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Basics of Research Paper Writing and Publishing

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Abstract. Writing and trying to publish research and its findings is an integral part of a researcher’s professional life. However, writing is not in every researcher’s talent pool, and the obstacles of making reviewers accept the own submission are often nerve-wracking. This paper gives an introductory report on basic issues of writing and organizing scientific papers, and preparing them for submission to a publisher. Additionally, the paper outlines the process of publishing research papers in journals and conference proceedings, aiming to provide interested novices with a helpful guide to paper writing and publishing.

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1 Introduction

Researchers must write [1]. Not only must they write to keep records of their work for themselves, but also for the readers and peer researchers who are expecting a standard form, language, and style when reading a research paper. Writing in a scientific style may be hard in the beginning for many research workers, but clear communication and concise research writing have no magic involved, nor is talent required [2]. Before continuing, it is important to line out what is meant with research paper or scientific paper. In [3, p.1], Robert Day defines a scientific paper as "a *written* and *published* report describing *original* research results", while acknowledging the fact that scientific papers also have to meet requirements regarding *how* the paper is written, and the *way* it is published. This means that the process leading to publication is equally important as the content, style, and organization of the published paper. A scientific paper has to be a *valid publication*, which means that it must be published in the right place, e.g., in a peer-reviewed journal in the respective field. When published in the wrong place (e.g., in a newspaper), even an excellent research report is not validly published. The Council of Biology Editors (CBE), a professional organization frequently cited on this topic, has come to the definition that an

"acceptable primary scientific publication must be the first disclosure containing sufficient information to enable peers

1. to assess observations,
2. to repeat experiments, and
3. to evaluate intellectual processes;

moreover, it must be susceptible to sensory perception, essentially permanent, available to the scientific community without restriction, and available for recognized secondary services ..." ([4, p.1-2], as cited in [3, p.2])

These requirements imply that newsletters, conference reports, internal reports, newspapers, and most other text sources do not qualify as scientific papers. To show the process of composing scientific papers, one major part of this paper focuses on primary issues of organizing and writing them.

Once a paper is drafted, written, rewritten, and finished it deserves to be published validly. However, dealing with publishers, their editors, peer reviewer's comments, deadlines, submission guidelines, and other obstacles on the way to the paper appearing in a printed volume can be one of the most time-consuming and exhaustive tasks in a researcher's life. Therefore, the second major part of this paper outlines motivations and ways to publish research papers, primarily to serve novices with a handy introduction to this process.

2 Research Paper Writing

This section deals with general issues of writing scientific research papers, from the intent to write a paper to planning the writing for professional publication. The major part of this section outlines principles of paper organization.

2.1 Intentions for Writing

One may ask why researchers have to write down what they have been doing, or what they are currently working on. Booth et al. [5, p.8-9] deliver three obvious reasons:

- to *remember*, because once something is forgotten, it cannot be reproduced (correctly) without having written notice;
- to *understand*, as writing about a subject can only be accomplished by approaching the subject in a structured way, which itself leads to better understanding thereof;
- to *gain perspective*, as writing includes looking at something from different points of view.

Still, it may be asked why researchers have to turn their writing into formal papers. Writing for others is more demanding than writing for oneself but it helps to better understand the own ideas [5]. As publications have system-maintaining roles in their respective sciences, additional motivations for researchers to write and publish their research work are [6, p.243-6]:

- Scientific communication. O'Connor [1, p.1] points out that this is essential if science is to progress.
- Ideal protection of intellectual property.
- Legal protection of intellectual property.
- Gain of reputation is certainly desirable.
- Thinking in economic measures, "sale to achieve high prices" may be transformed to "publish to achieve many citations" (economic theory of science).

Peat et al. [7, p.2] provide a list of rather pragmatic reasons for writing down and publishing research results. Among them are:

- You have some results that are worth reporting.
- You want to progress scientific thought.
- You want your work to reach a broad audience.
- You will improve your chance of promotion.
- It is unethical to conduct a study and not report the findings.

