CONFIOUS*: Managing the Electronic Submission and Reviewing Process of Scientific Conferences

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Abstract. Most scientific communities have recently established policies and mechanisms to put into practice electronic conference management, mainly by exploiting the Internet as the communication and cooperation infrastructure. Their foremost objective is to reduce the operational and communication costs but to maintain high quality reviewing and the fairness of the evaluation process. Interestingly, we report on experience gained by an implemented system named Confious. Confious [8] is a state-of-the-art management system that combines modern design, sophisticated algorithms and a powerful engine to help the program committee (PC) Chair to effortlessly accomplish a number of complicated tasks and carry out the necessary activities to produce the proceedings of a scientific conference. We are principally interested in (a) describing the workflow dynamics of a real-world scientific process, (b) identifying the main concerns of the person in charge of the conference organization, (c) providing mechanisms that enable the efficient management and monitoring of the overall coordination process.

1 Introduction

In the last few years, the need of systems for collaboration support has expanded, leading to their growing application in organizational, communication, and cooperation processes. At the same time, the World-Wide Web (WWW), by now the most popular service over the Internet, evolves rapidly, from a simple, read-only data sharing system, as it was a few years ago, to a universal, distributed platform for information exchange. Furthermore, the WWW has recently been perceived as an attractive base suitable to support extensive online cooperative work. Therefore, an interest arises for researchers to study technical, business and social impacts of collaboration systems and for engineers to put into practice functional implementations of sophisticated services that operate worldwide and employ

* Confious comes up as the combination of the words *Conference and Nous*, where *Nous* is the Greek word for Mind. Therefore, Confious may be interpreted as the Conference Mind.

distributed data, servers, and end-users [3]. However, usually an integration of the most recent technology with existing organizational practices remains challenging.

In this paper, we attempt to integrate two themes of practice and research: the functional and organizational issues with the algorithmic and implementation aspects of building online collaboration systems. We do so by specifying and implementing a system that exploits the Internet infrastructure as the cooperation medium to support the process of submission and evaluation of scientific documents. More precisely, we identify the activities that typically have to be performed by a number of people widely distributed all over the world in order to submit, select, and prepare the set of papers to be published in the proceedings of a conference [4].

The foremost motivation of our work is based on the observation that most scientific communities and organizations are looking for establishing policies and mechanisms to put into practice electronic conference management [2, 6]. Their main objective is to minimize the organizational efforts but maintain high the quality of accepted papers and the fairness of the selection process. This process commonly involves a number of activities and user roles and presents interesting coordination issues to study. In view of the fact that "coordination is the management of dependencies" [1], the coordination of a conference may well be regarded as the management of the dependencies that arise during the submission and reviewing process. These processes are sufficiently familiar to most scientists, who normally participate to conferences as authors, PC members, or PC chairs.

Interestingly, we report on experience gained by the development of a real-world system named *Confious*. *Confious* [8] is a state-of-the-art management system that combines modern design, sophisticated algorithms and a powerful engine to help a program committee chair to effortlessly accomplish a number of complicated tasks and carry out the necessary activities to produce the proceedings of a scientific conference. In our study we are primarily interested in:

- Describing the workflow dynamics of an essential scientific process
- Identifying the main concerns of the PC chair during the conference
- Providing mechanisms that enable the efficient management of the process

Confious may well be regarded as an example of a general class of services, in which either some from a set of documents need to be picked up according to an evaluation process or in which a composite document has to be produced as the result of a workflow of activities enacted by several people.

2 Dynamics of a Workflow System

Confious is in principle a document management and evaluation system, in which a number of user roles interact to carry out a scientific process by enacting a number of complicated tasks. Usually, these systems are referred to as workflow management systems. In this section, we try to identify the dynamics of a workflow system in Confious by defining *user roles* and *chronological dependencies*.

2.1 User Roles

There are four user roles that interact in Confious, each of which is described below.

- Program Committee Chair (or PC Chair), which is in charge of the enactment, coordination and monitoring of the necessary tasks.
- Senior Program Committee Member (or Meta-Reviewer), which supervises the reviewing process and makes recommendations for the final decision.
- Regular Program Committee Member (or Reviewer), which evaluates the overall quality of a paper that usually falls in his or her area of expertise.
- Contact Person (or Author), which submits documents of recent research.

