Association for Information Systems
AIS Electronic Library (AISeL)

AMCIS 1996 Proceedings

Americas Conference on Information Systems (AMCIS)

8-16-1996

Are Two Heads Better than One (At Reducing Spreadsheet Errors)?

Raymond R. Panko
University of Hawaii, panko@hawaii.edu

Are Two Heads Better than One
(At Reducing Spreadsheet Errors)?

Raymond R. Panko

Richard H. Halverson

University of Hawaii University of Hawaii

panko@hawaii.edu

Abstract

This paper describes an experiment in which subjects developed a spreadsheet model working alone, in teams of two (dyads) or in teams of four (tetrads). The goal was to determine whether synchronous development could reduce errors overall and could reduce different types of errors. Synchronous group development reduced errors compared to individual development, but only moderately. Group development was best for omission errors and Eureka logic errors. It was not good for reducing Cassandra logic errors. Mechanical errors tended to happen too quickly for team members to recognize.

Introduction

It is difficult to imagine a major decision being made in a corporation today without someone "going through the numbers" by building a spreadsheet model. Unfortunately, there is growing evidence that many of these spreadsheets contain errors. Previously, the authors [1996] summarized research on spreadsheet errors. Perhaps the most important finding was that every study that has looked for errors had found them and has found them in disturbingly high numbers. For instance, the authors [1996] cited three audits of operational spreadsheet models that found error rates of 21% to 30%. In another case [Hicks, 1995] a three-person team code-inspected a 4,000-cell model at NYNEX before releasing it for use. They found errors in 1.2% of the cells.

Laboratory studies have given us more detailed insights into errors. For experiments that looked at whole models, the authors [1996] found that the percentage of models containing errors ranged from 38% to 80%. In addition, they found that cell error rates (CERs)-the percentage of cells with errors-ranged from 1.7% to 9.3%. They also cite data from other studies that looked at error rates in particularly complex formulas or in formulas that referenced distant cells. Error rates in these studies ranged up to 17%.

Three laboratory studies looked at code inspection, in which subjects studied a model to discover errors. The fraction of errors not discovered ranged from 44% to 84%.

These numbers may seem high. But the cell error rates found in spreadsheet programs are very similar to error rates found in computer programming [Panko & Halverson, 1995], both during development and during code inspection. This may seem surprising, because there is a stereotype of spreadsheet models as small and simple files. However surveys have shown that many spreadsheets are very large [Hall, 1996; Floyd, Walls, & Marr, 1995] and involve complex logic [Hall, 1996].

Programmers have long known that to reduce programming errors to an acceptable degree is to impose a number of formal disciplines on requirements analysis, design, development, testing, and implementation. However surveys of spreadsheet developers [Hall, 1996; Floyd, Walls, & Marr, 1995] have shown that such practices are largely ignored or are applied only sporadically.

One way to reduce errors may be to have synchronous development. In this approach, small teams of developers would create a spreadsheet while working together, sharing a common image of the model on a screen or on multiple screens locked together. Steiner (1972) showed that groups are more likely to get the correct answer than an individual working alone. However there are diminishing marginal returns as group size grows, and of course costs rise when you add people to a task. This prompted us to compare individual development with development by groups of two (dyads) and groups of four (tetrads).

The Experiment

In the experiment, subjects developed a pro forma income statement from a word problem. The model solution contained 42 cells, 21 of which were formula cells.

All subjects were junior and senior business students. There were 132 subjects, excluding accounting and finance majors. Of these subjects, 42 worked alone, 46 worked in dyads, and 44 worked in tetrads.

