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Volume Editors

Antoni Olivé
Universitat Politecnica de Catalunya, Campus Nord, C5-D207
Jordi Girona 1-3, 08034 Barcelona, Spain
E-mail: olive@lsi.upc.es

Masatoshi Yoshikawa
Nagoya University, Information Technology Center
Furo-cho, Chikusa-ku, Nagoya 464-8601, Japan
E-mail: yosikawa@itc.nagoya-u.ac.jp

Eric S.K. Yu
University of Toronto, Faculty of Information Studies
140 St. George St., Toronto M5S 3G6, Canada
E-mail: yu@fis.utoronto.ca

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Preface

The objective of the workshops held in conjunction with ER 2002, the 21st International Conference on Conceptual Modeling, was to give participants the opportunity to present and discuss emerging hot topics, thus adding new perspectives to conceptual modeling. To meet this objective, we selected the following four workshops:

- 2nd International Workshop on Evolution and Change in Data Management (ECDM 2002)
- ER/IFIP8.1 Workshop on Conceptual Modelling Approaches to Mobile Information Systems Development (MobIMod 2002)
- International Workshop on Conceptual Modeling Quality (IWCMQ 2002)
- 3rd International Joint Workshop on Conceptual Modeling Approaches for E-business: a Web Service Perspective (eCOMO 2002)

ER 2002 was organized so that there would be no overlap between the conference sessions and the workshops. This proceedings contains workshop papers that were revised by the authors following discussions during the conference. We are deeply indebted to the members of the organizing committees and program committees of these workshops for their hard work.

July 2003 Antoni Olivé, Masatoshi Yoshikawa, and Eric S.K. Yu
Workshop Co-chairs
ER 2002

ECDM 2002

Change is a fundamental but sometimes neglected aspect of information and database systems. The management of evolution and change and the ability of database, information and knowledge-based systems to deal with change is an essential component in developing and maintaining truly useful systems. Many approaches to handling evolution and change have been proposed in various areas of data management, and this forum seeks to bring together researchers and practitioners from both more established areas and from emerging areas to look at this issue. The second ECDM workshop (the first ECDM workshop was held with ER 1999 in Paris and its report can be found in SIGMOD Record 29(1):21–25, March 2000) dealt with the manner in which change can be handled, and the semantics of evolving data and data structure in computer-based systems. The workshop topics included:

- Semantics of Change in Time and Space
- Modelling and Management of Time-Varying Data, Temporal Databases
- Handling Changes and Versioning of Semi-structured Data
- Handling Changes of Metadata, Schema Evolution and Versioning

- Change Detection, Monitoring and Mining
- Evolution and Change in Internet-Based Information Systems
- Evolution and Change in E-services and E-world Systems
- Induction of Cause and Effect, Logics for Evolution
- Maintenance of Views, Summaries, Dictionaries and Warehouses
- Managing Evolution of Sources in Information Integration

With respect to the main ER conference, the ECDM workshop aims at stressing the evolutionary aspects involved in conceptual modelling and in the development and implementation of systems, ranging from the modelling of information dynamics to the dynamics of the modelling process itself. Another explicit aim of ECDM 2002 (as it was also for ECDM 1999) was to bring together scientists and pratictioners interested in evolution and change aspects in different research fields and, thus, people who often belong to completely separate communities. It is our opinion that such interactions can be tighter and cross-fertilization can be more useful in the context of a collaborative workshop like ECDM than in the context of the main conference sessions. Moreover, since the emphasis is on the evolutionary dimension, a special insight is sought upon this specific aspect, one that could hardly find an appropriately broad coverage in the scope of the main ER conference.

Following the acceptance of the workshop proposal by the ER 2002 organizing committee, an international and highly qualified program committee was assembled from research centers worldwide. As a result of the call for papers, the program committee received 19 submissions from 15 countries, and after rigorous refereeing 10 high-quality papers were eventually chosen for presentation at the workshop, and these appear in these proceedings.

We would like to thank both the program committee members and the additional external referees for their timely expertise in reviewing the papers. We would also like to thank all authors for submitting their papers to this workshop. Last, but not least, we would like to thank the ER 2002 organizers for their support, and in particular the workshop co-chairs, Antoni Olivé, Eric Yu, and Masatoshi Yoshikawa.