2.2 Chronological Dependencies

In order to coordinate the overall process we have identified chronological dependencies that may allow or forbid the execution of specific tasks at a particular moment. We do so by defining independent, self-described chronological phases that determine the tasks and actions that are acceptable in particular time fragments. Even if, in general, these phases occur in a chronological order, they may overlap, thus allowing specific tasks to be executed in parallel. Mind that some phases in Confious are optional and may be omitted. The whole process may as well be separated in four meta-periods; *setup*, *submission*, *reviewing* and *publishing* periods. Fig. 1 illustrates the chronological dependencies of these phases in form of a Gantt Graph, where the horizontal axe is a time scale. Phases are better described below.

Setup Phase: The PC Chair provides functional information about the conference.

Invitation Phase: The PC Chair sends invitation letters to reviewers and meta-reviewers asking them whether they are willing to participate in the reviewing phase.

Abstract Submission Phase: Authors register to the system and submit abstracts and other useful information of their contribution.

Bidding Phase: Reviewers are asked to read the submitted abstracts and bid for papers that would prefer to review.

Full Paper Submission Phase: Authors submit a full paper of their contribution.

Assignment Phase: The PC Chair assigns papers to reviewers either automatically or manually taking into account specific constraints.

Reviewing Phase: Reviewers evaluate the quality of the papers assigned to them.

Revision Phase: The PC Chair, meta-reviewers and reviewers participate in a virtual PC meeting in order to decide on the set of papers to be accepted.

Notification Phase: The PC Chair communicates the final decision to authors.

Camera-ready Submission Phase: Authors of accepted papers submit a camera-ready copy of their contribution.

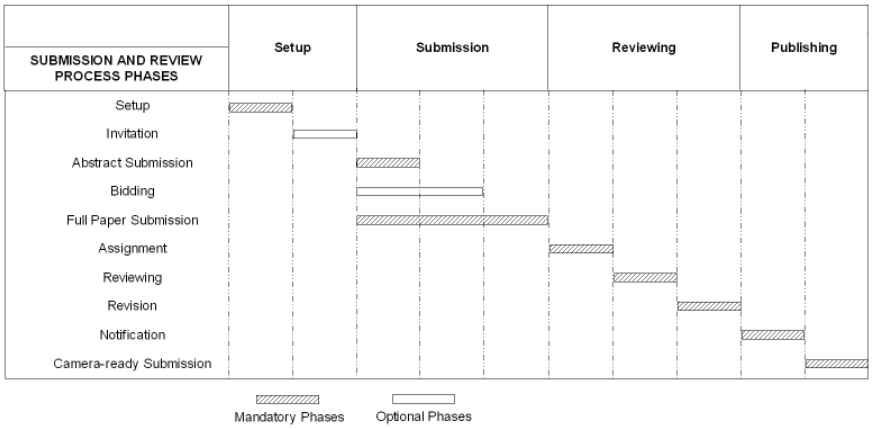

Fig. 1. Chronological dependencies of the phases that are defined in Confious

3. Identifying the PC Chair's Main Concerns

In this section, we try to identify the main concerns of the PC chair during the submission and reviewing process and subsequently to describe specific techniques and design policies we have followed to facilitate their efficient accomplishment. These concerns are methodically discussed in the following paragraphs.

3.1 Efficient Identification of Potential Conflicts of Interest

One of the main concerns of the PC Chair is to identify members of the program committee that may have a conflict of interest in reviewing a specific paper. Such occasions may arise in several ways, the most popular of which are that:

a. Scientists usually submit papers to a conference that they serve as reviewers.

b. PC members are usually associated with authors of submitted papers, either because they are occupied in the same institute or project or because they have co-authored an article in the past.

Even if both cases are officially authorized, they may offend the confidentiality of the review process and seriously affect the conference's overall reputation. In Confious, we have tried to efficiently identify and manage potential conflicts of interests that may exist in the review process between reviewers and papers. Additionally to the intentional definition of conflicts by users, we have designed mechanisms that recommend potential conflicts according to "*same institute appointment*" or "*previous co-authorship appointment*" techniques.

Same Institute Appointment

This technique tries to identify PC members and authors of submitted papers that are occupied in the same institute. Consequently, a potential conflict of interest may arise between a PC member and a submitted paper. The method is based on string comparison of their email accounts. Actually, a gradual string matching algorithm is applied that compares the different parts of the email accounts. The formula may as well consider the level of accuracy to be applied. In this way, the expected conflicts may be narrowed or broadened according to the precision that is required in each conference. For example, in an international conference, it may be of interest to find out conflicts between reviewers and authors that are occupied in the same institute. This information is more often indicated by the same suffix in their email accounts. However, such conflicts may be of less interest in the case of a national conference. The technique is better illustrated in Fig. 2.

