APPLIED COMPUTING 2006

PROCEEDINGS OF THE 2006 ACM SYMPOSIUM ON APPLIED COMPUTING

Volume 1 of 2

Dijon, France
April 23-27, 2006

Organizing Committee

Hisham M. Haddad
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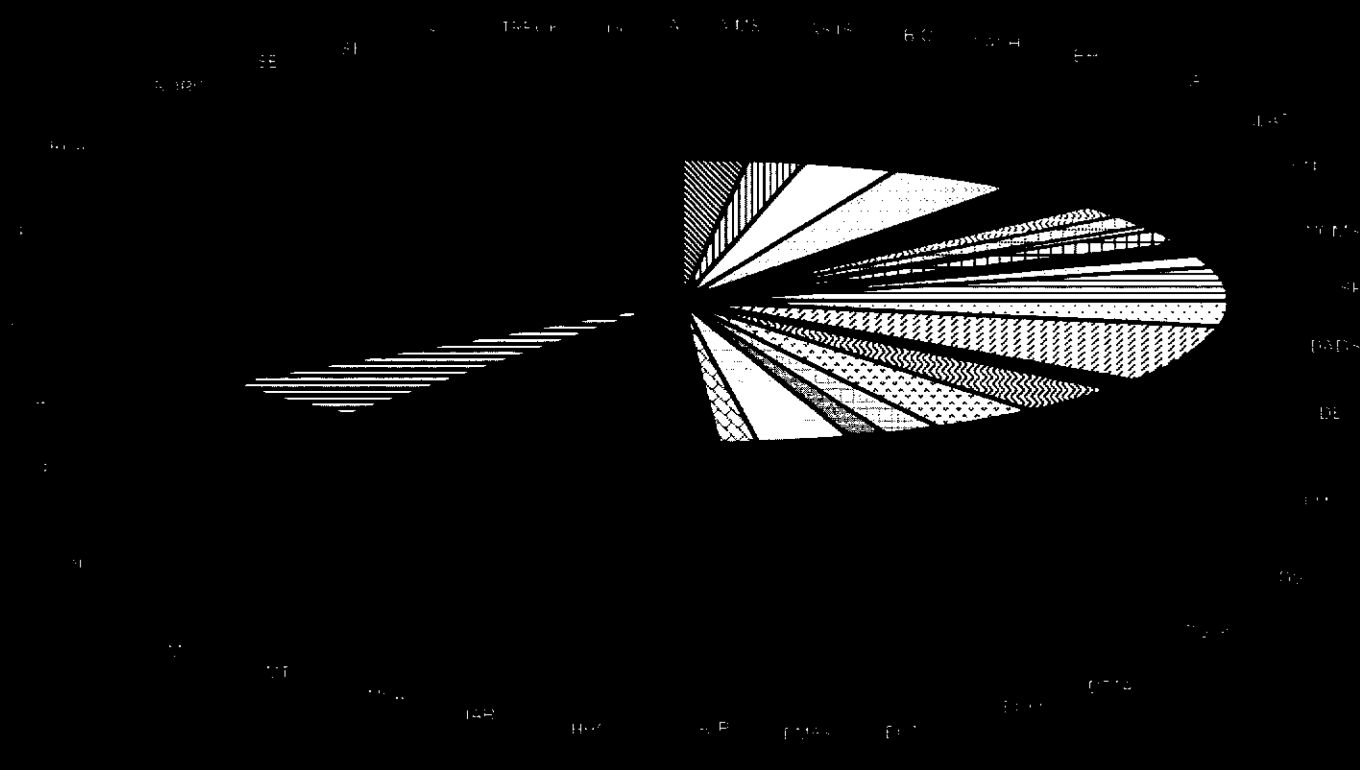

