# A Proposed Paper Template for improving the Quality of Practitioner Written Papers at Conferences and Symposia

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**Abstract**[1] Conference papers are a major source of information in postgraduate education and research. However, the quality of many practitioner-written conference papers describing their experiences is less than optimal. This paper suggests a template to try to improve the quality of practitioner presentations and papers in the Case Study genre (prototyped at SETE 2004) to format practitioner papers as a way to link their experiences into the literature to provide data to assist researchers improving the practice of systems engineering. Examples of the use of the template are included.

## CONFERENCE PAPERS

Conference papers are a major source of information in postgraduate education and research. Consequently, they ought to provide a contribution to the conference discipline (Kasser, 2002). In practitioner-oriented conferences such as INCOSE symposia the IEEE Engineering Management conferences and the Australian Systems Engineering Tests and Evaluation (SETE) conferences, the papers can be sorted into a number of categories including theoretical papers about various aspects of the profession, personal experiences, Case Studies and tutorials on an aspect of the profession. Practitioner written conference papers in these latter three categories provide anecdotal descriptions of situations, problem solving approaches and lessons learned from real-world projects. They have the potential to be excellent sources of information for postgraduate students; however

1. The academic quality of the published papers is less than desired. This is because these papers often document a discovery made after strenuous efforts, most of which would have not been necessary had the authors reviewed the literature or at least the proceedings of earlier conferences. As an example, (LaPlue; Garcia and Rhodes, 1995) discussed the development of a methodology for specifying requirements that describe the behavior of a system and its interaction with its environment. In fact they reinvented the environmental and behavioral models of the (Ward and Mellor, 1985) software development methodology[2]. This situation also escalated their project costs since the methodology existed and could have been used rather than reinvented had a literature search been conducted before the task began.

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[2] More recent examples were deliberately not cited.

2. It is often difficult to locate specific types of information such as lessons learned in these papers because there is no standard format for the location of information in these papers.

Thus while many of the practitioner-written papers may be interesting, from the perspective of improving the state of the art, and using the papers as research tools, they are less than optimal. This paper proposes a template for practitioner- written personal experience and Case Study papers to make them more useful both as readings in postgraduate classes on systems engineering and as sources for research.

## CASE STUDIES

Case studies are used extensively in research in practice-oriented fields (Yin, 1989). They are generally designed to answer a specific research question in the form of "how" and "why" as opposed to "who", "what", "where", "who much" and "how many" (Yin, 1989). The major difference between a Case Study and an Experiment is that a Case Study does not require control over behavioral events (Yin, 1989). (McNamara, 1999) provides a five-step process for developing a Case Study

1. Gather data about the case.
2. Organise the data to highlight the focus of the study.
3. Develop the narrative.
4. Validate the narrative.
5. Compare the study with appropriate others to identify areas of improvement.

The majority of practitioner written papers in the INCOSE personal experience and Case Study genre in which the practitioner tells a story concentrates on Step 3 and provides a conclusion. These papers are not true Case Studies in the sense discussed by (McNamara, 1999, Yin, 1989) but are close enough for our purposes. This is because in this situation the studies are generally not designed, they are documented anecdotal experience. However, that does not mean that:

- They should not be organised in some way to facilitate the writing and retrieval of information.
- They should also indicate how the lesson(s) learned from the story may also apply in other situations.

## TEMPLATES FOR PAPERS

While academic contributors tend to want to have full papers peer-reviewed and published, practitioners do not necessarily have the same goals, and are often not willing to take the time to write full papers yet are willing to take the time to prepare a presentation. Thus, in an effort to encourage practitioner contributions to the conference, for the last few years the annual SETE conferences in Australia have incorporated a non-refereed practitioner section for those in industry who have something to contribute but do not wish to submit a full paper to the refereeing process. Selection into this category is made based on a submitted abstract, so the presentations are not reviewed prior to the conference. This situation has produced descriptions of personal experiences and Case

Studies of varying quality in terms of linking the contents of the paper to previously published information (theoretical, Case Studies, or reports of practice).

**The UMUC experience.** This situation is similar to the responses to assignments in a postgraduate course the Graduate School of Management and Technology at University of Maryland University College[3]. However, when a template was introduced in one course, albeit for another purpose (Kasser and Williams, 1998), a serendipitous result was that the quality of the assignments also improved. In that instance, the students were asked to write term papers describing their personal experiences in projects that were in trouble. The papers were to adhere to the following template:

1. A description of a scenario based on personal experience.
2. An analysis of the scenario.
3. A list of the reasons the project succeeded or ran into trouble.
4. A list of, and comments on, the lessons learned from the analysis.
5. A section identifying a better way with 20/20 hindsight.
6. A list of a number of situational indicators extracted from the scenario that can be used to identify a project in trouble or a successful project while the project is in progress.