2.2 Paper Organization

The general structure of a paper comprises three major sections: introduction, body, and discussion. The progression of the thematic scope of a paper within these sections typically follows a general pattern, namely the "*hourglass model*" (Figure 1, cf. [8]): The introduction leads the reader from general motivations and a general subject to a particular research question to be dealt with in the paper. The body of the paper stays within a tight thematic scope, as it describes the research methods and results in detail. Finally, the discussion section tries to draw general conclusions from the particular results. This smoothly aligns with Berry's claim [9, p.99] that a research paper should be circular in argument, i.e.,

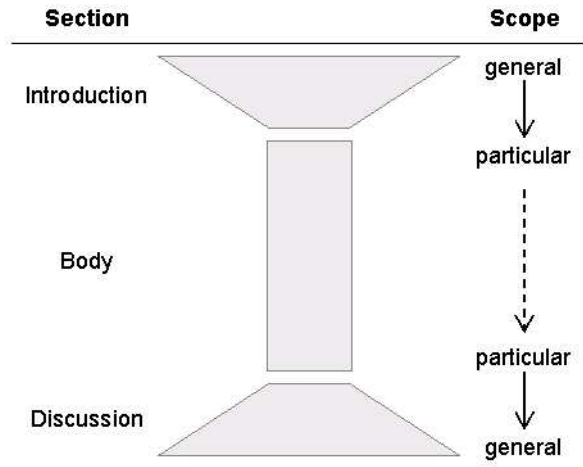


Fig. 1. The *hourglass model* of paper structure.

the conclusion should return to the opening, and examine the original purpose in the light of the research presented.

However, there are additional parts of a paper with equal importance: Title, abstract, and the list references. The following subsections describe all parts of a typical research paper according to their typical sequence.

2.2.1 Title

There is no doubt that the title is the part of a paper read the most, and it is usually read first. Additionally, electronic indexing services rely heavily on the accuracy of the title to allow users to find papers relevant to their queries. Robert Day defines a *good* title "as the fewest possible words that adequately describe the contents of the paper" [3, p.9]. If the title is too long, it usually contains too many *waste words*, e.g., "Investigations on ..." at the beginning of the title. On the other hand, titles which are too short often use words which are too general, e.g., the title "Writing Reports" does not provide any information on which kind of reports the paper focuses on.

Thus, according to [7, p.94], effective titles

- identify the main issue of the paper,
- begin with the subject of the paper,
- are accurate, unambiguous, specific, and complete,
- do not contain abbreviations, and
- attract readers.

2.2.2 Abstract

Basically, an abstract comprises a one-paragraph summary of the whole paper. Abstracts have become increasingly important, as electronic publication

databases are the primary means of finding research reports in a certain subject area today [10]. So everything relevant to potential readers should be in the abstract, everything else not.

According to [3, p.23], there are two general types of abstract:

- An *informative* abstract extracts everything relevant from the paper, such as primary research objectives addressed, methods employed in solving the problems, results obtained, and conclusions drawn. Such abstracts may serve as a substitute for the full paper.
- On the other hand, an *indicative* or *descriptive* abstract rather describes the content of the paper and may thus serve as an outline of what is presented in the paper. This kind of abstract cannot serve as a substitute for the full text.

A checklist listing relevant parts of an abstract is proposed in [10], whereas the author suggests each part to be packed into one sentence:

1. *Motivation*: Why do we care about the problem and the results?
2. *Problem statement*: What problem is the paper trying to solve and what is the scope of the work?
3. *Approach*: What was done to solve the problem?
4. *Results*: What is the answer to the problem?
5. *Conclusions*: What implications does the answer imply?

However, there are some things that should *not* be included in an abstract: Information and conclusions not stated in the paper, references to other literature, the exact title phrase, and illustrative elements such as tables and figures [3]. Helpful tips and comments on preparing and writing abstracts are given on various educational and professional web sites, such as in [10–14], to mention a few.