September 2002

Fabio Grandi and John Roddick
Program Co-chairs
ECDM 2002
http://kdm.first.flinders.edu.au/events/ECDM02.html

MobIMod 2002

Mobility is perhaps the most important market and technological trend in information and communication technology. With the advent of new mobile infrastructures providing higher bandwidths and constant connections to the network from virtually everywhere, the way people use information resources is predicted to be radically transformed. The rapid developments in information technology (IT) are substantially changing the landscape of organizational computing. Workers in many business areas are becoming increasingly mobile. Workers in more and more areas will be required to act more flexibly within the constraints of the business processes they are currently engaged in. At the same time they will often want to use the same information technology to support their private tasks. During the last few years, a new breed of information system has emerged to address this situation, referred to as m-commerce systems or mobile information systems. The objective of the workshop was to provide a forum for researchers and practitioners interested in modeling methods for mobile information systems to meet, and exchange research ideas and results.

The relevant topics for the workshop included the following aspects of m-commerce and mobile information systems:

- Mobile commerce models and architecture
- Service modeling
- Mobile access to enterprise systems (ERP, CRM, SCM, etc.)
- Enterprise modeling and business process re-engineering
- Workflow modeling
- Meta-modeling and method engineering
- Evaluation of modeling languages and experience
- Modeling of access control to provide security and privacy
- Content personalization and user modeling
- Context modeling
- Requirement modeling
- Information and database modeling
- Component engineering and integration
- Geographical information systems and location-based services
- Cross-platform conceptual interface modeling
- Mobile modeling tools
- Modeling of embedded systems
- (Mobile) Agent modeling and design
- Agile modeling, extreme modeling, and extreme programming

October 2002

John Krogstie
Program Chair
MobIMod 2002

IWCMQ 2002

Conceptual modeling has been recognized as a key task that lays the foundation of all later design and implementation work. The early focus on conceptual modeling may help in building better systems, without unnecessary rework at later stages of the development when changes are more expensive and more difficult to perform. Quality in conceptual modeling has been a topic of research since the early 1990s but recently a stronger emphasis has been given to the assessment, evaluation, and improvement of the models produced in the early phases of the system development life-cycle. The theme of the 1st International Workshop on Conceptual Modeling Quality was methodologies and instruments for the quality assurance of conceptual modeling processes and products. The workshop intended to provide a forum for researchers and practitioners working on approaches, frameworks, methods, techniques, guidelines, and tools for measuring, predicting, evaluating, controlling, and improving the quality of conceptual modeling processes and artifacts.

February 2003

Geert Poels
Workshop Co-chair
IWCMQ 2002

eCOMO 2002

The Internet is changing the way businesses operate. Organizations are increasingly relying on the Web to deliver their goods and services, to find trading partners, and to link their existing legacy applications to other applications. Web services are rapidly becoming the de facto enabling technology of today's e-business systems, and will soon transform the Web as it is now into a new distributed application-to-application computation network. This will be the basis for the future network economy which comes with the need for new and adapted business models, business technologies and, as a consequence, new challenges for the developers and users of e-business systems. They will have to supply and to adopt Web-based services over the complete supply chain as well, in the context of new digital products. In particular, services that allow enterprises to combine or integrate their business processes will have to be developed, respectively their models, with those of the partners when forming a dynamic network or a virtual enterprise.

Web service technology is generally perceived as an ideal candidate to fulfil the requirements of modern networked enterprises because they allow both loose-coupling and dynamic composition at both the enterprise and the business application level. Progress has been made in the area of Web service description and discovery, and there are some important standards emerging. Nevertheless, there is still a list of issues that need to be addressed and researched in connection with conceptual modeling methodologies that are tailored to deal with the specifics of Web-services and their alignment with e-business requirements before Web services becomes the prominent paradigm for distributed computing and electronic business. Industry is delivering new exciting solutions at a fast rate, but most of them lack a firm scientifically validated foundation.

The eCOMO workshop series was started in 2000. It aims to bring together experts from practice and academia who are working from different, but related perspectives on the same research questions, such as from the perspectives of business modeling, enterprise application integration, the semantic Web, business metadata and ontologies, process management, business re-engineering, business models, and business communication languages.

