DOCUMENTING SIMULATION STUDIES FOR MANAGEMENT

Belva J. Cooley
Virginia Polytechnic Institute
and State University

ABSTRACT

This paper provides a discussion of the pur-
poses of simulation documentation and the role of
documentation in gaining management acceptance and
implementation of recommendations. A documentation
approach is suggested which is directed toward pro-
viding management with an end-product, documenta-
tion, which will be useful in decision making.
Guidelines are given for writing simulation docu-
mentations which are aimed at several levels of
management audiences.

INTRODUCTION

Most of the material which has been written
concerning documentation of computer models has
dwelt on writing for the computer specialist. Fo-
llowing the lead set by those documenting computer
systems, the simulation practitioner has also
written documentation for the technical specialist.
Too often the documentation of a simulation project
consists only of a block diagram, a program listing
and some scanty information on verification and
experimentation results.

Management, on the other hand, continues to
complain that the results it receives from consul-
tants or project directors are incomplete and ina-
dequately backed by comprehensible reports outlin-
ing research procedures. (2,5,6) It is not diffi-
cult to understand the perplexity with which a man-
ager may view results, sometimes counter-intuitive
results, for which he can see no factual base. A
manager will rarely base a decision which commits
hundreds of thousands of dollars on research that
he does not believe.

The analyst who approaches a problem using the
simulation technique has an advantage in gaining
management acceptance over those using mathematical
algorithms. Simulation models often closely para-
llel the reality of the operating system. Block
diagrams can be drawn which closely resemble the
real system and which show the relationship of the
model to the system. The simulation practitioner
who perceives the manager's need to understand the
model can represent the model so that a layman can
gain at least a macro view of the project.

This paper focuses on documenting the simula-

tion project so that undistorted communication is
achieved between all parties of the project, in-
cluding management. Guidelines are proposed for
writing documentation which is aimed at four dis-
tinct audiences: 1) top management; 2) the manager
who initiated the study; 3) the project director;
and 4) the user. Each group has specific informa-
tional needs and requires a different approach.

PURPOSES OF SIMULATION DOCUMENTATION

The documentation of a simulation project
serves four functions.
1) It defines the problem to be solved or the
decision which must be made based on the simulation
experimentation. It specifies the scope of the pro-
ject as agreed upon by management and the project
personnel.
2) It describes the development of the model
and outlines the experimentation process so that
updating may be done more efficiently.
3) It provides a reference for future pro-
jects which may be similar in nature.
4) It communicates the results of the project
to management and facilitates implementation of the
recommendations based on the study.

The primary goal of documentation, then, is
undistorted communication between the parties inte-
rested in the project, both present and future. The
documentation of the simulation project should be a
complete reference to the project. Equipped only
with the documentation: 1) users of the model
should be able to experiment with new data; 2) ana-
lysts should be able to update the model or revise
the model for a similar, future project; and 3)man-
agement personnel should be able to evaluate the
work which was done on the project and make deci-
sions based on the results of the experimentation.

Previous work in the area of simulation doc-
umentation and documentation of computer models in
general has focused on the need to communicate with
the technical personnel involved in the project.
(4,7,8,10) A recent study suggests, however, that
consultants and practitioners have neglected to
communicate adequately with the individuals respon-
sible for initiating and funding the projects,
management. (1)

The membership of the TIMS (The Institute of
Management Science) College on Simulations and
Gaming participated in a mail survey in 1974. (1)

The purpose of the survey was to assess "the atti-
tudes of <u>users</u> relative to a number of topics bear-
ing on the education and preparation of those who
would engage in the practice of simulation."

The responses to the questionnaire indicated
that documentation is of major importance. The
respondents were particularly concerned with
writing user guides and providing the references
necessary for users to modify the model for closely
related situations. Some specific responses show
the concern for better communication with manage-
ment:

"...the ability to convey to laymen the re-
sults of technical [investigations]."

"...ability to communicate, both orally and
in writing, to colleagues, clients, and subordi-
nates."

"...ability to present results to management
in an intelligent manner."

"The future emphasis should contain a kind of
simulator's morality: Clear statements of assump-
tions, models, and sources of data; sensitivity
analysis; and truthful statement of the results
in laymen terms, stating as well as possibility
[sic] the regions of validity and uncertainties."

