A Methodology for Written and Oral Presentation of Research Results

Sanida Omerovic, Faculty of Electrical Engineering, University of Ljubljana, Slovenia
mail: sanida.omerovic@lkn1.fe.uni-lj.si
Saso Tomazic, Faculty of Electrical Engineering, University of Ljubljana, Slovenia
mail: saso.tomazic@fe.uni-lj.si
Milan Milutinovic, Massachusetts Institute of Technology, Department of Civil and Environmental Engineering, USA
mail: milan.milutinovic@mit.edu
Veljko Milutinovic, Faculty of Electrical Engineering, University of Belgrade, Serbia
mail: vm@etf.rs

Abstract — The purpose of the methodology described in this paper is to highlight an effective method for the organization of research results into written and oral forms. Authorities within supervising universities have realized that strong research by a candidate is often obscured by poor presentation, leading to the paper being ignored by the research community and journal reviewers. On the basis of their academic background, the authors of this paper decided to form a set of clear guidelines for writing research papers and giving oral presentations aimed at helping PhD students. To support the effectiveness of the methodology proposed, a statistical analysis has been conducted. The methodology described in this paper was initially intended for use in the fields of computer engineering; however, it is applicable more widely. In conclusion, if the methodology reported in this paper is followed strictly, it is much less likely that a good piece of work would be rejected for publication, and/or remain anonymous, due to inadequate presentation.

Index Terms—methodology, research, PhD, structure, presentation.
INTRODUCTION

The aim of the methodology described in this paper is to help PhD students to produce good papers and effective oral presentations. The underlying assumption is that good research is mainly concerned with producing high-quality research results. However, high-quality research results are often times not the only prerequisite for meeting the requirements for a PhD. Normally the candidate has also to publish a paper in a recognized leading international journal (e.g., SCI journal (Scientific Thompson 2009)). At the same time, no formal education is offered by universities on how to write papers for SCI journals.

The major goal of the methodology described here is to help candidates to produce papers with a high probability of acceptance by leading international journals, so that high quality research results become accessible to a world wide audience (our work relates to problem-solving papers). Oral presentations are also given due attention, since each thesis has to be presented orally at conferences, oral defenses, etc. Therefore, this paper is divided into two parts: the first stressing the writing of a research paper and the second stressing its oral presentation.

The proposed structure for the delivery of research results focuses on the following issues:

a) activities before writing a paper
b) selection of a title
c) writing the abstract
d) use of references
e) the structure of tables and figures
f) the structure of the paper, and

g) oral presentation.

This paper combines the key elements from (Milutinovic 1996) and (Milutinovic 1997), expanded with the most recent experiences of the authors. Our work presented here is influenced significantly by the work of others (Cohen et al. 1982)(Falkovych et al. 2006)(Fowler 2002)(Jones 1999)(Scheurich 1997)(Kotz et al. 2005)(Jarvinen 2000). The main ideas of this work were built on a set of a highly quoted papers related to changes in educational methodologies (Latchman et al. 1999)(Lee et al. 1998)(Turns et al. 2000)(Milutinovic 2006), and PowerPoint results presentation enhancements (Tufte 2003)(Doumont 2005)(Alley et al. 2005)(Farkas 2006). We also find work treating creativity and related phenomena (Milutinovic et al. 2008)(Milutnovic 2005)(Pearl 2007)(Friedman 2008) to be relevant. All references listed are of high value, and our only criticism is related to the fact that: (a) none are tailored to the specific problem of generating papers for leading international journals and (b) none are related to a specific course teaching the subject methodically. However, some efforts are visible in that direction (Wong 2008a)(Wong 2008b)(Day 1977), and our paper complements them.

The rationale for the proposed methodology is that poorly presented research results may be overlooked or rejected, as key findings may not be quickly and properly understood. A standard structure for presenting research permits the reviewers and the audience to comprehend the key points quickly and with minimal effort.
ACTIVITIES BEFORE WRITING A PAPER

Before writing a paper, PhD candidate with his/her advisor should decide which journal will be targeted for submitting research results. The PhD advisor should point out the most relevant publications. Also, the candidate can search through the SCI expanded database (Scientific Thompson 2009) for an appropriate journal. The choice of appropriate journal is important because of the amount of detail allowed in the methods section of the paper, the acceptable length of the entire manuscript, the scope of the journal, and the targeted audience. All these issues are usually defined on a journal’s web page, under Guidelines for Authors.