The contributions to eCOMO 2002 that are collected in these proceedings passed a careful review process in which each of the submitted papers was assessed by three experienced reviewers. They deal with modeling aspects of e-business processes, the model-based composition of processes and Web services, specific approaches to managing unstructured e-business information and to extracting relevant data from Web forms, and with the question of designing successful e-business Web applications.

Many persons deserve appreciation and recognition for their contribution to making eCOMO 2002 a success. First of all we have to thank the authors for their valuable contributions. Similarly, we thank the members of the program committee, who spent a lot of time in assessing submitted papers and participating in the iterated discussions on acceptance or rejection. Special appreciation is due to Christian Kop, who organized and co-ordinated the whole preparation process including the composition of these proceedings. We also express our thanks to Jian Yang and Klothilde Pack for the organizational support they provided. Last, but not least, we thank the ER organizers and the ER workshop co-chairs (Antoni Olivé, Masatoshi Yoshikawa, and Eric Yu) for their support in integrating eCOMO 2002 into ER 2002.

February 2003

Willem-Jan van den Heuvel
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Program Co-chairs
eCOMO 2002

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Research in Quality of Conceptual Models

Requirements and Entity Relationship Models

Class Models and Architectures

Web and Interactive Models

Third International Joint Workshop on Conceptual Modeling Approaches for E-business: A Web Service Perspective (eCOMO 2002)

Process, Models, and Web Services

Change Management for a Temporal Versioned Object-Oriented Database*

Renata de Matos Galante, Nina Edelweiss, and Clesio Saraiva dos Santos

Instituto de Informática - Universidade Federal do Rio Grande do Sul
{galante,nina,clesio}@inf.ufrgs.br

Abstract. In this paper, we propose a schema versioning mechanism to manage the schema evolution in temporal object-oriented databases. The schema evolution management uses an object-oriented data model that supports temporal features and versions definition - the Temporal Versions Model - TVM. One interesting feature of our proposal is that TVM is used to control not only the schema versioning, but also the storage of extensional database and propagation of the changes performed on the objects. The extensional data level supports integration with the existing database, allowing the maintenance of conventional and temporal versioned objects. The instance propagation approach is proposed through the specification of propagation and conversion functions. These functions assure the correct instance propagation and allow the user to handle all instances consistently in both backward and forward schema versions. Finally, the initial requirements concerning data management in the temporal versioning environment, during schema evolution, are presented.

1 Introduction

Object-oriented databases offer powerful modeling concepts as those required by advanced application domains as CAD and Case tools. Typical applications handle large and complex structured objects, which frequently change their value and structure. As the structure is described in the database schema, support to schema evolution is a highly required feature. In this context, the version concept has been applied to maintain all the history of the database evolution.

Schema evolution and schema versioning are two techniques that allow schema modifications while consistency is maintained between a schema and its data. According to accepted terminology [1], a database supports schema evolution if it allows schema changes without losing extentional data. In addition, the schema versioning support allows not only the maintenance of data, but also the access to all data through schema versions.

However, the representation of the temporal dimension is essential to keep the whole evolution history. This feature is necessary in many computer applications, as medical control, geographical information systems and flight reservation. Schema versioning with temporal features has been studied extensively

* This work has been partially supported by Capes and CNPq.

A. Olivé et al. (Eds.): ER 2002 Ws, LNCS 2784, pp. 1–12, 2003.

- How can we *measure* the quality of conceptual models? Quantitative vs qualitative evaluation of quality, metrics vs expert judgement, "hard" vs "soft" information.
- How can we *validate* quality frameworks? What are the desirable characteristics of quality frameworks (dependent variables)? Theoretical vs empirical approaches, field vs laboratory research, quantitative vs qualitative approaches to validating quality frameworks.
- *Product vs process* quality: According to the Total Quality Management (TQM) literature, the most effective way to improve the quality of a product is to improve the process by which it is developed. However so far, conceptual modelling quality research has focused almost exclusively on product quality.
- *Adoption in practice*: Regardless of the potential benefits of quality frameworks proposed, unless they are actually applied in practice, they will have no impact on the practice of conceptual modelling. Thus, if research in this field is to become more than just an academic exercise, researchers need to urgently address the issue of practitioner acceptance of quality frameworks.