Table 1: Summary of Errors

Category	Ugrad Alone	Ugrad Dyad	Ugrad Tetrad	MBA Total	MBA Experienced
Number	42	46	44	49	16
Percent of cells with errors	5.6%	3.8%	1.9%	1.0%	0.9%
Percent of models with errors	79%	78%	64%	57%	56%

Errors were analyzed in several ways, following a framework developed earlier by the authors [Panko & Halverson, 1996]. First, there was a count of errors overall. Next, errors were categorized by type. Most broadly, there were mechanical errors, logic errors, and omission errors. Mechanical errors included typographical and pointing errors. Logic errors involved the use of the wrong algorithm or the incorrect implementation of a correct algorithm. Omission errors involved leaving something out of the model that should be there. Logic errors were further divided into Eureka errors, which are easy to prove, and Cassandra errors, which are difficult to demonstrate as errors to other team members. In addition to counting errors, we computed a cell error rate for each type of error.

Table 1 shows that subjects working alone made errors in 5.6% percent of their cells and 79 percent of their spreadsheet models. This was clearly an unacceptable result from a business viewpoint. Dyads did slightly better, but the differences were not statistically significant. Nor were they enough to make spreadsheeting safe. Tetrads did make significantly fewer total errors than individuals, but the improvement was still not enough to make spreadsheet development safe.

Looking at types of errors, groups were very good at eliminating omission errors, which in past research in other areas have been found to be very difficult for individuals to detect. They did quite well at Eureka logic errors but not at Cassandra logic errors, again confirming expectations.

For mechanical errors, tetrads were significantly better than students working alone, but given the unlikely chance of two people simultaneously making the same error, the improvement was not as great as one would expect. Observation of the groups revealed that when one person was entering formulas, mechanical errors occurred very rapidly. Other team members were often looking away at the critical moment. Synchronous group development does not look like an effective way to eliminate mechanical errors.

Of course it can be argued that because the study used undergraduate students, it tells us nothing about real-world spreadsheet development. To test this possibility, we gave the task to 49 MBA students. Table 1 shows that they had a lower cell error rate but still had unacceptable numbers of incorrect spreadsheets. Even MBA students with more than 250 hours of spreadsheet development and debugging experience (averaging 630 hours) made an unacceptable number of errors.

Perspective

Overall, while synchronous group development reduced errors, it did not reduce errors enough to make spreadsheet development reliable. Other techniques will be needed to reduce errors to reasonable levels.

More broadly, there is enough evidence of spreadsheet errors to justify an aggressive program of research in this area. We need to study various approaches to reducing spreadsheet errors. In addition, we have to conduct more work outside the laboratory, on real groups. With four field studies already done, and with each showing errors, the focus in the future should be on understanding real-world cell error rates and on understanding the types of errors that working professionals make.

References

Floyd, B. D., Walls, J., & Marr, K., "Managing Spreadsheet Model Development," Journal of Systems Management (46:1) May/June 1995, pp. 38-43, 68.

Hall, M. J. J., "A Risk and Control Oriented Study of the Practices of Spreadsheet Application Developers," *Proceedings of the Twenty-Ninth Hawaii International Conference on System Sciences,* Maui, Hawaii, January 1996, pp. 364-373.

Hicks, L., NYNEX Corporation. Private communication with the first author, June 1995.

Panko, R. R. & Halverson, R. H. Jr., "Spreadsheets on Trial: A Survey of Research on Spreadsheet Risks," *Proceedings of the Twenty-Ninth Hawaii International Conference on System Sciences,* Maui, Hawaii, January 1996, pp. 326-335. http://

www.cba.hawaii.edu/panko/ ss/h6trial.htm.

Panko, R. R. & Halverson, R. H. "Patterns of Errors in Spreadsheet Development I: Quantitative Errors," Working Paper, Department of Decision Sciences, College of Business Administration, University of Hawaii, 2404 Maile Way, Honolulu, HI 96822, March 1995. ftp://splicer2.cba.hawaii.edu/panko/ sserrors/sswpmar.doc

Steiner, I. D. *Group Process and Productivity,* Academic Press, New York, 1972.

The space for this page is provided by the Hankamer School of Business at Baylor University. Please send correspondence relating to content directly to the author of the page. Please notify the webmaster webmaster@hsb.baylor.edu of technical problems or inappropriate material. This page was last modified on June 25, 1996