In addition to being concerned about documen-
tation, the respondents suggested that a major pro-
blem was gaining implementation of simulation re-
sults. Some excerpts from their responses are:

"Behavioral characteristics are perhaps more
important than technical expertise in implementing
simulations. The reason is that the model builder
must constantly be able to sell the validity of
the simulation to the user."

"A key pitfall in simulation is that [it] be-
comes and end in itself. The practitioner pursues
a more sophisticated/elegant/complex model, often
to the detriment of its value and usefulness to the
managers and decision makers. [It is] better
[that] simple, rudimentary models [be used], and
not state-of-the-art efforts that are shelved...
and not used in [actual]practice."

In viewing the two problems of communicating
with management and implementation of simulation
results, it becomes clear that there are not two
problems; there is one problem which is viewed
from two different perspectives. The simulation
practitioner complains that management does not be-
lieve him and will not act on his recommendations.
The manager complains that the reports he recieves
from the analyst are incomprehensible, written in
computer and statistical jargon. Neither seems to
be able to understand why thousands (or hundreds
of thousands) of dollars were spent on the project.
The underlying problem, then, is that the manager
must be sufficiently involved in the project so
that he understands the basic framework of the
model along with its assumptions and limitations.
Only then will the results of experimentation be

useful to him for decision making purposes.

The project documentation, then, is the formal
communication medium between the analyst and the
manager. As such, documentation writers should be
aware of the role they play in gaining management
acceptance of the project.

GUIDELINES IN WRITING FOR MANAGEMENT

To be effective, simulation documentation
should be written for the reader, not the writer.
The documentation writer should remember that his
goal is undistorted communication between the prin-
cipals of the simulation project. Thus, he is
writing for four basic audiences: 1) top manage-
ment; 2) the manager initiating the study; 3) te-
chnical personnel; and 4) the user. Each section
of the documentation should be aimed at one of
these audiences. Table 1 shows the target audience
of each portion of the documentation.

TABLE 1

Documentation Outline

READER	SECTION
Top Management	Abstract
Manager initiating study	Management Summary
	Problem Definition
	Model Description
	Assumptions
	Limitations
	Data Collection Proce- dures
	Validation Procedures
	Experimentation and Analysis Procedures
	Results
	Conclusions and Recomm- endations
	Costs and Resource Re- quirements
Project Director, Technical Supervisor	Technical Summary
	Notation
	Computer Diagram
	Computer Listing
	Data Used
	Validation results
	Experimental Design
	Statistical Analysis
	Experimentation Results
	Statistical Analysis
	References

ABSTRACT

Each simulation documentation should begin
with an abstract which is aimed at top management.
This target audience generally has responsibility
for reviewing the decisions made by lower-level op-
erating managers. The abstract will probably be
used as a partial justification for any decisions
which are based on the study. The interest of top

management is ordinarily confined to the macro aspects of the project. In addition, the abstract may also be distributed to managers of departments which parallel the one for which the study was done. Again, their interest lies primarily in an overview of the problem and its solution.

To satisfy the needs of this audience, the abstract should be brief and should capture the salient points of the project. It should include a brief description of the problem and the problem environment. It should report the relevant results of the study and recommended courses of action. The costs of completing the project should be briefly summarized. Finally, the abstract should suggest other possible uses of the model.

MANAGEMENT SUMMARY

The management summary is written for the manager who initiated the study and is responsible for the funding of the project. He has responsibility for making decisions based on the study. The only purpose of the simulation project is to help him make better decisions. Therefore, the management summary should include all the information necessary for him to understand 1) how the model was developed and 2) how to interpret the results of the experimentation. It is imperative that the management summary be free of technical jargon.

The management summary should begin with a complete description of the problem and the nature of the problem environment. It should concisely define the scope of the project which was undertaken. In addition, any assumptions which were made should be clearly stated.

A description of the model should also be included in the management summary. This description should be written in terms easily understood by a layman. The audience is the manager, not other simulation practitioners. A very general block diagram of the system might help the manager see the relationship between the simulation and the system being modeled. Any limitations of the model should be clearly defined.

The management summary should also include an overview of the statistical procedures used in the experimentation. The goal here is to acquaint the reader with the manner in which the experimentation was done; care should be taken to exclude formal statistical terms. This section should include the data collection procedures, the validation procedures and the general experimental design and analysis procedures.