Finally, this presentation will describe some initial efforts towards developing an international standard for conceptual model quality, and in particular, how to achieve consensus among researchers and practitioners on the quality characteristics of conceptual models. Up until now, most of the research on conceptual model quality has been undertaken in relative isolation of practice.

Quality in Conceptual Modeling – New Research Directions

Geert Poels[1], Jim Nelson[2], Marcela Genero[3], and Mario Piattini[3]

[1] Department of Management Information, Operations Management and Technology Policy, Ghent University
Hoveniersberg 24, 9000 Gent, Belgium
Geert.Poels@rug.ac.be

[2] Department of Accounting and MIS, Fisher College of Business
The Ohio State University
2100 Neil Avenue, Columbus, Ohio, USA
nelson_j@cob.osu.edu

[3] Department of Computer Science, University of Castilla-La Mancha
Paseo de la Universidad, 4, 13071, Ciudad Real, Spain
{mgenero,mpiattini}@inf-cr.uclm.es

Abstract. Quality is currently one of the main research topics in conceptual modeling. In this paper nine new research contributions are organized using a classification framework that is based on the well-known framework for conceptual modeling quality of Lindland, Sindre, and Sølvberg. The aim of this work is to identify new directions in conceptual modeling quality research.

1 Introduction

Quality has been identified as one of the main topics in current conceptual modeling research [6]. In this paper we classify nine new research contributions, accepted for the first International Workshop on Conceptual Modeling Quality[1], using the framework of conceptual modeling quality that was proposed by Lindland, Sindre, and Sølvberg [4] in the mid-nineties. Although since its proposal, the Lindland et al. framework has been repeatedly extended and several alternative frameworks have been developed, its role as inaugural work in this field of research is undisputed. The comprehensive nature of the framework allows us to link, compare and differentiate the workshop contributions in order to identify related work and current areas of interest and to sketch a (necessarily incomplete) state-of-the-art in conceptual modeling quality.

We hope that this paper will help to better evaluate the different contributions in order to assess their scope and value. We also hope that this exercise will help to

[1] The first International Workshop on Conceptual Modeling Quality (IWCMQ'02) was held in conjunction with the 21st International Conference on Conceptual Modeling (ER'02) in Tampere, Finland, on October 11, 2002.

A. Olivé (Eds.): ER 2003 Ws, LNCS 2784, pp. 243-250, 2003.

discern uncovered areas, remaining research questions, and future opportunities for research in conceptual modeling quality.

The rest of this paper is structured as follows. In section 2 the basic ideas underlying the Lindland et al. framework and some of its extensions are presented. We further discuss how the framework can be used to classify and structure the nine workshop papers. The actual classification and comparison of the workshop contributions is presented in section 3. Finally, in section 4 we summarize our work by distilling the new research directions in conceptual modeling quality as observed in the workshop contributions.

2 A Classification Framework

High quality conceptual models are critical to the success of system development efforts. Despite this importance, quantitative methods for evaluating conceptual model quality are virtually nonexistent. Even definitions of quality (when they are given) are vague and complicated, and there is no underlying structure that helps the user to understand how the properties relate to one another. Lindland, Sindre, and Sølvberg [4] addressed this problem with a systematic examination of the nature of quality in conceptual models.

The original framework consisted of three types of model quality: syntactic, semantic, and pragmatic quality. Syntactic quality describes how well the model follows the rules of the modeling language. Semantic quality describes how well the model captures the domain of interest within the context of the user. Pragmatic quality captures how well a conceptual model is understood by its audience. Within each of these types of quality are two main quality concepts: completeness and validity. A model is complete if it contains all of the elements of the domain. It is valid if it does not contain any elements that are not in the domain.

This framework was extended by Nelson, Monarchi, and Nelson [5] to include two types of quality that cover the earliest stages of modeling and one type that gives an overall assessment of model quality. Perceptual quality measures how well the actors within the domain of interest understand that domain. Descriptive quality measures the ability of the modeler to elicit a description of that domain. Finally, inferential quality measures how well the conceptual model as understood by the audience matches the original domain.