2.2.3 Introduction

As already sketched above, the introduction section leads the reader from a general subject area to a particular field of research. Three phases of an introduction can be identified [8, p.141]:

1. Establish a territory:
 - a) bring out the importance of the subject *and/or*
 - b) make general statements about the subject *and/or*
 - c) present an overview on current research on the subject.
2. Establish a niche:
 - a) oppose an existing assumption *or*
 - b) reveal a research gap *or*
 - c) formulate a research question or problem *or*
 - d) continue a tradition.
3. Occupy the niche:

- a) sketch the intent of the own work *and/or*
- b) outline important characteristics of the own work;
- c) outline important results;
- d) give a brief outlook on the structure of the paper.

In brief, the introduction should guide the reader to current research in the field and should allow the reader to understand the rest of the paper without referring to previous publications on the topic [3].

2.2.4 Body

The body of a paper reports on the actual research done to answer the research question or problem identified in the introduction. It should be written as if it were an unfolding discussion, each idea at a time [15, p.187]. Normally, the body comprises several subsections, whereas actual structure, organization, and content depends heavily on the type of paper, for example (adapted from [16]):

- In *empirical papers*, the body of the paper describes the material and data used for the study, the methodologies applied to answer the research questions, and the results obtained. It is very important that the study be described in a way that makes it possible for peers to repeat or to reproduce it [3, p.29].
- *Case study papers* describe the application of existing methods, theory or tools. Crucial is the value of the reflections abstracted from the experience and their relevance to other designers or to researchers working on related methods, theory or tools.
- *Methodology papers* describe a novel method which may be intended for use in research or practical settings (or both), but the paper should be clear about the intended audience.
- *Theory papers* describe principles, concepts or models on which work in the field (empirical, experience, methodology) might be based; authors of theoretical papers are expected to position their ideas within a broad context of related frameworks and theories. Important criteria are the originality or soundness of the analysis provided as well as the relevance of the theoretical content to practice and/or research in the field.

Generally, the body of a paper answers two questions, namely *how* was the research question addressed (materials, methods) and *what* was found (results) [2, 3, 7].

2.2.5 Discussion

The discussion and conclusion section is somehow the counterpart of the introduction, when thinking in terms of the hourglass model (cf. Figure 1), as this section leads from the particular results to general conclusions. Generally, this section includes (cf. [3, 8]):

- Presentation of background information as well as recapitulation of the research aims of the present study.
- Brief summary of the results, whereas the focus is on discussing not recapitulating the results.
- Comparison of results with previously published studies.
- Conclusions or hypotheses drawn from the results, with summary of evidence for each conclusion.
- Proposed follow-up research questions.

According to [3, p.38-9], something that is often not adequately dealt with is a discussion about the significance of the results; a good place for doing so is the end of the discussion section.

2.2.6 References

Embedding the own work in related literature is one of the essential parts of research writing. So there will be citations of references in the text, as well as a list of cited references at the end of the paper. Different systems define different formats of citing in text and for listing references. The most commonly used referencing systems are (cf. [3]):

- *Name and Year System*. References are cited by their respective authors and the year of publication, e.g., "Chuck and Norris (2003) define ...". This system is very convenient for authors, as the citation does not have to be changed when adding or removing references from the list. The fact that sentences become hard to read when subsequently citing many references in one single parenthesis this way is one negative aspect for readers.
- *Alphabet-Number System*. This system lists the references in alphabetical order and cites them by their respective number in parentheses or (square) brackets, e.g., "As reported in (4), ...". This system is relatively convenient for readers, as it does not break the flow of words while reading a sentence with many citations. On the other hand, the author has to keep an eye on the references cited in the text as their numbers may change when the reference list is updated.
- *Citation Order System*. This system is similar to the alphabet-number system with one major difference: the reference list is not sorted alphabetically, but in the order of appearance (citation by number) in the text.