**Templates for documents**. Templates for the contents of documents to assist in locating the information stored in a document are not a new idea. For example

- The US Government request for proposals (RFP) uses a template so that Section M of the RFP always contains the evaluation criteria for the proposals.
- MIL-STD 490 specified which type of requirements to group into which section of a requirement specification.

**The SETE 2004 Experience.** There is little difference between a postgraduate term paper and a conference paper[4]. Having observed that the template both improved the quality of submitted assignments and helped UMUC postgraduate students to upgrade their assignments to conference papers, it was felt that a similar template for personal experience and Case Study papers would improve presentations in the SETE 2004 conference. Such a template was provided to prospective practitioner authors upon acceptance of their abstracts, but its use was optional. While no quantitative measurements were made, there was an impression that those authors who used the template produced better presentations than those who didn't.

## THE PROCESS FOR PRODUCING THE PRACTITIONER PAPER

A suggested process for producing the practitioner written papers based on (McNamara, 1999) is as follows:

1. Decide on the point(s) to be made in the paper.

[3] These students are employed in the workforce and are working towards their degree in the evening. Their employment positions range from programmers to project managers. Some also have up to 20 years of experience in their respective fields.
[4] At least in my classes!

2. Determine what data needs to be collected to reinforce the point(s) to be made.
3. Collect the data.
4. Research the literature to determine if the points have been made before.
5. Write up the story.
6. Analyse the story and document the analysis.
7. Write up the lessons learned.
8. Summarise the Case Study.
9. Develop and document the conclusions.

This is the basic difference between the practitioner personal experience and Case Study and the research Case Study. In the practitioner instance, the event has happened and is being documented. In the research instance the experiment is being designed, hence the outcomes may not be known (for sure) ahead of time. Moreover, this process is not proposed as being a sequential series of activities however Step 1 should come first.

## THE STRUCTURE OF THE TEMPLATE

The purpose of the template is to try to improve the quality of practitioner presentations and papers in the personal experience and Case Study genre by providing a template (prototyped at SETE 2004) to format practitioner papers as a way to link their experiences into the literature to provide data to assist researchers improving the practice of systems engineering. The format of the proposed template is as follows:

- Abstract or overview.
- Background.
- The Story.
- Analysis and commentary.
- Lessons learned.
- Summary.
- Conclusion.
- References.
- Glossary of acronyms and corporate terms.

Consider the content and rationale for each section. Examples are provided from an unpublished Case Study because while an example was provided to the prospective SETE 2004 authors in presentation format, the example was written up, submitted, accepted for, presented and published in INCOSE 2005 as (Kasser and Mirchandani, 2005).

### *Abstract or overview*

This first section presents an overview of the paper to interest the reader in the paper. This section provides a brief statement of the problem solved, the improvement made, etc. This is the part that entices the reader to read the entire text of a paper or stay in the room for the remainder of the presentation. For example, consider the following introduction to the Pacor Upgrade Case Study.

In about 1992, NASA Goddard Space Flight Center (GSFC) Code 560 was faced with a major problem. When the manufacturer of the minicomputer used in their Packet Data Processing (Pacor) facility announced that they would no longer be supporting the minicomputer, Code 560 suddenly realized that they had a major risk in that the then current architecture would probably not be able to support the operational spacecraft due to the aging of equipment and the lack of spare parts to repair expected failures. This is a problem being faced by many current systems in the Defence environment. In this instance, an out-of-the box solution to the problem not only provided the needed support but also saved NASA $1,500,000.

Note how the paragraph point out a major problem, its relevance to the reader and provide an indication of the solution without any details as follows:

**The problem.** In about 1992, NASA Goddard Space Flight Center (GSFC) Code 560 was faced with a major problem. When the manufacturer of the minicomputer used in their Packet Data Processing (Pacor) facility announced that they would no longer be supporting the minicomputer, Code 560 suddenly realized that they had a major risk in that the then current architecture would probably not be able to support the operational spacecraft due to the aging of equipment and the lack of spare parts to repair expected failures.
**The relevance to the reader.** This is a problem being faced by many current systems in the Defence environment.
**The indication of the solution.** In this instance, an out-of-the box solution to the problem not only provided the needed support but also saved NASA $1,500,000.

