



Information Technology for European Advancement

Task 1.2 - Inventory of Methods and Tools(D.1.2.2)

Version 01 - Public

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Software Development Process for Real-Time Embedded Software Systems (DESS)

ITEA COMPETENCES involved:

- 1) Complex Systems Engineering**
- 2) Communications**
- 3) Distributed Information and services**

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Design of the Quantitative Tools Questionnaire Database

1 Introduction

The initial Qualitative Tools Questionnaire provided enough information to serve as input for developing the DESS methodology, which was the purpose of task 1.2. During the further activities in the DESS project, the need was felt for a more quantitative approach and the experience was available to pursue this. This has resulted in the development of the Quantitative Tools Questionnaire Database.

For this purpose, a completely new design was made for the database, rather than adding quantitative questions to the old database. The reason for this new design was to set up the database in such a way that an automated analysis of most of the results is possible. The main difference between the old database and the new one is that in the old database, only free-form answers were collected, whereas in the new design, mainly fixed-form answers are included to enable automated analysis. This required major changes to the table structure and to the user interface of the database. The fixed-form answers were added to the database in a set of new tables and the user interface was changed to present these to the user. Also, a web interface was added to enable interviews via the web.

Automated analysis is possible with only a minor addition to the new structure as presented below, namely the inclusion of a value field to express a weighting of the answers.

2 Description of the Quantitative Tools Questionnaire Database

The aims of the quantitative tools questionnaire database are to find out for which purposes a tool is used in the different workflows and how well the activities are supported by the tool. Some general information is collected as well, e.g., about the environment in which the tool is used and about functionality provided by the tool.

The questionnaire takes the form of an MS-Access database with a web interface implemented with Active Server Pages. Before the web interface was developed, a prototype was developed with MS-Access forms. Currently, only a single user can access the questionnaire. An extension to multiple-user access would be a useful extension, which should not be too difficult to accomplish.

Most of the questions provide a fixed-form answer. Therefore, automated evaluation of a large part of the results is possible. A free-form answer (Comment field) is also provided for all questions to allow for remarks and clarifications or a history. For example, certain questions need only one answer in the database (e.g. information about the producer of a tool). Therefore, these questions are shown with the previously given answer once an answer is obtained. If newer information is available, the previous answer can be

overwritten and an appropriate remark can be made in the Comment field, so the older information is not re-entered.

Filling in the questionnaire can be interrupted at any time and resumed later, because a company name is selected at the beginning. Likewise, previous answers can be viewed and corrected, if necessary. Currently, the questionnaire can only be filled in for a particular tool by only one person from a certain company. It is likely that this is generalized in the future so different people of the same company can fill in the questionnaire for the same tool.

The questions are grouped into general, workflow independent and workflow dependent sets. Within these sets, questions are grouped into categories to provide additional information about the purpose of the questions. For each tool type, it is recorded in which workflows the tool could be used. For example, a compiler is not used in the analysis workflow, so questions about compilers are only asked for the detailed design and implementation workflow.

The set of general questions consists of questions about the tool (producer, version used) and the company of the user (application area, contact person). The set of workflow independent questions consists of question that concern general features of the tool, such as overall rating and functionality provided by the tool. The set of workflow dependent questions aims to get information on how the tool is used during the workflow and how well the activities of the workflow are supported by the tool.

The design of the database is presented in figures 1 and 2. The first figure is focuses on the generation of the question sets, whereas the second figure centers on the storage of the answers. Only the part relevant for the interviews is modeled; the part to enter questions has been left out.

Primary keys have been left out in the attributes section, but are indicated in the role name of the links with other tables. A relation name (in the middle of a link) represents an intermediate table for a many-to-many relation.