Next, the management summary should contain the results of the experimentation. It should also contain any suggested courses of action and recommendations for the implementation of these suggestions. The manager should be advised of possible external variables which may affect the success of the plans. The results of sensitivity analysis should be helpful to the manager as he reaches decisions based on the study.

Finally, the summary should include a complete statement of the costs of conducting the simulation

project. It should specify all resources which were required to complete the study.

TECHNICAL SUMMARY

The technical summary is written for the project director or technical supervisor. The purpose of this section is communication between simulation specialists. The project should be completely specified to allow efficient updates and to facilitate the building of similar models in the future.

The technical summary should include a technical description of the model. All symbols and notations should be completely specified. A computer diagram and a program listing should be included. In addition, the details of model validation should be presented. All input data should be listed.

The experimentation on the model should be explained. The experimental design procedures and data analysis techniques should be fully specified. All results should be shown.

Finally, a list of pertinent references should be included. The list should include works cited in the report as well as related works which might prove useful to a specialist referring to the simulation project in the future.

USER'S OPERATING INSTRUCTIONS

An additional section may be necessary for simulation models which are to be used as part of the day-to-day decision making process in the firm. Users of the model might be first-level management or even operating personnel. They will not be technically oriented. Nor will the user need the detail necessary in the management summary. This audience needs only to understand how to use the model and to interpret the results. Therefore, the writer should prepare this section so that it may stand alone.

The user's operating instructions should begin with a statement of the purpose for which the model was intended. It should include detailed information concerning 1) the nature of the input data, 2) how it should be prepared and 3) how it should be entered. It should also specify the content of output reports and should explain how the output is to be translated into operating decisions.

CONCLUSION

This paper suggests an approach toward documentation of simulation projects which is based on the premise that management has purchased a product, documentation. When a manager initiates and funds a simulation project, whether it is through an outside consultant or an in-house specialist, he expects useable results. The creative process in which the modeller engages and the model he completes are secondary to the results of the project. The manager is interested only in obtaining results which he can understand and believe. The formal communication of the results of the project and the

-method by which they were obtained is the simulation documentation.

As the operating costs of business continue to rise, all projects will be subject to scrutiny. Thus, simulation practitioners will have to be able to show that their efforts have merit. Effective simulation documentation is the key to justifying the costs of simulation projects.

BIBLIOGRAPHY

1. Beckwith, R. E. "Report On A Simulation Survey," Unpublished Manuscript, Graduate School of Business, Tulane University.

2. Konczal, Edward F. "Models Are For Managers, Not Mathematicians," Journal of Systems Management, Vol. 26, No. 1, pp. 12-15.

3. Lesikar, Raymond V. Report Writing for Business, Richard D. Irwin, Inc., Homewood, Illinois, 1969.

4. London, Keith R. Documentation Standards, Petrocelli Books, New York, 1974.

5. Lucas, Henry C. Jr., "The Implementation of Computer-Based Models," Management Accounting, Vol. 57, No. 8, pp. 49-50.

6. Luecke, Michael C. "Computer Models: 'Black Box' or Management-Oriented?" Management Reivew, Vol. 62, No. 4, pp. 48-50.

7. McLeod, John. "Toward Uniform Documentation - PHYSBE and 1130 CSMP." Simulation, Vol. 14, No. 5, pp. 215-220.

8. Menkus, Belden. "Defining Adequate Systems Documentation," Journal of Systems Management, Vol. 21, No. 12, pp. 16-21.

9. Menkus, Belden. "Effective Systems Reports," Journal of Systems Management, Vol. 27, No. 9, pp. 18-20.

10. Robinson, John P. and James D. Graviss. Documentation Standards Manual For Computer Systems, Association For Systems Management, Cleveland, Ohio, 1973.

11. Silbey, Val. "Management Reporting of Simulation Results," Unpublished Manuscript, School of Business and Organizational Sciences, Florida International University.

12. Watt, Kenneth F. "Why Won't Anyone Believe Us?" Simulation, Vol. 28, No. 1, pp. 1-3.

13. Yorks, Lyle. "Managing Professional Relationships: Part 1 - Communication Skills," Journal of Systems Management, Vol. 28, No. 1, pp. 6-11.