspective IS in
 WITH border width := 1
 WITH background color := 192,192,192
 WITH fill color := 192,192,192
 WITH highlight color := 255,255,255
 WITH shadow color := 128,128,128
 WITH location := 5,5,205,220

INSTANCE the domain ISA domain

INSTANCE I5odbc 1 ISA I5odbc
 WITH connection prompting := FALSE
 WITH auto commit := TRUE
 WITH append := FALSE
 WITH default error handling := TRUE

INSTANCE I5odbc 2 GENERAL ISA I5odbc
 WITH data source := "general"
 WITH connection prompting := FALSE
 WITH auto commit := TRUE
 WITH action IS connect
 WITH append := FALSE
 WITH default error handling := TRUE

INSTANCE navigate 1 ISA navigate
 WITH class attachment := current

INSTANCE navigate 4 ISA navigate
 WITH class attachment := finished

INSTANCE navigate 6 ISA navigate
 WITH class attachment := temporary current

INSTANCE navigate 11 ISA navigate
 WITH class attachment := last alternative data

INSTANCE navigate 12 ISA navigate
 WITH class attachment := data_elements

INSTANCE navigate 13 ISA navigate
 WITH class attachment := LastHighLavel

INSTANCE the application ISA application
 WITH unknowns fail := TRUE
 WITH threshold := 50
 WITH title display := starting display
 WITH ignore breakpoints := FALSE
 WITH reasoning on := FALSE
 WITH numeric precision := 8
 WITH demon strategy IS fire first

INSTANCE display 1 ISA display
 WITH wait := TRUE
 WITH delay changes := FALSE
 WITH items [1 ] := UNDETERMINED
 WITH items [2 ] := UNDETERMINED
 WITH items [3 ] := UNDETERMINED
 WITH items [4 ] := UNDETERMINED
 WITH items [5 ] := UNDETERMINED
 WITH items [6 ] := UNDETERMINED
 WITH items [7 ] := UNDETERMINED
 WITH items [8 ] := UNDETERMINED
 WITH items [9 ] := UNDETERMINED
 WITH items [10 ] := UNDETERMINED
 WITH items [11 ] := UNDETERMINED
 WITH items [12 ] := pushbutton 8
 WITH items [13 ] := pushbutton 9
 WITH items [14 ] := pushbutton 10
 WITH items [15 ] := pushbutton 11
 WITH items [16 ] := pushbutton 12
 WITH items [17 ] := pushbutton 6
 WITH items [18 ] := UNDETERMINED
 WITH items [19 ] := UNDETERMINED
 WITH items [20 ] := pushbutton 7
 WITH items [21 ] := UNDETERMINED
 WITH items [22 ] := UNDETERMINED
 WITH items [23 ] := UNDETERMINED
 WITH menus [1 ] := UNDETERMINED

INSTANCE starting display ISA display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 2
 WITH items [2 ] := border 1
 WITH items [3 ] := textbox 2
 WITH items [4 ] := UNDETERMINED
 WITH items [5 ] := UNDETERMINED
 WITH items [6 ] := UNDETERMINED
 WITH items [7 ] := UNDETERMINED
 WITH items [8 ] := UNDETERMINED
 WITH items [9 ] := UNDETERMINED
 WITH items [10 ] := UNDETERMINED
 WITH items [11 ] := pushbutton 13
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE select_project_display ISA display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 2
 WITH items [2 ] := border 1
 WITH items [3 ] := UNDETERMINED
 WITH items [4 ] := listbox 2
 WITH items [5 ] := textbox 4
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE select_case_display ISA display
 WITH wait := FALSE
 WITH delay changes := FALSE
 WITH items [1 ] := border 2
 WITH items [2 ] := border 1
 WITH items [3 ] := listbox 1
 WITH items [4 ] := textbox 3
 WITH items [5 ] := UNDETERMINED
 WITH fill color := 192,192,192
 WITH menus [1 ] := UNDETERMINED

INSTANCE dataFileOut ISA file
 WITH filename := "CPMin.dat"
 WITH shared := TRUE
 WITH default error handling := TRUE

INSTANCE events data in ISA file
 WITH filename := "cpmout.dat"
 WITH shared := TRUE
 WITH default error handling := TRUE

INSTANCE listbox 1 ISA listbox
 WITH show current instance := TRUE
 WITH source := CASE_ID OF available change case
id
 WITH destination := CASE_ID
 WITH location := 20,175,190,205

INSTANCE listbox 2 ISA listbox
 WITH show current instance := TRUE
 WITH source := Project_name OF Current_projects
 WITH destination := project_name
 WITH location := 15,170,195,205

INSTANCE pushbutton 8 ISA pushbutton
 WITH label := "delete A-CPMdata"
 WITH attribute attachment := delete A_CPMdata
 WITH location := 166,57,302,83

INSTANCE pushbutton 9 ISA pushbutton
 WITH label := "connect"
 WITH attribute attachment := action OF I5odbc IS
connect
 WITH location := 167,30,309,54

INSTANCE pushbutton 10 ISA pushbutton
 WITH label := "fill data elements"
 WITH attribute attachment := fill data elements
 WITH location := 170,87,307,114

INSTANCE pushbutton 11 ISA pushbutton
 WITH label := "make first alternative"
 WITH attribute attachment := make first alternative
 WITH location := 170,118,322,152

INSTANCE pushbutton 12 ISA pushbutton
 WITH label := "next alternatives"
 WITH attribute attachment := make other alternatives
 WITH location := 174,208,324,242

INSTANCE pushbutton 6 ISA pushbutton
 WITH label := "read last alternative in order"
 WITH attribute attachment := read the last alternative
 WITH location := 156,179,354,209

INSTANCE pushbutton 7 ISA pushbutton
 WITH label := "Start Calulations"
 WITH attribute attachment := start calculations
 WITH location := 368,55,502,90

INSTANCE pushbutton 13 ISA pushbutton
 WITH label := "Go Ahead"
 WITH attribute attachment := go_ahead
 WITH location := 30,170,180,205

INSTANCE textbox 2 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic, underline CF FALSE,
strikeout CF FALSE
 WITH font size := 16
 WITH text := "PLANNING AND SCHEDULING
MODULE"
 WITH location := 16,42,190,123

INSTANCE textbox 3 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 18
 WITH text := "Select
Change Case ID"
 WITH location := 20,35,185,120

INSTANCE textbox 4 ISA textbox
 WITH pen color := 255,255,255
 WITH fill color := 0,0,128
 WITH justify IS center
 WITH font := "Times New Roman"
 WITH font style IS bold, italic CF FALSE, underline
CF FALSE, strikeout CF FALSE
 WITH font size := 18
 WITH text := "Select a Project from the List"
 WITH location := 15,45,195,105

INSTANCE main window ISA window
 WITH location := 206,121,423,373
 WITH menus [1 ] := UNDETERMINED
 WITH style IS moveable, sizeable, closeable
 WITH title := ""
 WITH visible := TRUE

END
```