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Beirut, Lebanon
25–29 June 2001

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Arab Computer Society
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AICCSA 2001

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ACS/IEEE International Conference on Computer Systems and Applications (AICCSA 2001)

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Foreword

Welcome to the First ACS/IEEE International Conference on Computer Systems and Applications, and welcome to Beirut. The scope of this conference is fairly wide, since it covers in principle Computer Systems and Applications. In order to narrow down the focus of the conference, we have adopted a rallying theme, which is: Taking Stock of Existing Technology, Charting Future Trends. In other words, we have tried to give this conference a technology transfer slant: This conference is as much about exploiting existing technology as it is about exploring new horizons. Our hope/expectation is that the width of the scope will enhance the conference by increasing the potential for cross-fertilization. The program of this conference is divided into five areas of interest, which are: Artificial Intelligence; Databases and Data Engineering; Distributed Computing; Software Engineering; and Web Engineering. The program includes a total of 94 papers, divided into 50 full papers and 44 short papers. Full papers are alloted 30 minutes for presentation and discussion, while short papers are alloted 20 minutes; the sessions are scheduled in such a way as to enable participants to cross over between parallel sessions.

The track of Artificial Intelligence includes 14 full papers and 8 short papers. These are divided into the following topics of interest: Genetic programming; Machine Learning; Problem Solving; Pattern Recognition; Neural Networks; and AI applications. The track of Databases and Data Engineering includes 5 full papers and 8 short papers, and covers such topics of interest as Data Engineering, Multimedia Databases, Database structures, and Database Processing. The track of Distributed Computing includes 9 full papers and 3 short papers, and is divided into the following topics of interest: Analysis of Distributed Computing; Synthesis of Distributed Computing; and Techniques of Distributed Computing. The track of Software Engineering, by far the longest track, includes 16 long papers and 20 short papers, and covers such topics of interest as Software Metrics, Software Testing, Software Engineering Management, Object Oriented Software Engineering, Programming Languages, and Software Reliability. Finally, the Web Engineering track includes 6 full papers and 5 short papers, and covers such topics as Web applications design, and Web applications management. In addition to these peer-reviewed papers/communications, we have scheduled three Keynote Presentations. Three distinguished scholars have agreed to give keynote presentations at this conference: Dr. Mohammad Fayad, University of Nebraska, will speak about Software Architectures; Dr. Salim Hariri, University of Arizona, will speak about Distributed Computing; Dr. Bashar Nuseibeh, the Open University, will speak about Requirements Engineering. The conference program also includes tutorials, as well as collocated specialized workshops.

We are gratified by the international diversity of this conference; authors in this conference hail from no less than 30 countries, including Algeria, Australia, Austria, Brazil, Canada, China, Egypt, France, Germany, Greece, India, Jordan, Korea, Kuwait, Lebanon, Malaysia, Morocco, Portugal, Russia, Saudi Arabia, Singapore, Spain, Sudan, Switzerland, Taiwan, Turkey, Tunisia, the United Arab Emirates, the United Kingdom, and the United States.

We are very grateful to the institutions that are participating in the organization of this conference. Our sponsors include, the Arab Computer Society and the IEEE Computer Society (through the Technical Council on Software Engineering and the Technical Committee on Computer Architecture). Our co-sponsors include the Lebanese American University, the American University of Beirut, and Lebanon's National Council for Scientific Research. The Association of Computing Machinery, through three of its Special Interest Groups (SIGART, SIGPLAN and SIGSOFT), agrees to cooperate in the sponsorship. We are also very grateful to the program committee for their help in assessing and selecting papers among those that were submitted. Also, we gratefully acknowledge the support of the organizing committees who, in addition to their organizing responsibilities, have offered us a great deal of technical support to manage the flow of papers and reviews. Dr. Nash'at Mansour, from the Lebanese American University, has played a very important role in the organization of this conference, well beyond his official duties as chairman of the organizing committee. We wish to gratefully acknowledge his contribution.

We hope you enjoy attending this conference, and that you find its proceedings to be a useful resource for your future work. Also, we look forward to your participation in future sessions of this conference.

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A Case Study with Relational Database Metrics

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Abstract

Metrics are useful mechanisms for assuring database quality. However, it is necessary to prove the practical utility of the metrics because they must be used in real life. Consequently if the metrics are not useful from a practical point of view, they must be rejected. In this paper we present the metrics we have proposed for controlling the quality of relational databases and we present the case study developed in a Spanish enterprise aimed at discovering if the metrics are really useful in relation to the purpose for which they were designed, that is to say the control of quality.

1. Introduction

Quality is a critical success factor for all economical and organisational aspects, and especially in Information Systems (IS). It is important to be able to evaluate software applications for each relevant quality characteristic using validated metrics. Software engineers have been putting forward huge quantities of metrics for software products, processes and resources ([8], [3]). Unfortunately, almost all the metrics proposed are focused on program, disregarding data-related quality ([11]). However databases are introduced in most of the important IS, becoming their essential core, so it is fundamental to have metrics for databases at our disposal because by controlling the database quality, we are controlling system quality.

Database quality depends on several factors: functionality, reliability, usability, efficiency, maintainability and portability ([6]). Our focus is on maintainability because maintenance accounts for 60 to 90 percent of life cycle costs and it is considered the most important concern for modern IS departments ([4], [7], [10]).

In this paper, we present metrics for controlling maintainability and, consequently, the quality of relational database schemas.

In section 2 we summarize the method we use for defining metrics. Section 3 presents the metrics proposed for relational databases. The results from a case study developed with the metrics are shown in section 4. Conclusions and future work come in the last section.