Once the target journal is selected, preparations for writing the paper can begin. However, the processes of “writing” and “working” is often iterative, with these two processes supporting, challenging, and reinforcing each other. One can write a draft, revise it, and after the submission and review processes, one can again return to the draft and improve it.

SELECTION OF A TITLE

A title is often the first thing a reader will see when considering a technical work. It is a powerful tool for drawing the readers’ attention to a paper.

The main goal of a good title is an accurate and efficient communication of the essence of the paper. It should accurately describe the research done and get the reader interested in the subject. The title should enable an expert reader to understand the basic idea of the work, even without reading the paper or seeing the presentation. It should also provoke the reader to think about the deeper issues involved in the topic of
the presentation.

An example of a title that fulfills these requirements is: “Cross-layer Control in Wireless and Satellite Networks: Scheduling, Routing, and Power Allocation”. This title clearly states the subject of the paper and gets the reader thinking about some of the issues involved.

WRITING THE ABSTRACT

A research abstract should be compact and informative. The language should be simple, direct, and precise. Whenever possible, it should include the following components:

a) a problem statement of the research to be described;

b) a brief explanation of the existing solutions and their weaknesses, in relation to the problem statement;

c) the essence of the suggested solution, and why it is expected to be better under the same circumstances;

d) the type of analysis performed to demonstrate that the suggested solution is better than existing approaches, in terms of performance and complexity (for engineers, performance and complexity are equally important);

e) the major numerical highlights of the analysis and research results (for engineers, numbers are essential).

The most critical element of an abstract, from the reader point of view, is the main conclusion of the work. Many abstracts – by professionals and by students – are poorly written (e.g. descriptive rather than informative) and if the conclusions of the work are omitted, then the abstract fails in its major purpose: to be a miniaturized version of
the paper.

USE OF REFERENCES

The list of references should be completed before the actual writing of the paper begins. This ensures that no important reference is left out.

According to (Batchman 2008): "If you have no references, it usually raises concerns with the reviewers, because the message you are giving them is that either you are unaware of anyone else working in the area, or you don’t feel anyone else has done any work of significance. Second, authors should not just include a large number of related papers that really do not support their paper. Including the additional 'references' just makes it look like you are trying to impress the reviewer with your knowledge." Basically, the unrelated papers should not be included, because authors should not waste a reader’s time in searching for unrelated or irrelevant papers. The real challenge of referencing is as an abbreviated or short form of communication of what has been done previously, to say only what is essential to bring the reader and reviewer to an understanding of the essentials of the new work in the current paper, and to properly acknowledge sources.

For the syntax of the references, follow the example of the most prestigious journal in the field of the research being discussed, unless otherwise required explicitly. When pointing to a reference in the body of the paper itself, the approach using the full name of the first author and the year of publication is easiest for the reader, since it quickly conveys the research group from which the paper comes. These full-name references can be easily converted to numerical references, as required by some technical journals.
THE STRUCTURE OF TABLES AND FIGURES

All figures and figure details should be completed before the writing of the paper starts. The figures should contain as little text as possible; instead, they should include only commonly used mnemonics or acronyms that are independent of the language in which the paper is written. This approach is helpful when figures need to be transported back and forth between different languages.

For all figures and tables, captions should contain all information necessary to understand and interpret them. Whenever possible, reading the details of the figures should substitute for a casual hearing or rough reading of the paper or presentation itself. To that end, figure captions should contain five important elements:

a) a title which shows the main highlight(s);
b) a legend which explains the mnemonics in the figure itself;
c) descriptions of attention-deserving phenomena in the figure (e.g., fourth quarter 3G mobile penetration was 10% higher than in the third quarter);
d) explanations of the reasons behind the attention-deserving phenomena (e.g., the fourth quarter penetration was higher due to the introduction of new services);
e) implications of these phenomena (e.g., if higher 3G penetration is desired, new services requiring high-speed data access must be introduced). By stating implications of the phenomena, we do not mean to compress a summarized version (of the paper) into a figure caption, but to give the reader an opportunity to get the bird’s eye view of the paper, without having to read the entire paper.