Variations of the referencing systems mentioned above are used in most of the common standards, such as in the American Psychological Association (APA) Style [17], Chicago Style [18], Council of Biology Editors (CBE) Style [19], Modern Language Association (MLA) Style [20, 21], and others.

In general, the citation system used depends on the research field (e.g., psychologists mainly use APA style) as well as on the publisher (different publishers may require to use different referencing styles even in the same field). Authors have no other choice than adhering to the style imposed on them by publishers.

2.3 Writing for Publication

It is easier to get a paper accepted for publication if it is written for a specific audience. This is particularly important for doctoral students trying to publish parts of their dissertations. The doctoral thesis has been written to please the supervisor, a scientific paper should be written for the editor and audience of the intended journal (cf. Section 3.2), thus the place of publication has to be selected prior to writing the paper [2, p.74], and chapters extracted from theses have to be reconsidered accordingly. Berry [9, p.105-8] notes that,

- “theses are written for supervisors who have to be convinced that one has really done work. No corners are cut. Space is no object [...] Nothing of this applies to learned journals”.
- The professional public does not need to have everything spelled out, instead it “would like to learn something it did not already know, expressed in succinct prose, the points made in an agile and alert manner”.
- Two of the most important rules are: “target the journal” (i.e., its editor and audience) and “research the market” to get to know available and appropriate journals in the field.
- After having chosen the preferred journal for publication, all efforts should be directed to place the paper in that specific journal. It is helpful to study papers previously published in that journal with respect to paper organization, presentation, and writing style.

According to [1], several steps have to be taken to prepare a research paper for professional publication: First, the researchers have to ask themselves some preliminary questions to make sure that the studies are designed to answer precisely the research question under examination, that the experiments meet accepted standards, and that the process of keeping records of the research work is agreed-upon. Subsequently, the research work has to be assessed constantly in order to be able to decide whether the work is suitable for submission (speaking to colleagues and writing while work is in progress may turn out to be very helpful in this respect). A paper that “records significant experimental, theoretical or observational extensions of knowledge, or advances in the practical application of known principles” is worth publishing [1, p.3]. If it seems feasible to write such a paper it is time to select a place of publication.

Even if the work reported on is considered worth publishing, a major prerequisite for a paper to stand the peer review process (cf. Section 3.1) prior to publication is a clean, concise, and coherent writing style (cf. Section 2.4), as well as thorough organization and elaboration of the statement unfolding in the paper. To achieve this, many revisions may be necessary, as Davis’ [2] proposed plan for paper writing shows (Figure 2).

2.4 Writing Tips

There are many sets of writing tips available from many different authors. Two sets of tips (or rules) covering frequently stated tips may be presented here. Davis [2, p.20] gives the following set of rules for technical and scientific writing:

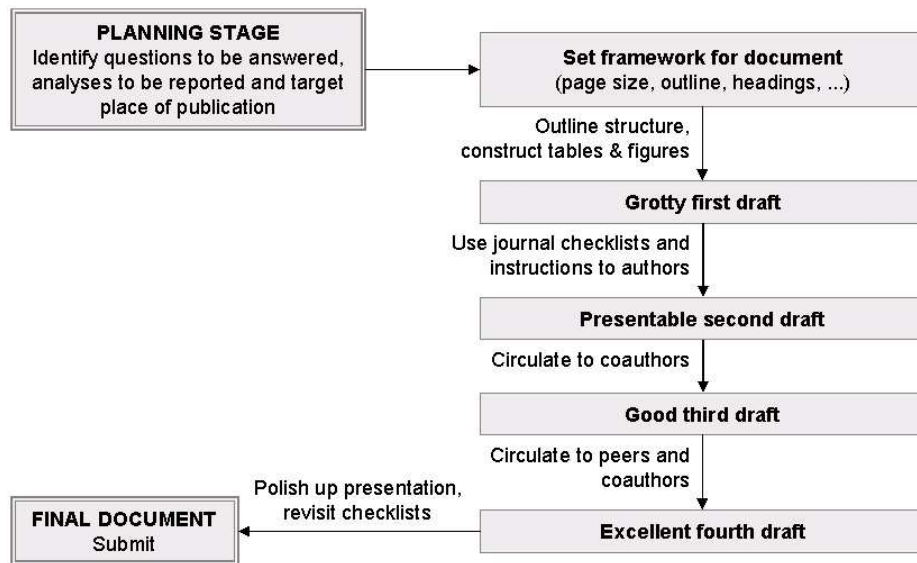


Fig. 2. Plan for preparing and writing a paper for publication.

- If it can be interpreted in more than one way, it's wrong.
- Know your audience, know your subject, know your purpose.
- If you can't find a reason to put a comma in, leave it out.
- Keep your writing clear, concise, and correct.
- If it works, do it.

O'Connor [1, p.97] restates Woodford's principles for solving problems of writing style:

- Be simple and concise.
- Make sure the meaning of every word.
- Use verbs instead of abstract nouns.
- Break up noun clusters and 'stacked modifiers' (that is, strings of adjectives and nouns, with no clue about which modifies which).

Additionally, it should be mentioned that *plagiarism* (i.e., using the ideas of someone else without acknowledging the source of information [22]) is considered a serious offence in the scientific community and must therefore be avoided. Credit *must* be given when using one of the following in the own work [22]:

- another person's idea, opinion, or theory;
- any facts, statistics, graphs, drawings - any pieces of information - that are not common knowledge;
- quotations of another person's actual spoken or written words; or
- paraphrase of another person's spoken or written words.

3 Publishing Scientific Papers

When the researcher has finished writing a paper reporting on a piece of research, and if the writer and co-writers - and optimally also the colleagues at the department - consider the paper to be worth publishing, the subsequent step is to submit it to a journal or conference for publication. Especially when the paper is sought to be published in a major journal, it can be a very exhausting and sometimes dead-end way to the paper finally appearing in a printed or online issue of the desired journal. The following sections cover the scientific community's way of assuring scientific quality of published papers and the central stages of the editing and publishing process.

3.1 Scientific Quality Management

Before going into detail with the process of publishing research papers, we will first introduce *the* central mechanism of scientific quality management, namely the *peer review* process. As research papers are reviewed by colleagues of the writers in the respective field's scientific community prior to publication, this process is referred to as peer review.

Peer review ensures publishable quality of research papers [3], and should continue to do so in the future [23]. For most of the options of publishing papers the review process is quite similar, with some distinguishing differences, mainly concerning the roles of people involved and the outcome of the process. This will become obvious in the following two sections on publishing in journals and in conference proceedings. Common to serious peer reviewing practices is the fact that authors do not know the identity of their reviewers (*blind review*); depending on the editorial policy it is also possible that reviewers do not come to know the name(s) of the author(s) of the paper (*double-blind review*).

3.2 Journal Publications

A journal paper reports on a finished piece of research or some significant achievement or discovery in a certain scientific field. Unlike at conferences, it is uncommon that international journals accept reports on research in progress at an early stage.

3.2.1 Roles Involved

The main roles (except authors) involved in the journal editing and publishing process and their responsibilities shall be introduced (cf. [2, 3, 7, 24, 25]) first:

Referee. A journal has an *editorial board* that includes a number of referees who are responsible for reviewing and evaluating submitted papers. Having reviewed a paper, each referee independently advises the editor whether to accept or to reject the paper. Referees may also advise the editor on the development of the journal's thematic scope and focus. However, final decisions

are made by the editor. It is also common practice that editors designate *external* referees for certain submissions, for example when the referees of the editorial board do not have appropriate expertise to make fruitful, professional comments on a particular paper.