2. Method used for metrics proposal

As we have said previously, our goal is to define metrics for controlling database quality through its maintainability. However metrics definition must be done in a methodological way, and it is necessary to follow a number of steps to ensure the reliability of the proposed metrics. Figure 1 presents the method we apply for the metrics proposal.

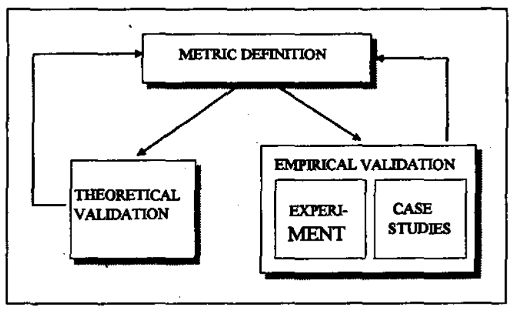

Figure 1. Steps followed in the definition and validation of the database metrics

In this figure we have three main activities:

Metrics definition. This definition is made taking into account the specific characteristics of the database we want to measure and the experience of database designers and administrators of these databases.

Theoretical validation. The second step is the formal validation of the metrics. Formal validation helps us to know when and how to apply the metrics. There are two main tendencies in metrics validation: the property-based frameworks ([12] and [1]) and the ones based on the measurement theory ([14] or [13]).

Empirical validation. The aim of this step is to prove the practical utility of the proposed metrics. Basically we can divide empirical validation into experimentation (carried out using controlled experiments) and case studies (working with real data). Both of them are necessary, the controlled experiments for the initial approach and the case studies for enforcing results.

As we can see in figure 1, the process of defining and validating database metrics is evolutionary and iterative. As a result of the feedback metrics could be redefined or discarded depending on theoretical or empirical validations.

Formal verification of the proposed metrics can be found in ([9]) from the point of view property-based approaches and in ([2]) from the point of view of the measurement theory. An experiment related to some of the presented metrics can be found in ([2]). In this paper we will present all the information related to the case study we have developed.

3. Metrics for relational databases

Traditionally, the only indicator used to measure the "quality" of relational databases has been the normalization theory, upon which [5] propose to obtain a normalization ratio. However we believe that normalization is not enough to measure the quality of relational databases, so we propose the following three metrics ([2]): *NT* (number of tables in the schema database), *NA* (number of attributes in all the tables of the schema) and *NFK* (number of foreign keys in the schema database).

4. Case study

Due to the limitations (such as the large number of variables that cause differences, dealing with low level issues, a microcosm of reality and a small set of variables) and limits (they do not scale up, are done in a class in training situations, are made in vitro and face a variety of threats of validity). of the controlled it is convenient to run case studies.

In this section, we will present the case study developed. As maintainability is a factor of quality and it is influenced by analyzability, changeability, stability, and testability ([6]), our purpose is to prove that a relation exists between our metrics and all these factors. We have not considered the study of compliance (the only factor of maintainability which does not appear in the list before) as we have no standard for making the empirical validation.

4.1. General characteristics

Our study is centered on four different databases from the CIEMAT (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas) one of the biggest public Spanish research centers. CIEMAT works with large databases, which they have developed themselves. The values of the metrics presented in the previous section are presented in table 1. The names of the databases have been omitted for confidentiality reasons.

Database	Number of tables	Number of attributes	Number of Foreign Keys
ONE	912	11683	3621
TWO	7	81	9
THREE	8	80	10
FOUR	6	83	24

Table 1. Characteristics of the case study databases

4.2. Data collection

We needed the schema database (which allowed us to calculate the metrics values). However for confidential reasons, instead of giving us the schemas, they gave us the calculated metric values. Furthermore, we asked the designers about different aspects of the development process, all of them related to the different factors of maintainability.

4.3. Data analysis and results

For the correlation test we used Spearman's non-parametric correlation to identify potential relationships between the information given by the designers and the measures defined. The results are shown in table 2.

		NT	NA	NFK
Spearman	Analysability	0.775	0.775	0.775
	Changeability	0.775	-0.258	-0.258
	Stability	-0.949	-0.316	-0.316
	Testability	0.775	0.775	0.775

Table 2. Spearman's correlation coefficients

Analyzability. Based on the results obtained, we can conclude that analyzability is closely related to the three metrics. That means that the greater the metric values are, the more analyzable the schema is.

Changeability. In this case, there is no relation between changeability and the metrics NA and NFK. However, the more tables the schema has, the more changeable it is.

Stability. From the results obtained, stability is related only to the number of tables, and it is an inverse relationship. This means that the fewer tables there are, the more stable the schema is.

Testability. Testeability is closely related to the three metrics. That means that the greater the metric values are, the more testable the schema is.

More case studies and experiments must be considered in order to explain the influence of the metrics on the factors and in order to draw stronger conclusions about the metrics and their relation to changeability and stability.

5. Conclusions and future work

It is important that databases, are evaluated for each relevant quality characteristic, using validated or widely accepted metrics. These metrics could help designers, choosing between alternative semantically equivalent schemata and understand the contribution of the databases to the overall IS maintainability.

We have put forward three simple measures (for internal attributes) in order to measure the maintainability (an external attribute) of relational databases and to control its quality.

As the controlled experiments present problems, it is convenient to run case studies. In this paper we have presented the case study developed with the presented metrics. We wanted to prove that our metrics are good mechanisms for controlling the maintainability of a relational database schema. Therefore, we have studied the relation between the metrics and the maintainability factors described by the ISO9126 ([6]). As a result of this study we have demonstrated that the three metrics seem to be related with analyzability and testability and changeability and stability are only related to the number of tables. However, we are aware that this study alone is not enough, but, more experiments and case studies are needed to confirm the obtained results.

Acknowledgements

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We want to thank CIEMAT for its collaboration in the development of this case study.

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