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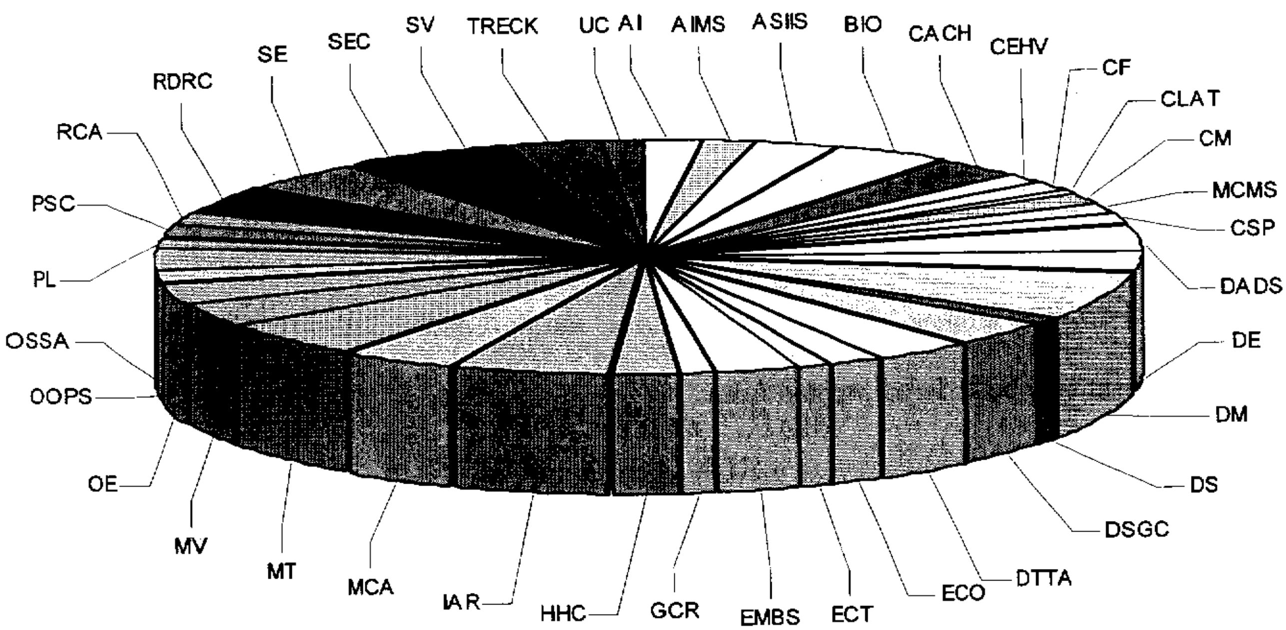

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The ACM Special Interest Group on Applied Computing is ACM's primary applications-oriented SIG. Its mission is to further the interests of the computing professionals engaged in the development of new computing applications and applications areas and the transfer of computing technology to new problem domains. SIGAPP offers practitioners and researchers the opportunity to share mutual interests in innovative application fields, technology transfer, experimental computing, strategic research, and the management of computing. SIGAPP also promotes widespread cooperation among business, government, and academic computing activities. Its annual Symposium on Applied Computing (SAC) provides an international forum for presentation of the results of strategic research and experimentation for this inter-disciplinary environment. SIGAPP membership fees are: $30.00 for ACM Non-members, $15.00 for ACM Professional Members, and $8.00 for ACM Student Members. For further information on SIGAPP, please contact Barrett Bryant at bryant@cis.uab.edu or visit the SIGAPP website at http://www.acm.org/sigapp.

Local Support

Local support for SAC 2006 is provided by Bourgogne University, City of Dijon, and CROUS de Dijon at Bourgogne University. The conference organizing committee acknowledges and thanks the local supporters for their generous contributions to SAC 2006. Their support has been essential to the success of Symposium and is greatly appreciated.

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Message from the Symposium Chair

On behalf of the Organization Committee, it is my pleasure to welcome you to the 21st Annual ACM Symposium on Applied Computing (SAC 2006). This year, the conference is hosted by Bourgogne University, in the city of Dijon, France. Thank you for your participation in this international event dedicated to computer scientists, engineers, and practitioners seeking innovative ideas in various areas of computational applications.