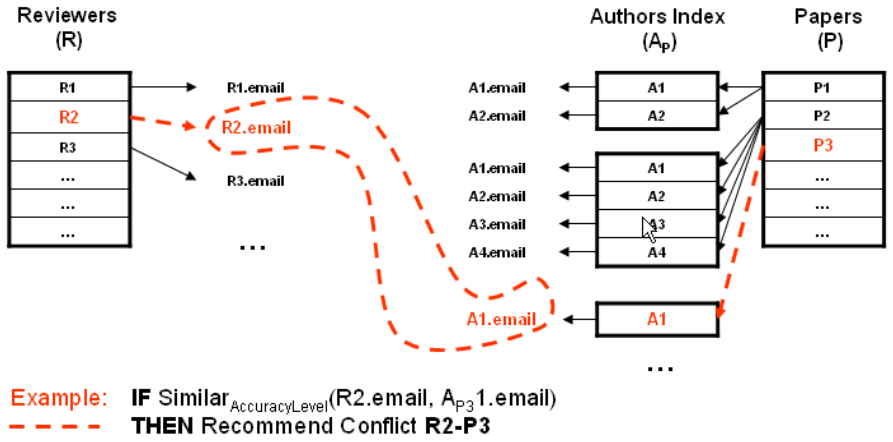

Fig. 2. Recommendations of Conflicts based on "Same Institute Appointment"

Previous Co-authorship Appointment

This technique tries to identify pairs of PC members and authors of submitted papers that have co-authored one or more papers in the past. Consequently, a potential conflict may arise between a PC member and a submitted paper. The dataset employed for this identification purpose comes from a co-authorship index, as it has been compiled by DBLP Library [7]. Actually, for each conference only a small part of the DBLP co-authorship index is required. Subsequently, we scan the set of paper authors and the set of reviewers' co-authors to identify matches that define potential conflicts. Matches are based on string comparison of their first and last names. The technique is better illustrated in Fig. 3.

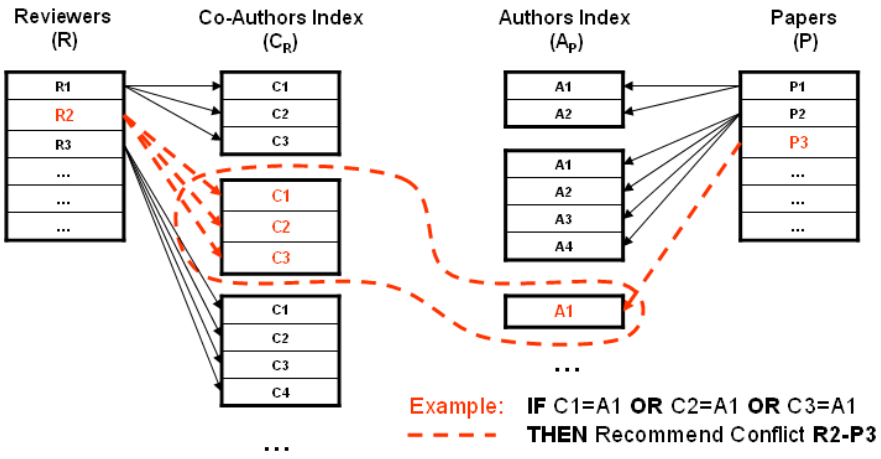

Fig. 3. Recommendations of Conflicts based on "Previous Co-authorship"

3.2 Reliable Assignment of Papers to Reviewers

The peer review process requires that every paper be independently reviewed by a number of reviewers. However, in the last years the number of submissions and the number of reviewers of popular conferences has evidently increased [2]. Considering the diversity of the reviewers' research interests and the range of topics that submitted papers cover is almost impossible to manually assign papers to reviewers. Therefore, one of the most agonizing and critical tasks that a PC Chair needs to carry out is the appropriate assignment of papers to reviewers. Actually, PC members are regularly pleased to review papers that match their interests, so the correct assignment may as well affect the overall quality of the reviews delivered.