These six types of quality form the first dimension for classifying conceptual model quality research. Another useful dimension is the object of the study. Quality research can focus on any (or all) of three modeling objects. The first object is the conceptual model itself, the product of the modeling activity. The second object is the process of creating the model. In general, the quality of the modeling process is directly proportional to the quality of the model produced by the process. If the modeling process is of high quality, then the conceptual model that is produced should also be of high quality. The third object is the modeling facility. The modeling facility includes all of the tools, techniques, and controls that are used to direct the modeling process.

The final conceptual model quality research classification dimension is the research goal. There are five research goals in the classification framework: understanding, measuring, evaluating, assuring, and improving conceptual model quality. Research into understanding quality seeks to define the various dimensions, or measures, of quality. It develops the scales that can be used to determine quality. Measuring quality examines how to apply those dimensions against conceptual models. Research that evaluates quality explores the correlation between the quality measurements and real-world experiences with the model. For example, how various measurements correlate with model understanding, model maintenance, and so on. Quality assurance research examines how to ensure that the process that produces the conceptual model actually does produce a quality model. Finally, the research into improving quality examines how to make conceptual model quality better.

The three classification dimensions that form the framework are summarized in the table below. In the next section, we will use the classification framework to organize the research contributions in the workshop.

Table 1. Quality research classification dimensions

Type of Quality	Object of Study	Research Goal
perceptual quality	product	understanding quality
descriptive quality	modeling process	measuring/assessing quality
syntactic quality	modeling facility	evaluating quality
semantic quality		assuring quality
pragmatic quality		improving quality
inferential quality		

3 Classification of New Research Contributions

In this section we classify the nine papers along the dimensions proposed in the previous section. The section is structured according to an initial grouping that is roughly based on the type of conceptual model considered. The same structure has been used for the workshop agenda. We end this section by summarizing our classification efforts.

3.1 Requirements and Entity Relationship Models

Two of the papers propose techniques to improve the quality of conceptual data models developed using Entity Relationship (ER) modeling. In his paper, Bowers presents and demonstrates an algorithm to detect redundant relationships in ER models. The presence of such relationships may cause automatically generated relational schemas to be un-normalized. In terms of the Lindland et al. framework, this work contributes towards developing a modeling activity (i.e. using an algorithm, implemented in a CASE tool, to detect and subsequently remove redundant relationships) to ascertain the presence of a quality-carrying property (i.e. the absence of redundant relationships) with the goal of improving quality. The type of quality considered is pragmatic quality, in the sense of making the conceptual model easier to use by the techniques that generate relational schemas from ER diagrams. It should be noted that in the Lindland et al. framework, users of conceptual models include technical actors, like for instance CASE tools, which need to 'understand' the model.

In another paper related to ER modeling, Danoch, Shoval, and Balaban present a method, called HERD, to create hierarchical ER diagrams starting from a 'flat' diagram. In their paper, Danoch et al. describe the design and results of an experiment to compare the user comprehension of hierarchical and flat ER diagrams. Like Bowers, the authors propose a means (i.e. the HERD method) to assure a quality-carrying model property (i.e. being hierarchically structured) to improve pragmatic quality. The experiment aims at evaluating the effectiveness of this method.

The paper of Matulevicius and Strasunskas is different from the other workshop contributions in the sense that it does not focus on the quality of a conceptual model as a product, but on the quality of modeling facilities. Their proposal concerns a new quality framework to evaluate the validation and verification capabilities of requirements engineering (RE) tools. The authors show that their evaluation framework covers all quality dimensions in the semiotic framework for conceptual modeling quality by Krogstie, Lindland, and Sindre [3][2]. They further test the framework on a set of commercial RE tools and compare the results of their evaluation with an independent survey of RE tools.

3.2 Class Models and Architectures

The quality of UML class diagrams is the topic of two workshop papers. But apart from the object of study these papers take different positions in our classification framework.

Letelier and Sanchez present a graphical animation environment that is used to animate the behaviour of an object system that is specified in a UML class diagram. They propose animation as a means to help assuring the 'right' product functionality. Through animation differences between stakeholder requirements and the conceptual model can be detected. The type of quality concerned is therefore semantic quality. As a proof of concept the authors apply their animation tool on a simple banking example.