The sponsoring SIG of this Symposium, the ACM Special Interest Group on Applied Computing, is dedicated to further the interests of computing professionals engaged in the design and development of new computing applications, interdisciplinary applications areas, and applied research. The conference provides a forum for discussion and exchange of new ideas addressing computational algorithms and complex applications. This goal is reflected in its wide spectrum of application areas and tutorials designed to provide variety of discussion topics during this event.

The Symposium depends on the organization of technical tracks. As in past successful meetings, talented and dedicated Track Chairs and Co-Chairs who are committed to the success of the conference have organized SAC 2006 tracks. Each track maintains a program committee and group of highly qualified reviewers. Many thanks to Track Chairs, Co-Chairs, and participating reviewers for their commitment to making SAC 2006 another high quality conference. We thank our invited keynote speakers for sharing their knowledge with SAC attendees. Most of all, special thanks to the authors and presenters for sharing their experience with the rest of us and to all attendees for joining us this year in Dijon.

The local organizing committee has always been a central contributor to the success of the symposium. This year, we thank our local team from Bourgogne University. In particular, we thank Richard Chbeir for his role as the conference Vice-Chair, Kokou Yetongnon for organizing the Tutorials Program, and Christophe Nicolle for chairing the local organization effort. We also thank the City of Dijon and Bourgogne University for hosting the conference and for their generous contributions and support. Other committee members I would like to thank are Lorie Liebrock for her tremendous effort putting together the conference proceedings, Mathew Palakal for coordinating another successful Posters Program, and Roger Wainwright and Sascha Ossowski for bringing together the Technical Program. All aspects of the Symposium have been guided by the dedication, enthusiasm, and foresight of these professionals. Many thanks to all of them for the countless hours of volunteer work they spent to bring us together another successful SAC meeting.

Again, we welcome you to SAC 2006 and the beautiful city of Dijon. We hope you enjoy your stay in Dijon and leave this event enriched with new ideas and friends. Next year, we invite you to participate in SAC 2007 to be hosted by Seoul National University and Suwon University in Seoul, Korea.

Hisham M. Haddad,
SAC 2006 Chair, Treasurer, and Webmaster

Message from the Program Chairs

***Roger L. Wainwright**, University of Tulsa*
***Sascha Ossowski**, University Rey Juan Carlos*

Welcome to the 21st Symposium on Applied Computing (SAC 2006). Over the past 20 years, SAC has been an international forum for researchers and practitioners to present their findings and research results in the areas of computer applications and technology. The SAC 2006 Technical Program offers a wide range of tracks covering major areas of computer applications. Highly qualified referees with strong expertise and special interest in their respective research areas carefully reviewed the submitted papers. As part of the Technical Program, this year the Tutorial Program offers several half-day tutorials that were carefully selected from numerous proposals. Many thanks to Kokou Yetongnon from the University of Bourgogne for chairing the Tutorial Program. Also, this is the third year for SAC to incorporate poster papers into the Technical Program. Many thanks to Mathew Palakal from Indiana University Purdue University for chairing the poster sessions.

SAC 2006 would not be possible without contributions from members of the scientific community. As anyone can imagine, many people have dedicated tremendous time and effort over the period of 10 months to bring you an excellent program. The success of SAC 2006 relies on the effort and hard work of many volunteers. On behalf of the SAC 2006 Organizing Committee, we would like to take this opportunity to thank all of those who made this year's technical program a reality, including speakers, referees, track chairs, session chairs, presenters, and attendees. We also thank the local arrangement committee lead by Christophe Nicolle from the University of Bourgogne. We also want to thank Hisham Haddad from Kennesaw State University for his excellent job again as the SAC Treasurer, Webmaster, and Registrar.