Editor. Also called *Associate Editor*. The most important function of an editor (can also be a group of persons) is to make the final decision whether to accept or to reject a submitted paper. Indeed, the comments of the referees just serve as suggestions. Nevertheless, as the editor alone would not be able to review and comment on all submissions in detail, he usually relies on the advice of his editorial board, where he can choose from a pool of experts in diverse fields of the journal's main topics.

Managing Editor. Also called *Editor-in-Chief*. Many journals - at least important ones - have managing editors who are full-time employed. Their job is to relieve the editor from administrative and other day-to-day tasks in producing a journal [25], e.g., coping with publishers. Generally, the difference between editors and managing editors is that the review process (dealing with the author and referees) is mostly within the realm of the editor, whereas post-acceptance issues are taken care of by managing editors [3].

Publisher. Publishers print accepted papers in (periodical) journal issues.

3.2.2 The Process

Important activities in the publishing process of journal papers are depicted in the UML activity diagram in Figure 3. The vertical swimlanes separate the areas of responsibility of the main actors in the process.

The first step is to be taken by the author. After choosing an appropriate journal for submission, the author has to submit the paper according to the instructions issued by the journal editor. Most journals today offer the opportunity to submit the paper via the journal's web site (in computer science, most journals rely on electronic submission and reviewing systems). At this stage, it is very important that the author follows the instructions at the utmost accuracy, because papers submitted not compliant with (parts of) the instructions will most likely be rejected without taking into account the paper's actual content. Some common authors' mistakes at this stage include:

- Not adhering to the journal's paper formatting and layout guidelines (e.g., using the wrong font size, line spacing, page numbering, etc.).
- Exceeding maximum paper length (word count, page count).
- The paper's thematic focus is not within the scope of the journal's subject areas.

If any of the above is true when the editor does the preliminary revision, the paper will be directly rejected regardless of its scientific contribution and quality.