The last element is of special importance, because it shows the candidate’s ability to interpret data and produce new scientific knowledge.
All of these details should be clearly visible to the viewer. Keep in mind that figures are often moved from written papers to presentation slides and back, and that this should be achievable with minimal effort (appropriate modifications are always needed when moving figures between papers and slides). See Appendix 2 for a statistical analysis of the effectiveness of figure captions.

THE STRUCTURE OF THE PAPER

Whenever possible, an author should first develop the skeleton of the paper, to include sections related to the following issues:

a) an introduction, to include the basic facts needed to attune the reader to the subject, and to explain the point of view of the author’s research;

b) a problem statement, to convey the importance and exact definition of the problem the research is addressing;

c) existing solutions and criticism of them, to show the relevant major solutions and indicate their inadequacies (from the point of view of the author’s research), all with reference to the problem statement;

d) conditions and assumptions of the research to follow, to summarize the environment of interest; the specific requirements of the real environment (conditions), and the elements that simplify the analysis without any negative impact on the validity and representativeness of the final results (assumptions), should be clarified and itemized (e.g., application, system software, architecture, organization, design, and technology);

e) the proposed solution and its advantages, to give the essence of the proposed solution (the idea which is to be introduced), followed by a logical and/or
philosophical discussion about expected benefits stemming from the idea;

f) **mathematical modeling and analysis**, to show one or more of the following:
   
   (f1) establishment of an appropriate mathematical model, according to the pre-specified conditions and assumptions,
   
   (f2) a validity proof of the major idea,
   
   (f3) a calculation of initial values for simulations to follow,
   
   (f4) an estimate of performance,
   
   (f5) an estimate of complexity,
   
   (f6) other relevant analysis.

Note that modeling and analysis is helpful to both reader and researcher in aiding understanding of the concept, but will usually not provide final answers related to performance and complexity;

**g)** **simulations**, to show performance (usually the major and the longest part of the paper);

**h)** **implementation or implementation-oriented issues**, to show complexity, reliability, availability, and other properties (in some research, this may be the major and the longest part of the paper);

**i)** the **conclusion**, with the following three main elements:

   (i1) revisiting the major contribution from the performance/complexity point of view,
   
   (i2) stating who will benefit from the presented results,
   
   (i3) highlighting freshly discovered problems and defining possible future research avenues.
One should keep in mind that some readers will read only the abstract and the conclusion;

j) **references**, as discussed in a previous section.

The proposed structure should be used as a guideline for writing papers, rather than a rigid structure to be followed literally. Suggested sections should be inserted only when applicable.

Appropriate section headings should be formed following the guidelines for selecting the paper title. After the skeleton on the level of first-level headings is defined, the author should develop the skeleton at the paragraph level; this means defining all subheadings on lower levels and the contents of all paragraphs under each lowest-level heading.

Specifying the first (and therefore the major) sentence of each paragraph leads to the strategy of a senior person (e.g., the advisor) developing the skeleton, while a junior person (e.g., the PhD student) does the actual writing of the paper. The proceeding sentences of the paragraph are used to explain and/or justify the statement conveyed by the first sentence. Consequently, after the paper is written, advisor comments are restricted to the paragraph level and are thus easier to locate and correct.

In order to emphasize the paper's main idea, details that are unnecessary for understanding the essence of the idea should be omitted from the main body of the paper. If some details are required for implementation purposes (for example, if the reader is expected to be able to repeat the experiments), they should be moved into appendices that are referred to at appropriate locations in the main text.
See Appendix 3 for a statistical analysis of effectiveness of paper structures. Remember, this paper promotes the model in which one first does the work, and then writes it up. Note that, after one has seen what one had written, one may decide to do some extra work, followed by extra writing, so the process becomes iterative.

**ORAL PRESENTATION**

Oral presentation is of great importance for conference presentations (usually preceding the journal submission) and PhD thesis defense.