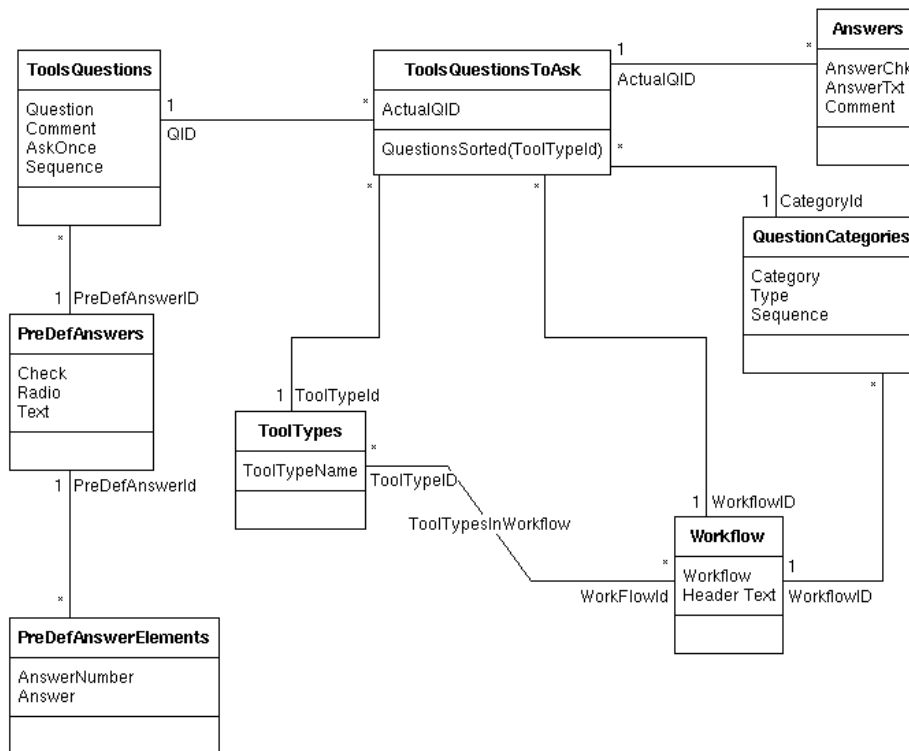


Figure 1 Design of the data structures that concern the questions

ToolsQuestionsToAsk This table determines which questions are asked for which tool type. The primary key of this table is composed of the primary keys of the ToolsQuestions, ToolTypes, Workflow and QuestionCategories tables. The field ActualQId is a unique number generated for each combination of the primary keys. Only one query is directly called from the web interface: QuestionsSorted. This query sorts the results of a union query that merges the results of the questions specific for the tool type with the questions that are asked for all tool types that are used in the workflow

ToolsQuestions This table contains all the questions. The field Question contains the actual question. The Comment field contains a clarification of the question. The field AskOnce specifies if the question needs to be answered only once, e.g., the question about the name of the producer of a tool. These questions are shown with the previously given answers already filled in. This allows updates to questions about functionality or latest version numbers of a tool. Sequence is a number to order the questions within a category. The table also contains a reference to a record of the PreDefAnswers table, which determines the type(s) of answer can be given to the question.

PredefAnswers This table determines the type of answer(s) that can be given to a question. The Comment field is present for all questions. Experience shows that comments often provide valuable information. The disadvantage of a free-form answer is, of course, that automated evaluation is not possible. The Check field determines if the fixed-form answer is given in the form of check boxes, which allows multiple answers to

a question. This is used in, e.g., questions about the different (UML) modeling views that are used in different workflows. The Radio field specifies a radio button answer type. This allows a choice of a single answer from any number of possible answers. Radio buttons and check boxes may not both be selected. The Text field specifies a free-form answer, which can be combined with a fixed-form answer. For example, for modelers there is a question about the modeling language and the functionality of the tool. The language can be selected by a radio button and the functionality is described in a text box. The Comment field is, in this case, used for comments that do not directly concern the functionality of the tool.

PreDefAnswerElements For each answer type defined in the PreDefAnswers table, the individual choices are listed in this table. Currently, only a description of the possible answers is given in the field Answer and a number AnswerNumber to order the answers are included. For evaluation purposes, a value should be associated with the answers to some questions, e.g., where ratings are given.