Instead of quality assurance, the goal of the work of Genero, Olivas, Piattini, and Romero is quality prediction. They propose a set of metrics to measure the structural complexity (i.e. a quality-carrying property) of UML class diagrams and conduct a controlled experiment to show a relationship with the maintainability (i.e. a pragmatic quality issue) of the diagrams. By means of a machine learning technique called Fuzzy Prototypical Knowledge Discovery, the authors were able to build a maintainability prediction model based on structural complexity metrics. This work addresses the need for 'quantization' of conceptual modeling quality, as suggested by Lindland et al. [4]. The metrics-based prediction model can be considered as an indirect measurement instrument for UML class diagram maintainability.

The paper of Avgeriou, Retalis, and Skordalakis is different from the other contributions as the object of study is a high-level systems design artifact, rather than a conceptual model. This paper describes the use of a new architectural quality evaluation framework, similar to the quality frameworks for conceptual modeling, to evaluate a proposed software architecture for learning management systems. By applying their framework the authors show that pragmatic quality attributes are built into the architecture.

3.3 Web and Interactive Models

Two of the workshop papers propose instruments to measure and evaluate the quality of conceptual representations of web artifacts. Comai, Matera, and Maurino present a new quality model for conceptual schemas that are specified using the WebML modeling language. This quality model is related to the Lindland et al. framework in the sense that it incorporates different types of quality, including syntactic quality (e.g. syntactic correctness), semantic quality (e.g. semantic correctness) and pragmatic quality (e.g. usability attributes). As a quality model (instead of a purely conceptual framework) the proposal of Comai et al. also addresses the need to decompose quality goals into measurable attributes, as suggested by Lindland et al. in [4]. The authors further present and demonstrate an XSL-based framework, called WebML Quality Analyzer, as a tool to automatically measure and evaluate the quality attributes of WebML conceptual schemas.

Abrahao, Olsina, and Pastor describe the WebFP_QEM methodology for evaluating the quality of operative web sites and applications. This methodology considers both quality aspects related to nonfunctional requirements (i.e. pragmatic quality) and functional requirements (i.e. semantic quality). In their paper, the authors specifically discuss the interplay between conceptual modeling (using the OOWS modeling approach) and measurement (using new structural complexity metrics for object models, agents, navigational maps and navigational context). They demonstrate their ideas using a simple example of adaptive maintenance of an e-commerce web application. The empirical validation of the metrics, as in the previously mentioned paper of Genero et al., is listed as a topic for further work.

In the final paper we discuss here, Krogstie and Jorgensen propose a further extension of the conceptual modeling quality framework of Krogstie et al. [3]. Their new framework is specifically intended to better understand the quality of interactive models, which are a special type of active models.

3.4 Summary

Table 2 summarizes our classification efforts. Each paper is identified by its first author.

[2] This framework is another extension of the Lindland et al. framework. It adds two lower-level, technical quality aspects (i.e. physical quality and empirical quality) and one higher-level, social quality aspect (i.e. social quality) to the syntactic, semantic, and pragmatic quality types.

ssification of new contributions to conceptual modeling quality research

	Type of Quality	[illegible]	[illegible]
	pragmatic	product	improving
	pragmatic	product	improving
s	syntactic semantic pragmatic other	modeling facility	evaluating
	semantic	product	assuring
	pragmatic	product	measuring
	pragmatic	product	evaluating
	syntactic semantic pragmatic	product	measuring, evaluating
	semantic pragmatic	product	measuring, evaluating
	syntactic semantic pragmatic other	product	understanding

›ns

ɪre of the conceptual representations that are the object of study in the ḯ for IWCMQ'02 demonstrates the bridge function fulfilled by eling. As an early stage activity, conceptual modeling plays a crucial , database, and web development. Therefore the success of systems ·ongly depends upon the quality of the conceptual models that are : massive response to the workshop's call for papers[3] is another e huge importance of quality in conceptual modeling products, 'acilities. It also shows that quality issues are nowadays high on the ptual modeling researchers.