When making slides for an oral presentation, there are several points worth keeping in mind:

a) The title slide should include the presentation title, the name(s) of author(s), affiliations, and all relevant contact data.

b) Presentations should begin with an introductory slide to give the audience the basic ideas of the presentation.

c) When introducing a research presentation, the approach is similar to writing an abstract. The introductory slide should feature a brief outline of the detail of the talk itself.

d) Remember that research problems are also logic problems and have to be presented in a manner that states the underlying logic explicitly.

e) Presentation should follow the presentation structure outlined earlier in this paper.

f) Semantic-line splitting aids understanding – and is best done manually, rather than automatically by a word processor.

g) The aesthetics and layout of each slide is important.

h) The presentation should conclude with another "short and effective" slide.
The content of presentation slides above are taken from lecture notes of the course on the proposed methodology presented at the University of Belgrade, Serbia and the University of Ljubljana, Slovenia. Details of the course are outlined in Appendix 1, and on the web page of our laboratory (Omerovic et al. 2009).

Semantic line-splitting is an important element of a presentation that makes it easier for the audience to remember the key ideas of a slide. In any instance where bulleted text in a slide must be spread over more than one line, each line should present a different thought. In situations where a line seems impossible to split semantically, restating the line using alternative wording will often result in a text that is much easier to understand and split semantically.

One of the authors of this paper performed an experiment to prove the effectiveness of splitting lines in this way. He taught the same subject to two different groups of students, using two sets of slides, one with semantic line-splitting and one without. A test was given to both groups after the subject was completed. After performing this experiment several times, he noted that test results were significantly higher for the students who were exposed to slides that featured the semantically split lines. See Appendix 4 for details.

CONCLUSION

Following the guidelines set out in this paper (for organizing research papers and oral presentations) will lead to improved performance in communication, because the research content and the research results will be more effectively communicated to the audience. Consequently, a paper presenting valuable research results is less likely to be rejected for publication, or if published, is less likely to be ignored by the research
community. This paper is most useful to Ph.D. students, but it can be of benefit to all those who have to present their thoughts, in either written or oral forms. Finally, this paper opens a number of new research avenues, mostly those leading to statistical analysis which can shed more numerical light on the issues and advice presented here.

APPENDIX 1: OUTLINE OF A COURSE ON THE METHODOLOGY FOR WRITTEN AND ORAL PRESENTATION OF RESEARCH RESULTS

This course was held for postgraduate students at University of Belgrade, Serbia and University of Ljubljana, Slovenia. The rational for the course was that postgraduate engineers are very well skilled when it comes to obtaining research results (by doing formal analysis, simulations, and implementations), but that they are lacking presentation methodology for writing and presenting research results.

This course’s outline includes the following: (a) weekly schedule, (b) reading assignments, (c) creation of the final deliverable (a paper to be submitted to an SCI journal), and (d) professor-student interaction.

The weekly schedule comprises the following:

- three weeks of lectures on methodology issues; at the end of this course section, each student has to summarize his or her PhD thesis work into the ten points from section THE STRUCTURE OF THE PAPER,
- three weeks related to the analysis of the seminal work of others, projected onto the same ten points as indicated in section THE STRUCTURE OF THE PAPER, and
- six weeks related to the analysis of papers and presentations generated by students attending the course.
Reading assignments include the references listed in this paper; also, each student is expected to locate and present one outstanding paper from his or her thesis research, identifying the ten points indicated in section THE STRUCTURE OF THE PAPER.

The creation of the final deliverable is a process which progresses during the last six weeks of the course, with students (as well as the professor) reading sections of each candidate paper to be submitted to an SCI journal.

Professor-student interaction is performed in three phases: (a) discussing the ten points of each students' PhD thesis, (b) evaluating the students' presentations (based on the same ten points) of the seminal research of others, and (c) evaluating the students' presentations (based on the same ten points) of their own work.

Some of the postgraduate students who have attended the course at the University of Belgrade managed to publish papers in leading international journals (Radivojevic et al. 2004) (Milutinovic et al. 2003). Of course, attending the course itself is not enough to publish a paper. The most important issue is that the idea of the PhD candidate is proven to be original, and that it gives better results than existing solutions. Besides presentation methodology, postgraduate students are also taught through examples from practice (Rudan et al. 2005), to enhance their creativity and to materialize abstract ideas into practice.

Another benefit of publishing a paper in a leading international journal (besides, it sometimes being a prerequisite for obtaining a PhD degree) is that research done becomes available to a wide research audience, and consequently new research opportunities may arise (student exchange, invited lectures, joint EU projects, industry
applications, etc).