In Confious, PC Chair has the option to assign papers either automatically or manually. The most advantageous process includes an automatic assignment by the system followed by manual adjustment of assignments by the PC chair. The automatic assignment algorithm takes into account the following constraints:

- *Matches between paper topics and reviewer interests*: Reviewer interests are matched to paper topics so as to improve the assignment precision.
- *Bids of reviewers to specific papers*: During the bidding phase, reviewers may express their *high*, *neutral* or *low* interest to be assigned specific papers and therefore to favor their chances to review or avoid them.
- *Conflicts of interest between PC members and papers*: Conflicts of interest prohibit the assignment of specific papers to specific reviewers.
- *Workload Balance*: Papers need to be normally distributed between reviewers.

3.3 High Quality of the Reviews Communicated to Authors

In this paragraph, we present two features that are enabled in Confious to make the reviewing process flexible and to help maintain the quality of the reviews high.

Dynamic Review Form Construction
One of the main drawbacks of the majority of electronic software for the management of the reviewing process is that they do not permit a dynamic customization of the review form. As a result, they usually employ static predefined forms. However, this inflexibility may negatively affect the evaluation process. Confious provides the possibility to either construct a new review form or customize a predefined review form. This is one of the most advantageous features of Confious, as it is not supported by almost any other known conference management system.

Hierarchical Reviewing
Organizing committees of acknowledged conferences have recently employed a meta-review process, additional to the regular review process, to ensure that the quality of the reviews communicated to authors is as decent as possible. Meta-reviews are carried out by meta-reviewers, which role is usually twofold:

a. To provide a summary of the regular reviews and the rational behind the acceptance or rejection decision by pointing out comments of reviewers.
b. To monitor the reviewing process, identify problematic reviews, such as incomplete and weakly argued ones, and ask from reviewers to update them.

Therefore, Confious, by enabling a hierarchical reviewing process, helps PC chairs to obtain better control over the quality of the reviews communicated to the authors, by boosting part of their overall responsibility to meta-reviewers. This is certainly beneficial to authors that receive more constructive comments and may also affect the conference's overall reputation.

3.4 Making Correct Decisions Efficiently

One of the most challenging, as well as time-consuming tasks that the PC chair is in charge of is to decide on the sets of papers that are going to be accepted and the set of papers that are going to be rejected. Actually, it is hard to reduce the results of several reviews into a single meaningful score because when papers are ordered numerically, there may often be some high ranked papers that are rejected, and some low ranked papers that end up being accepted [5]. Moreover, the decisions are made even more efficiently if papers with comparable evaluations are grouped together and when conflicted evaluations are identified as early as possible.

In Confious, the papers are first classified in five meaningful classes and then the papers of each class are ordered according to the average score of their several individual overall evaluations. Due to the classification, a much more meaningful ordering occurs that evidently facilitates the decision making.

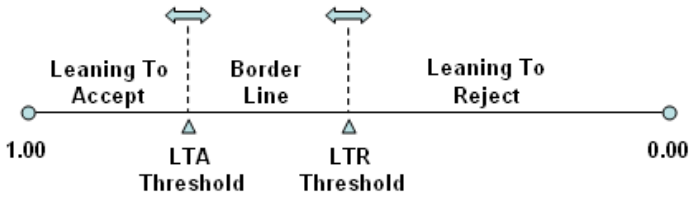

Fig. 4. LTA-threshold and LTR-threshold are employed to classify papers

To define these classes we employ two thresholds; the LTA-threshold and the LTR-threshold, which are better illustrated in Fig. 4. The former defines the lower bound over of which an evaluation is considered positive, while the latter defines the upper bound below of which an evaluation is considered negative. Both thresholds may be adjusted by the PC chair to meet specific requirements. Therefore, the following classes may be defined:

- *Leaning to Accept*: The reviews are either over the LTA-threshold or below the LTA-threshold but over the LTR-threshold, and their normalized average score is over the LTA-threshold, which indicates a "leaning to accept" paper.
- *Border Line*: The reviews are either over the LTA-threshold or below the LTA-threshold but over the LTR-threshold, and their normalized average score is between the LTA-threshold and the LTR-threshold, which indicates a "border line" paper. Some of these papers are going to be accepted.
- *Leaning to Reject*: The reviews are either below the LTR-threshold or over the LTR-threshold but below the LTA-threshold, and their normalized average score is below the LTR-threshold, which indicates a "leaning to reject" paper.
- *Conflicted Reviews*: There is at least one review over the LTA-threshold and at least one review below the LTR-threshold, which indicates that there is probably a conflict in the reviewers' evaluation and therefore further investigation is required.
- Incomplete Reviews: There are missing reviews for this paper.