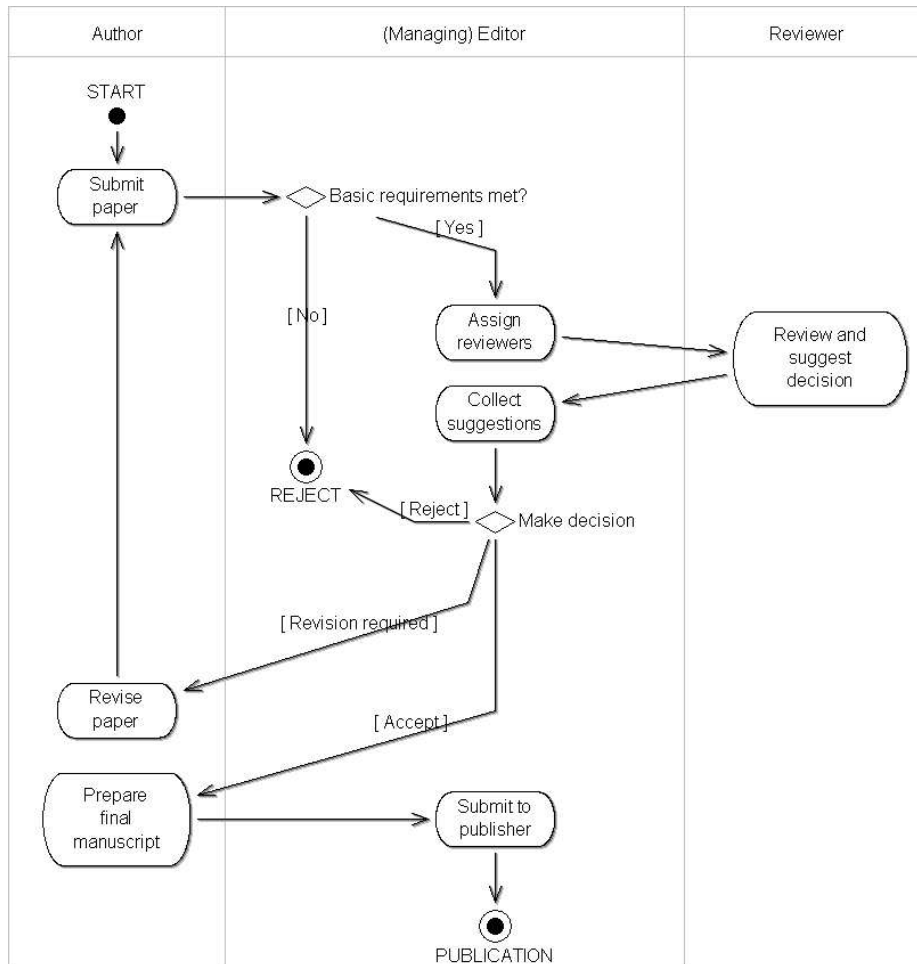


Fig. 3. The process of publishing a paper in a journal.

On the other hand, if these conditions are met ("proper paper on a proper subject" [3, p.83]) the paper will be considered for publication. The submitting author is notified of either of these decisions.

The next step the editor takes is to select referees for peer reviewing the paper. The number of referees involved in the review process may vary from journal to journal, but usually the editor forwards the paper to two or three referees. Besides making comments and suggestions for improvements to the authors, referees generally support the editor in making a decision by providing information on the following general issues, which may vary in importance among different journals (the following items have been compiled from [2, 3, 7, 15, 24, 26, 27]):

- Thematic relevance to the journal's scope of subjects.
- Significance of contribution.
- Originality of the work.
- Coverage of relevant literature.

More focusing on the writing style of the paper, the following aspects are relevant to reviewers and influence their recommended decision:

- Clarity of writing: readability, organization, conciseness, and technical quality of the paper.
- Appropriate title and abstract.
- Appropriate use of *well-designed* (cf. [3, p.48-67]) figures and tables.
- Sound conclusion and discussion.
- Length of the paper relative to its usefulness.

Also increasing the likelihood of acceptance are the following characteristics of submitted papers [24]:

- Strong reputation of the author.
- Successful test of the proposed theory.
- Different content than usually published in the journal.

When the assigned referees have finished reviewing and commenting the paper, the editor collects their recommendations and makes a decision which is sent to the corresponding author of the paper (usually the first author). Generally, the notification from the editor will carry one of the following messages [1, 3, 7]:

"Accept" The editor accepts the paper without modifications. The paper will be published in one of the journal's forthcoming issues (for details on the printing process and on how to deal with printers refer to [1, 3, 7]). This outcome is very unlikely on initial submission. Only in very rare cases the paper will be accepted right away. It is more likely that the paper has to be revised.

"Modify" The editor requests revision of certain parts of the paper. The author has to modify the paper according to the suggestions and comments of the reviewers and the editor in order to be further considered for publication.

After revising the paper accordingly, the author may resubmit the paper to the journal.

- ”Reject”** The editor does not see any chance for the paper to be published in the journal. The editor usually encloses detailed reasons for rejection, which should be read carefully by the author. Most likely, one or more referees
- had serious objections to one of the preconditions relevant to reviewers mentioned above;
 - found the paper out of the journal’s scope;
 - found fundamental flaws in the paper’s argument, data, etc.

If modification is required and the author feels unable to comply with the editors recommendations, the author may either (politely) tell the editor about the disagreement, or alternatively the paper may be sent to another appropriate journal in the field. The same applies to rejected papers.

3.3 Conference Publications

The review system at conferences is quite similar to the journal paper review system. Nevertheless, there are some differences in the publishing process, which will be explained in this section. Generally, papers published in conference proceedings do not have as high reputation as journal papers. However, in computer science there are some conferences with equivalent status to journal publications [28].