Some of the postgraduate students attending the course at the University of Belgrade, Serbia, had an opportunity (based on their research) to attend student exchange programs in the Supercomputing Centre of the University of Barcelona, Spain, University of Siena, Italy; to give invited lectures at the Fraunhofer Institute, Germany, University of Valencia, Spain; to attend specialized conferences like HiPeac, Sweden; and to join industry projects like Dow Jones, USA, StorageTech, USA, and EU FP 6 and FP 7 projects like WeGo or ProSense.

APPENDIX 2: A STATISTICAL ANALYSIS OF THE EFFECTIVENESS OF FIGURE CAPTIONS

A group of 108 students (divided into two groups, 56 and 52) was exposed to two different versions of the same paper (the test was performed in the morning hours). In one case, the paper included only one-line figure captions (title only). In the other case, the same paper included carefully written figure captions based on the methodology proposed in this work. Students were given one hour to read the paper and were then given a test with ten questions. On average, those exposed to the full five-element captions scored 83%, and the others scored 71% (the lower bound was 43% versus 32%, and the upper bound was 100% versus 96%).

In a following student group, the same test was performed in evening hours, when students are relatively tired. In our context, the term "evening" meant "after many hours of attending classes" (when concentration goes down) and not "at the time of the day when students have difficulties accepting new facts". In the latter case, some of the students, the so called "owl types," have, in fact, better concentration. The scores were 79% and 64% respectively (the lower bound was 39% versus 29%, and the upper
bound was 98% versus 91%). This is also an indication that the proposed approach gives a higher relative advantage in more difficult teaching circumstances.

APPENDIX 3: A STATISTICAL ANALYSIS OF THE EFFECTIVENESS OF PAPER STRUCTURES

In 24 different cases of oral thesis defense (MSc or PhD), when the 10-element structure was reinforced, students were able fairly crispy and precisely to answer the following questions:

a) what is the problem addressed by the thesis?

b) what is the best solution in the open literature and what are its drawback from the point of view of the subject research?

c) what is the essence of the proposed approach, and why is it supposed to be better?

In the alternative case of 41 different oral defenses (by other major professors, who did not reinforce, for whatever reason, the above-mentioned 10-element structure, the answers to the questions above were relatively ambiguous and fuzzy. Since issues like "crisp" and "fuzzy" cannot be treated numerically, when a question was asked in these cases, it was underlined that an answer should be given in one sentence, and the number of sentences in the answer was used as an indication of how "crisp" or "fuzzy" it was.

When the structure proposed in this paper was reinforced (24 cases), the essence was answered in one sentence 88% of the time (88% of 72 questions). In the alternative group (41 cases) the essence was answered in one sentence only 32% of the time (32% of 123 questions).

The results presented above demonstrate that the existence of the structure brings greater presentation success.
In this appendix and in the previous two, the term "statistical analysis" should be taken conditionally, bearing in mind the size of the pattern and the nature of the circumstances.

APPENDIX 4: A STATISTICAL ANALYSIS OF THE EFFECTIVENESS OF SEMANTIC LINE-SPLITTING

A group of 102 students was exposed (during the morning hours of the same day) to teaching of the same subject matter, in 2 different classrooms (52 in one classroom, 50 in another classroom). In the first case, the subject matter was presented using slides based on line-splitting forced by a word processor (i.e., no semantic splitting, except by accident). In the second case, slides were based on semantic line-splitting. For both groups, a short test with exactly ten questions was given to the students, after each one of ten lectures during the semester. In the case of those exposed to semantically split lines, the test hit score, on average, was 72%. In the alternative case, it was 61%.

The next trial tested teaching in the evening hours, when the students are relatively tired, and less able to concentrate. In this case, the advantage of semantically split lines was much higher, with an average score of 69% versus 53% in favor of semantic splitting. This may be treated as evidence that semantic line-splitting is more effective, when students are less able to concentrate (through tiredness, etc).

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REFERENCES


(Omerovic et al. 2009) Omerovic, S., Tomazic, S., Milutinovic, M., Milutinovic, V. “DO’S AND DON’T’S OF POWER POINT PRESENTATION”,