As a second example, the overview in (Kasser and Mirchandani, 2005) began

In 1989, the National Aeronautics and Space Agency's (NASA) Goddard Space Flight Center (GSFC) Multi-Satellite Operations Control Center (MSOCC) was facing the problem of replacing the data switch that routed signals from multiple low earth orbit (LEO) satellites to data processing computers. The problem was compounded by the following conditions:

1. There was no physical space to locate a replacement switch in the MSOCC;
2. The data streams from the satellites could not be switched off;
3. Data could arrive at any time without warning;
4. Loss of LEO satellite scientific data could not be tolerated;
5. There were a plurality of stakeholders in the MSOCC

This paper describes how, by the use of a soft system intervention methodology, the operation and transition requirements for the data switch were developed to satisfy all stakeholders to the point where a complete consensus was documented at the data switch System Requirements Review (SRR) (NASA/GSFC, 1989).

Note how the claim is supported by a reference to the delivered document.

## *Background*

This section contains the background to the situation. This section provides the context to the story. The Pacor upgrade Case Study might start with the reason for the importance (in the author's opinion) of the paper written as:

These days, Sustainment and support of operational equipment well beyond their original lifetimes has become a major issue in Defence Logistics and Maintenance.

The background section would then continue as follows.

> This Case Study documents an example of one way of dealing with the problem of Diminishing Manufacturing Sources and Material Shortages (DMSMS). In about 1992, NASA GSFC Code 560 operated Pacor, a facility consisting of two minicomputers supporting operational spacecraft using redundant minicomputers, and a new facility under development that was being constructed to support both the then operational spacecraft and new ones under construction planned for launch two years later. The upgrade schedule was such that the upgrade was not planned to be operational until just before the launch of the first of the new spacecraft, about two years later. When the minicomputer manufacturer announced that they would no longer be supporting that brand was faced with a major problem. Reliability calculations predicted that the aging minicomputers could fail any time between 12 and 18 months into the future. There would thus be a potential six month gap without support of the operational spacecraft which was the cause of the panic.

The key to a good Case Study is to only include information pertinent to the case. The important points to be made are the aging of the equipment and the predictions of the probability of a supportability gap, thus the details of the brand and performance of minicomputer have been omitted.

## *The Story*

This section is the description part of the Case Study. This section is a narrative of what was done without comments. This is the section that many current papers do well. The story is abridged in the following example.

> Code 560 presented their support contractor with their options which were:
>
> 1. Do nothing, hope for the best, and fail to meet spacecraft support requirements if enough system hardware failed.
> 2. Begin a crash development of replacement equipment in parallel with the upgrade to provide a temporary solution.
>
> The first option was unacceptable. The second option was estimated as costing about $2,000,000 and contained a major risk in that there was a high probability that it would not be completed on time. We developed a third option. After reviewing the situation the lead engineer asked a simple question which was “when are the orbits of the operational spacecraft (in near earth orbit) expected to decay to the point where the spacecraft would re-enter the atmosphere and burn up?” The answer which took some time to determine was “in about a year plus or minus several months.” With that response, the solution to the problem became obvious at minimal risk. The recommended computer system procurement plan was:
>
> 1. Not to support the operational spacecraft with the upgraded Pacor because they would have dropped out of service at least six months before the upgrade was completed. This also reduced the scope of the software being developed hence reducing its cost and development time.
> 2. Purchase a previously owned minicomputer (an innovation) as a spare to extend the supportability of the operational satellites until they dropped out of orbit. This required an acquisition strategy using a Justification for Other than Full and Open Competition (JOFOC) for a sole source item, but could be competed among vendors of previously owned computer, and would only cost about $500,000.

This recommendation was implemented saving NASA Code 560 at least $1,500,000.

## *Analysis and commentary*

This section is generally lacking in most practitioner-written papers. It contains the analysis and reflections on why the success happened. (This section is proposed as being mandatory for acceptance of the paper for the conference). This section shall

1. Comment on the story citing references to the literature (eg INCOSE handbook, Journal articles, Symposia proceedings, text books, etc.) and state how the events described support or refute the cited references.
2. Point out differences between the Case Study and context in the literature to explain the reasons for the success or failure.

For example, the analysis section of the Pacor paper would include the following paragraphs.

> The third option was developed by changing the boundaries of the system (Kasser and Palmer, 2005). By changing the boundaries of the system to include the spacecraft the solution to the problem became obvious at minimal risk. This is an example of defining he correct problem, rather than the observed one.
>
> The requirements for the upgraded Pacor had inherited the all requirements for the current Pacor facility without considering their rationale. Had the requirements for support of the then current on-orbit spacecraft contained traceability to their projected lifetime, and had that property been examined, the upgraded Pacor would not have been designed to support those spacecraft. This means that the third option might have appeared sooner. In any event NASA would have not incurred the early costs associated with upgrading Pacor to support spacecraft that would not be operational when the upgraded facility would be brought online.