SAC's open call for Track Proposals resulted in the submission of 41 track proposals. These proposals were carefully evaluated by the conference Executive Committee. Some proposals were rejected on the grounds of either not being appropriate for the areas that SAC covers traditionally or being of rather narrow and specialized nature. Some others were merged to form a single track, on the grounds of having substantial overlap with each other. Eventually, 38 tracks were established, which then went on to produce their own call for papers. In response to these calls, 927 papers were submitted, from which 300 papers were strongly recommended by the referees for acceptance and inclusion in the Conference Proceedings. This gives SAC 2006 an acceptance rate of 32% across all tracks. Furthermore, it makes SAC 2006 the most successful conference in the history of SAC so far. SAC is also one of the most popular and competitive conferences in the international field of applied computing.

We hope you will enjoy the meeting and have the opportunity to exchange your ideas and make new friends. We also hope you will enjoy your stay in Dijon, France and take pleasure from the many entertainments and activities that the city and France has to offer. We look forward to your active participation in SAC 2006, and encourage you and your colleagues to submit your research findings to next year's technical program. Thank you for being part of SAC 2006, and we hope to see you in Seoul, Korea for SAC 2007.

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ABSTRACT
This work presents a set of measures to evaluate the structural complexity of business process models at a conceptual level, and also the general plan of a family of experiments whose aim is to validate the measures proposed. We believe that the early evaluation of business process models would provide business process management with support which would make their maintenance tasks easier. This proposal is based on the standard notation for business process modelling BPMN and on the adoption and extension of the FMESP framework.

Keywords
Business Process, Conceptual Model, Measurement, BPMN.

1. INTRODUCTION
One of the main activities carried out in the early stages of business process management projects is the design of business processes which are closely related to business process modelling [5], where the core concept is the process itself.

Business processes constitute the means through which organizations seek to achieve their main objective of producing goods or services to satisfy the clients' demands [4]. However, the environment of a competitive market in a state of constant change has increased organizations' needs to analyse, measure and improve their business processes.

We believe that with a suitable analysis and evaluation of business processes at the modelling stage it would be possible to make maintenance tasks easier and at the same time give support to business process management. In order to do this, we have concentrated upon the conceptual level of evaluating and measuring business processes, because nowadays the investigations have been focused principally upon the evaluation of business process models from the point of view of their performance and the results obtained, including aspects such as time and costs of the process.

2. MEASURES FOR CONCEPTUAL BUSINESS PROCESS MODELS
Our interest resides in the business processes evaluation by starting from the model which represents them at a conceptual level, and in order to do this we have used BPMN (Business Process Modeling Notation) [1], the most recent specific standard notation for business process modelling, that provides a graphic notation to perform business processes through a Business Process Diagram.

Our work is also based on the proposal FMESP (Framework for the Modeling and Evaluation of Software Processes) [3] in which a set of measures to evaluate software process models at two levels is defined: i) model scope to evaluate the overall structural complexity of the model; ii) and core elements scope, to evaluate the concrete complexity of fundamentals elements such as *activities, roles* or *work products*. The objective in FMESP was determine a set of indicators which would be useful in the maintenance of software process models through the evaluation of their structural complexity.

In order to achieve our objective we have taken the idea of FMESP and adapted and extended it to business process models (BPMs) represented with BPMN. Likewise, we have defined a set of measures that have been placed in two categories: base measures and derived measures.

The base measures consist principally of counting the business process model's significant elements and a total of 43 base measures have been defined according to the main elements of BPMN metamodel. These are distributed, in accordance with the four categories of elements, in the following way: 37 base measures correspond with the *Flow Objects* category, 2 with the *Connecting Objects* category, 2 with the *Swimlanes* category and 2 with the *Artefacts* category. The first 37 base measures which correspond with the *Flow Objects* category, are grouped according to the common elements to which they correspond. In this way, 23 measures have been defined for the Event element, 9 for the Activity element and 5 for the Gateways element.