4 System Overview

Confious is a web information system that is based on the client-server model, where many clients may connect to and interact with the server. On the server side it follows the *3-tier* architecture which distinguishes between *presentation*, *business* and *data* logic layers. Each logic layer has been implemented around a number of self-determining engines so as to smooth the development process and to facilitate its future extension. Each engine is consisted of a number of modules, which are responsible for the execution of specific tasks. Our main objective is to design an as much as possible extensible architecture that may push the complete functionality and

complexity of specific tasks to independent, re-usable, easily invoked, effortlessly developed and efficiently executed components. Fig. 5 illustrates this architecture, while a brief description follows for each of these engines.

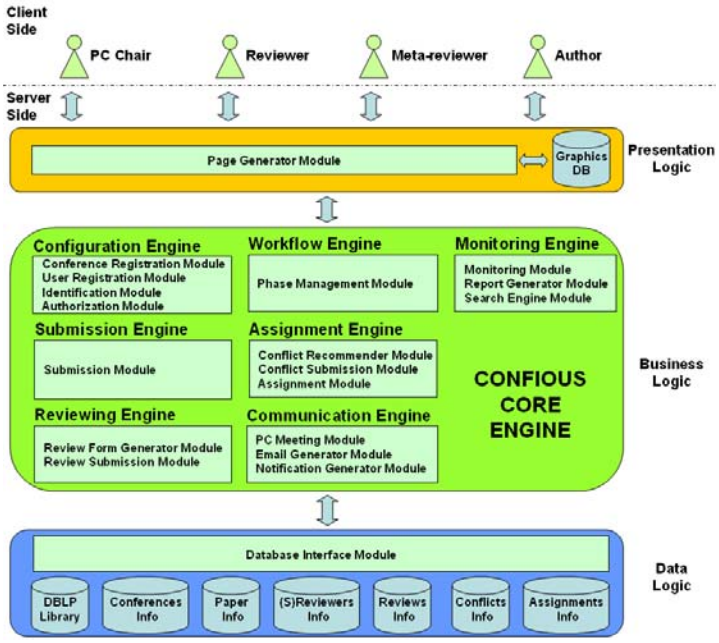

Fig. 5. Modular 3-Tier Architecture of Confious

Configuration Engine: It consists of four modules; one that handles conference details, one that enables user profiling, one for user and conference identification and one for secure login procedure.

Submission Engine: It consists of one module that handles the abstract, full and camera-ready paper submissions. It also encapsulates the functionality of an upload manager to handle the submitted files.

Assignment Engine: It consists of three modules; one that handles the assignment of papers to reviewers, one for defining explicit conflicts and one that handles automatic recommendation of potential conflicts.

Reviewing Engine: It consists of two modules; one that enables the dynamic construction of the review form and one that enables the submission of reviews.

Workflow Engine: It consists of one module that coordinates the multiple dependencies throughout the submission and reviewing process.

Communication Engine: It consists of three modules; one that enables the virtual PC meeting, one that handles the email based communication, and one that enables the customization, compilation and delivery of the notification letters to authors.

Monitoring Engine: It consists of three modules; one that enables monitoring functionality, one that creates printable reports on useful statistics, and one that enables the access of specific papers according to predefined criteria or keywords.

Other Modules: There also exist two self-determining modules; one that is responsible for the compilation and delivery of the dynamic web pages and one that enables the straightforward portability of the system to another DBMS.

5. Conclusions

In order to support scientific committees to efficiently manage the submission and evaluation process of a conference, we have designed and implemented *Confious*, a state-of-the-art conference management system. Confious provides mechanisms for efficient management of scientific data, intelligent identification and analysis of constraints during the reviewing process, enhanced monitoring and better communication. While loosely related to more conventional business workflows, the actual scientific workflow poses a quite different set of challenges due to the special needs for large-scale distributed data collection and evaluation. We tried to specify Confious through dynamics of a workflow management system, to identify the PC Chair's responsibilities and to facilitate their qualitative accomplishment during the coordination process. In order to address portability, reliability and scalability issues, a modular architecture approach has been adopted keeping the functionality independent of the repository used. We are confident that the rational and algorithmic ground on which Confious has been designed and developed will catch the attention of the interested reader and will exert a pull on conference organizers and scientific committees to consider Confious for their future conferences.

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