As a second example, the analysis and commentary section of (Kasser and Mirchandani, 2005) began with

> Consider the following aspects of the case description.
> - Stakeholder involvement in requirements elicitation.
> - Process architecting.
> - The object-orientated approach.
> - Completeness of the SRR as a result of applying lessons learnt from other people's experiences.
> - Supply chain requirements.
> - Decision makers need the authority to make the decisions.
> - Organizational roles.

The section then discussed each point with the appropriate references to the literature.

As a third example, the analysis and commentary section of another Case Study on a system that contained mirrors that tracked the sun (Kasser, 2001) might contain the following.

> However, there while the concept of flexibility worked well in the control and electronics area, it was not employed in other departments. The sun sensor provided an example of what can go wrong. The sun sensor used a lens to focus the sun onto a pair of photo diodes. During the assembly process, the diodes were glued to a baseplate with transparent glue. The physics department who were building the sun sensors did not place a requirement that there be no glue on the side of the diode illuminated by the sun. After all, the glue was transparent. A year or so later, they found that the glue slowly became opaque when subjected daily to the very high temperature at the focal point of the lens. This phenomenon resulted in the need to replace all the sun sensors. From a manufacturing perspective, there was little difference in mounting the diodes if the glue could or could not be allowed to cover the face of the diode, just a matter of care. Nobody asked about possible changes to the characteristics of the glue over long periods of time under high temperature. If the requirement had been placed on the process, not to allow glue on the face of the diode, the characteristics of the glue under the high temperature conditions would not have mattered and the expensive sun-sensor replacements would have been avoided (Kasser, 1995).
>
> This is an example of introducing an unnecessary failure mode by not utilizing the "don't cares". Thus if it doesn't make any difference don't do it.

The last paragraph would be moved to the lessons learned section of the paper, and might there be written as:

> If it doesn't make any difference don't do it until you have analyzed the effect on other parts of the system.

**The Literature Review.** The questions that drive the literature review are:

1. Has anybody faced the same situation in the past?
2. What worked then?
3. What didn't work then?
4. What is different about that situation and the current one?

**Improving the systems engineering process.** There is a secondary purpose for this section which is to improve the systems engineering process. The idea is that during the course of completing the paper according to the template, the practitioner will currently perform the literature review after the event. Having determined that some of the effort put in to the discovery could have been saved by performing the literature review prior to commencing the task documented in the Case Study, the next time a task is begun, the literature review will be performed at the start of the activity, hence preventing some unnecessary work.

## *Lessons learned*

This section is a summary section where the lessons learned are itemised and briefly discussed. References to the literature are appropriate where the literature discusses identical or similar lessons. The lessons learned from the Pacor study might include:

1. Requirements for replacement systems should not be automatically inherited from the current system without checking if they are still applicable.
2. When faced with an insurmountable problem, redefine it (think out of the box).

### *Summary*

This is the standard summary of the paper which summarises the content.

### *Conclusion*

This section contains a conclusion about the Case Study. The reader is referred to the conclusion section of this paper as an example.

### *References*

This section contains the list of references sorted by author and year, unless the conference paper preparation template requires a different order. In that case the conference instructions take precedent.

### *Glossary of acronyms and corporate terms*

While corporate jargon is undesirable, it often is used in a Case Study. This section contains a table which identifies the acronyms. It is good practice to spell out all acronyms in full the first time they are used. Pacor examples would be

| | |
|---|---|
| GSFC | Goddard Space Flight Center |
| JOFOC | Justification for Other than Full and Open Competition |
| Pacor | Packet Data Processing facility |

## SUMMARY

Conference papers are a major source of information in postgraduate education and research. However, the quality of many practitioner-written conference papers is less than optimal. This paper described a previous experience of the use of a template for postgraduate student assignments and has proposed a template to try to improve the quality of practitioner presentations and papers in the personal experience and Case Study genre to format practitioner papers as a way to link their experiences into the literature to provide data to assist researchers improving the practice of systems engineering. Examples of the use of the template have been included. For a more detailed example, the reader should refer to (Kasser and Mirchandani, 2005).

## CONCLUSION

The use of a template can improve practitioner-written personal experience Case Study papers and should be recommended for use to future prospective authors.

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## Author's Biography

**Joseph Kasser** has been a practising systems engineer for 35 years. He is the author of "*Applying Total Quality Management to Systems Engineering*" and many INCOSE symposia papers. He holds a Doctor of Science in Engineering Management from The George Washington University, and is a Certified Manager. He is the DSTO Associate Research Professor at the Systems Engineering and Evaluation Centre at the University of South Australia. He performs research into the nature of systems engineering and the properties of object-oriented requirements. He is a recipient of NASA's Manned Space Flight Awareness Award (Silver Snoopy) for quality and technical excellence for performing and directing systems engineering.