: workshop papers cover diverse application domains and focus on types of conceptual models, our classification shows that the main rrent research efforts is product quality. In spite of the need for process guidelines and quality assurance of modeling processes in recognized in the frameworks of Krogstie et al. [3] and Nelson et al. that current research has largely disregarded quality aspects of eling processes and facilities. Given that quality processes result in :, we identify this topic as a major opportunity for future research in eling quality.

:d papers represent less than half of the submitted papers.

Regarding the types of quality considered in the papers, the main focus is on pragmatic quality and, to a lesser extent semantic quality. The concern for pragmatic quality issues is not unrelated to the current interest in the quality of software development artifacts. Syntactic quality issues seem to be well understood and supported by automated tools. The other quality types, added by the Nelson et al. framework, are not addressed, perhaps because they do not lend themselves easily to objective measurement [5].

In section 2, the goals of conceptual modeling quality research were organized into a hierarchical structure. According to our classification, workshop papers are found at each level. Some papers focus on understanding quality by elaborating a conceptual framework or multi-level quality model for specific types of model (or modeling facilities). A subset of these papers go further by using the framework or model as a practical quality assessment and evaluation instrument. Other papers aim at developing objective and automatically computable measurement instruments (i.e. metrics) for quality attributes of conceptual models. In domains were quality seems to be reasonably well understood (e.g. static conceptual models like Entity Relationship diagrams and class diagrams), research aims at techniques to assure and improve model quality. In other domains, like web development, the quality of the conceptual models is a relatively new research topic that needs to be further elaborated.

As another idea for future research we like to stress that, to our knowledge, little work has been done towards measuring, evaluating and assuring the quality of conceptual representations of behavior, activities, processes, etc.. The need for more research on the quality of functional and dynamic models has also been pointed at in the recent software engineering literature (see e.g. [1]).

We end this paper by drawing the attention upon the research method employed in the papers that we discussed. Although some papers include a well-designed experiment or a representative case study, in most papers new research ideas are only illustrated by means of some proof of concept. We believe that to grow into a mature research discipline more scientific validation is needed. Again we refer to recent developments in software engineering research, where there is a remarkable increase in empirical validation efforts of existing or new theories, methods, techniques, and tools. We believe that research in conceptual modeling quality can benefit from the experiences and guidelines of empirical software engineering research (see e.g. [2], [7]). Clearly more quality models and metrics are needed, but also a thorough validation of these models and metrics in a real (or realistic) environment.

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Evaluation Framework of Requirements Engineering Tools for Verification and Validation

Raimundas Matulevičius and Darijus Strašunskas

Dept. of Computer and Information Science, Norwegian Univ. of Science and Technology
Sem Sælands vei 7-9, NO-7491 Trondheim, Norway
{raimunda, dstrasun}@idi.ntnu.no

Abstract. This paper presents an evaluation framework for requirements engineering tools (RETs). We provide a list of qualitative requirements to guide the customer in evaluating the appropriateness and features functionality of RET. Verification and validation (V&V) activities should be an on-going process throughout life cycle of system development. The paper discusses the framework for evaluating the requirements engineering tools capability for V&V. We tested our proposed evaluation framework on eight different commercial requirements engineering tools. Proposed framework guides the participants (developers and end-users) in evaluating the RET features for assessing the accuracy of RE process.

1 Introduction

Requirements engineering (RE) is the branch of software engineering concerned with the real world goals for, functions of, and constraints on software systems. It is also concerned with the relationships of these factors to precise specifications of software behavior and to their evolution over time and across software families [28]. RE includes different activities – like elicitation, specification, negotiation, analysis and other.

Verification and validation (V&V) are the generic name given for checking processes, which ensure that system conforms to its specification and meets the needs of customer. Verification deals with the building the model right, validation – building the right model. As no model is absolutely accurate, the purpose for V&V is to ensure that conceptual model is sufficiently accurate. To ensure validity of the conceptual model, V&V should be performed in a RE stage as well as in all system engineering phases.

We are interesting in how requirements engineering tools (RETs) ensure the process and product quality and how they support V&V of information between project stakeholders during RE activities. V&V is difficult to make automatically, but semi-automatic V&V is desirable feature of RET, as an automatic validation of the further phases.

There are several attempts to evaluate and classify the RET [10, 13, 26]. Some of them are evaluations of few tools at a certain time [13, 26]; some [10] are being up-

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