Most conferences are part of a series taking place annually. Several months before the conference date, the *conference chair* (who can be considered the counterpart to the editor of a journal) issues a *Call For Papers* (CFP) to invite authors to submit papers to be published in the *conference proceedings* and to be presented at the conference venue. The CFP, which can normally be downloaded from the conference’s web site, comprises the following information:

Title and Venue For example: 22nd International Conference on Conceptual Modeling. Chicago, Illinois, USA.

General information This section can be found on most CFPs describing the scope of the conference, i.e., putting the main topic of the conference in the light of current developments.

Topics of interest Encloses a list of topics of particular interest for the respective conference’s subject area.

Submission guidelines Most CFPs comprise a section where general guidelines for submissions are communicated to authors. Additionally, if the conference proceedings are published by a well-established publisher, the publisher is also mentioned on the CFP.

Deadlines This section is very important, as there are a number of deadlines to be necessarily met by authors:

- *Submission deadline*: This is the deadline for submitting the proposal, which might either require submission of a full paper or an (extended) abstract thereof. Most submission deadlines are firm, whereas failure to meet the deadline results irreversibly in not being considered for presentation and/or publication. For conferences taking place overseas the time change has to be taken into account when submitting papers close to the submission deadline.

- *Notification date*: This specifies the date when the author is notified of acceptance or rejection. The notification date given is often not very accurate, as the *program committee* cannot anticipate the number of submissions, to mention one reason; thus the review process may take longer than expected. Conferences that use peer review to decide whether a submission should be accepted or not, emit one of two possible messages to each submitting author at the notification date:
 - *Accept*: The paper has been accepted as is and will be published in the conference proceedings. However, reviewers may have suggested minor modifications to be incorporated in the published paper. Usually, acceptance letters (or mails) sent by organizers entail the invitation to orally present the paper at the conference. This is a very good opportunity to receive immediate feedback in discussions with peers after the presentation.
 - *Reject*: The paper has been rejected and will not be published in the conference proceedings. Most reviewers supply valuable comments to authors on how to improve the rejected paper. Unlike journals, most conferences do not consider the option of asking authors for revision. Papers are normally either accepted or rejected right away.

Depending on the importance of the conference and the response to the call for papers, the acceptance rate varies significantly among different conferences. From my own (little) experience and from talks with department colleagues, I can state that at major international, selective conferences in computer science only about a quarter of the submissions are accepted (cf. also [29, 30]).

- *Camera-ready paper deadline*: In case of acceptance, this is the submission deadline for "camera-ready" papers, i.e., final versions to be included in the conference proceedings. At some conferences, failure to meet this deadline may result in not being included in the conference proceedings. Anyway, program committees announce their policy of dealing with deadline exceeding.

As with journals, it is vital to meet all deadlines and to comply with all guidelines (such as paper formatting instructions). See Figure 4 for an example of

the web site header of the International Conference on Conceptual Modeling (ER2003), which comprises the conference deadlines on a prominent spot.

Important Dates	
Paper abstracts (soft deadline):	8 March 2003
Full papers (firm deadline):	24 March 2003
Notification:	17 May 2003
Camera-ready papers:	14 June 2003

Fig. 4. Deadlines for ER2003 conference (<http://conceptualmodeling.org/er2003>).

Other information Other information of interest, e.g., call for panel discussion proposals, demonstrations, and information on sponsors, publisher, invited speakers, etc.

4 Concluding Remarks

This paper has given an introductory report on major aspects of writing and organizing scientific papers as well as on the process of trying to publish a research paper in a journal or in conference proceedings. It should be useful for ambitious beginners (e.g., thesis writers) seeking to join the publishing scientific community. As the whole of this subject area is too complex and extensive to be discussed in detail within the scope of this seminar report, not all aspects of writing and publishing scientific papers have been considered with appropriate attention. However, this paper includes a list of useful references to printed and online sources for readers interested in details, whereas I highly recommend two works of remarkable quality: Robert Day's "*How to Write and Publish a Scientific Paper*" [3], and Meave O'Connor's "*Writing Successfully in Science*" [1] should answer most of the questions arising on the topic.

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