Workflows Besides a numeric primary key, this table contains the names of the workflows and the header text that is displayed in the questionnaire.

QuestionCategories This table contains the headers for the different question categories. The field Category is the header text shown in the questionnaire. Type indicates the type of questions asked: the main types are technical and process related questions. The workflowId determines in which workflow the questions in this category are asked and Sequence determines the sorting order of the categories.

Tooltypes This table contains the names of the tool types distinguished. Apart from a numeric primary key, it only contains the name of the tool type.

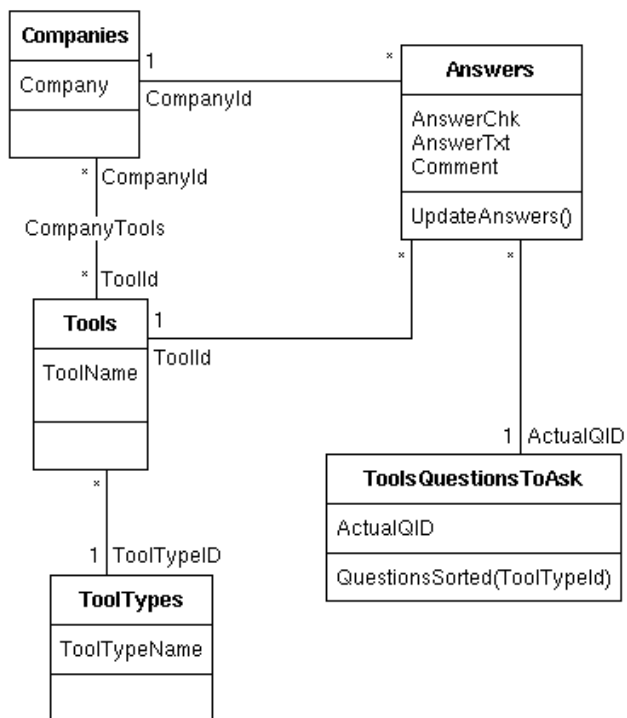


Figure 2 Design of the data structures that concern the answers

Answers This table stores the answers to the questions. For each answer, the CompanyId, the ToolId and the ActualQID are stored. The actual answers are stored in the AnswerChk field for both check- and radio-button type answers. Check box answers are stored in a binary encoded form. Free-form answers are stored in the AnswerTxt field and comments in the Comment field.

UpdateAnswers is a Visual Basic for Applications procedure in the prototype forms interface and a Visual Basic Script procedure in the web interface. It makes the appropriate controls visible on the interface and searches the database for a previously given answer to the current question. This answer can either be an answer given for the tool by anyone before in case the question is marked “AskOnce” or an answer given by the same company if this is not the case. If an answer is found, it is displayed by the controls and the underlying record is set to edit mode. If no answer is found, a new record is created.

Companies This table stores the names of the companies participating in the questionnaire.

Tools This table stores the tool names and types of all tools encountered during the initial tools questionnaire. For some tools, it was decided not to include them in the quantitative questionnaire, which focuses on the technical tools.

Tooltypes This table contains a list of the tool types that were distinguished after completion of the initial tools questionnaire.

3 Extension to tool integration

It would be very useful to investigate the quality and functionality of tool integrations. For example, consider the integration of a Requirements Management tool with a Test tool. One would expect that this integration would allow to generate coverage information automatically. However, as the results from WP 3.5 show, the integration of RequisitePro with Testmate does not provide this basic functionality. Because this functionality was lacking, Testmate was not used and RequisitePro was customized to manage test results as well.

Technically, an extension of the database to include tool integrations in a structural way is not very complicated. Essentially, it means adding a table that links pairs of tools and extending the user interface. Some modifications are needed to the ToolsQuestions table to accommodate the questions and to the Answers table to store the results.

Acquiring the information is a more difficult question. For N tool types, there are $O(N^2)$ options for combinations, so the first step would be to identify which combinations actually exist or are desired. The next step would be to identify the appropriate set of questions for each combination. This is a major effort for which the capacity is not present in DESS.