With the base measures, it is possible to discover how many significant elements there are in the business process diagram. Nevertheless, starting from the base measures a set of 14 derived measures has been defined which allows us to see the proportions that exist between the different elements of the model. With all measures defined, it is possible to evaluate the structural complexity of business process models developed with BPMN. In this way, when we structurally analyse the model, it is also possible for us to evaluate its quality.

3. EXPERIMENTAL PLAN

In order to obtain reliable results and to discover whether the measures proposed for the evaluation of business process models are useful in real cases, it is necessary to carry out an experimental validation. To this effect, and basing our proposal on the work presented in [2], we have planned a set of experiments with the aim of evaluating the quality aspects of conceptual business process models expressed with BPMN.

3.1 Participants

The subjects should have some knowledge of software modeling (UML, databases, etc.) and ideally they should also be familiarized with business process modeling. An introductory lecture about BPM modeling and the BPMN metamodel will be given and a training session will be developed in order to provide the subjects with the necessary knowledge to carry out the tasks required in the experiment. However, the subjects will not be aware of what aspects we intend to study.

3.2 Material

The material prepared consists of ten BPMs represented with BPMN, which have different characteristics and structural dimensions, and therefore different degrees of complexity. Moreover, two questionnaires were formulated for each of the models, and are structured in the following way:

- In the first questionnaire (group X) there are questions relating to the model's understandability, which is to say the semantic aspect of the process's graphic representation with relation to the model's intrinsic meaning.
- In the second questionnaire (group Y) a series of specific modifications to the original model are proposed with the end of evaluating the BPMN notation's influence upon the models' modifiability.

At the end of each questionnaire a question is included asking for a subjective rating of the degree of complexity of the process model presented.

3.3 Experimental Task

Each subject will receive material composed of ten BPMs (five with understandability questions and five with modification requests). Depending on the model (group X or Y) the subjects have to carry out one of the following tasks: to answer "yes" or "no" to five questions about the model or to carry out four modifications consisting of adding and/or deleting tasks, data objects, events, roles or dependences among these elements.

Each type of task (understandability or modifiability) to be developed has to be similar in its complexity. For this reason, the only source of variation in effort to perform tasks of the same type is the complexity of each model. Before starting to perform the tasks required in each model the subjects are required to write down the starting time, and at the end they have to write down the finishing time. Finally they have to subjectively rate their opinion of the overall complexity of the model.

3.4 Dependent Variables, Independent Variables and Hypothesis

The independent variables correspond with the base measures and derived measures proposed and before described. The dependent variables are related to the understandability and modifiability of the BPMs which will be measured according to the time taken for the understandability and modifiability aspects, and also according to the success rate in the questions relating to the understandability tasks, the success rate in the modifications of the tasks and the subjective rating with respect to complexity.

The hypotheses proposed with respect to the objective of our investigation are the following:

Null hypothesis, H_{0u}: There is no significant correlation between the structural complexity metrics and the understandability.
Alternative hypothesis, H_{1u}: There is a significant correlation between the structural complexity metrics and the understandability.
Null hypothesis, H_{0m}: There is no significant correlation between the structural complexity metrics and the modifiability.
Alternative hypothesis, H_{1m}: There is a significant correlation between the structural complexity metrics and the modifiability.

4. CONCLUSIONS

This work presents a refined and adapted framework for the evaluation of conceptual business process models represented with BPMN. The framework is based on FMESP philosophy and includes the definition of base measures and derived measures to evaluate the structural complexity of business process models. Also presents the experimental plan to develop a family of experiments which is being applied to an integrated population by experts in business analysis and software engineering, with the intention of validating the proposed metrics as well as evaluating quality aspects of the business process models at a conceptual level.

We consider that at model level, the measures may be useful when selecting models which prove easier to maintain than other alternatives. In this way, support is given to business process management through the evaluation in their definition stage and modeling of the process. If we take into account the best maintained models, the benefits obtained may be: the guaranteed understanding, spreading and evolution of processes without affecting their correct execution, as well as a reduction in the effort necessary to change the models with a consequent reduction in future maintenance.

5. ACKNOWLEDGMENTS

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