

## ***Improving Performance with Enhanced Measures and Causal Analysis in an Agile Organization***

*Paul E. McMahon  
CMMI/Agile Consultant  
PEM Systems*

*Bela Joshi, Ph.D.  
Sr. Principal and EPG Member  
Alion Science and Technology Corp.*

**Abstract:** The Advanced Modeling and Simulation Technology Operation (AMSTO) of Alion Science and Technology Corp is a CMMI-DEV Maturity Level 3 organization. In 2013, AMSTO personnel, with guidance from their CMMI/Agile consultant, undertook an initiative to improve performance through enhanced measures and causal analysis. This paper presents the analysis and describes the resulting improvements implemented.

**Background:** AMSTO provides technical solutions to the Department of Defense mainly in the modeling and simulation arena. The majority of its software projects use a tailored version of Scrum.<sup>1</sup> AMSTO's process journey began in 2003 and culminated in CMMI DEV Maturity Level (ML) 3 appraisal in the year 2007. The organization maintained their ML3 with a re-appraisal in 2010. The processes developed by their working groups are lightweight, providing the minimum essential "must dos" for all projects supporting their agile approach.

**Motivation for 2013 Improvement Effort:** AMSTO is a successful organization with happy customers providing repeat business for the organization. AMSTO had been planning a move toward CMMI Maturity Level 4/5 since the 2010 appraisal. As the organization prepared for the second re-appraisal in 2013, the CMMI/Agile consultant strongly encouraged maturing the Measurement and Analysis (MA) process area. While MA was institutionalized, it was felt that there was significant potential for reaping benefits by performing an analysis of the defects that were "escaping" AMSTO internal test.

**How the Improvement Effort was Conducted:** The improvement effort was initiated with a brainstorming session that included the Engineering Process Group (EPG) members and some project personnel. Various improvement ideas were considered for adoption. Some of these included enhancing sprint retrospectives, task estimation improvements, and defect analysis improvements focused on reducing escapes (a defect that *escaped* detection during AMSTO testing and was instead discovered by the end-user). While multiple improvement efforts were ensued, this report focuses on defect analysis and how improvements were initiated based on that analysis.

**Defect Analysis:** Defect analysis was performed on a successful on-going project (over 8 years), in which AMSTO was the prime developer for a software product used by the U.S. Department of Defense. The project had well established processes for all aspects of software engineering including requirements gathering, design, development, integration, verification, and validation. The project team had a mix of experienced, senior developers, as well as some newer, junior developers. The software product underwent a

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<sup>1</sup> [http://en.wikipedia.org/wiki/Scrum\\_\(software\\_development\)](http://en.wikipedia.org/wiki/Scrum_(software_development))

joint verification event with the government customer, before being released and installed in the end-user environment for further validation.

The first step was to extract key information about each escape by interviewing project developers. The goal was to determine the root cause for each escape by utilizing the 5 Whys technique<sup>2</sup> while conducting the interviews. By categorizing each escape according to the root cause (e.g., analysis, design, test) we hoped to use the Pareto principle and apply improvement efforts to the category with most escapes. This was a crucial step in obtaining management buy-in for applying scarce overhead resources in order to get maximum returns on improvement efforts.

At first glance, the Pareto principle did not hold (i.e., no single category was responsible for most escapes). However, upon closer analysis of data it became apparent that “requirements” were most often the underlying cause. This discovery led us to re-categorize and the Pareto principle was supported. Further analysis was conducted to find underlying and assignable cause(s). We also asked developers for suggestions on how to keep escapes from occurring in the future. A report to Senior Management contained the above results as well as the amount of time it took to conduct the study. This data was crucial in “selling” this approach as a new part of the AMSTO MA process.

*Results Achieved:* In the aforementioned interviews, the two most common patterns that emerged were "inadequate requirements" and "inadequate regression testing." The root cause for both conditions was found to be weaknesses in the practice of requirements development. Poor requirements not only lead to an inferior product but also lead to inferior tests.

*Validation:* An important aspect of the study was to validate the results before making significant changes in AMSTO processes that had worked successfully for many years. We compared the results of the study with observations made through periodic gap analyses and training workshops conducted by the CMMI/Agile consultant. It was clear that AMSTO teams frequently found themselves performing on the cutting edge, in which technical solutions were built in a dynamic manner for first use in a research and development environment. “Incomplete,” “ambiguous,” “insufficient,” and “vague” requirements were raised by numerous AMSTO engineers as concerns during the gap analyses interviews. Oftentimes, in such situations, customers and end-users did not know all the requirements upfront, which prompted the engineers to employ an iterative approach to developing requirements. An iterative approach also worked well with the agile/scrum development cycle. However, even though AMSTO engineers enjoyed a good collaborative relationship with customers, due to busy schedules and priorities, customer representatives were not always able to provide clarifications in a timely manner. In order to comply with contractual timelines, project teams sometimes had to make assumptions while performing development and also while producing test scripts. The results of the analysis study were thus validated in this manner.

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<sup>2</sup> [http://en.wikipedia.org/wiki/5\\_Whys](http://en.wikipedia.org/wiki/5_Whys)

*Implementation of Improvements:* It was determined that there were no "assignable causes" or "quick fixes" that could be applied. Employees would have to be trained and mentored on the importance of developing complete and unambiguous requirements. To this end, improved requirements development guidelines were developed. These improved guidelines included concrete and practical methods to develop requirements under the common conditions teams often faced. As an example, when a customer is unavailable to collaborate, the guidelines suggest finding a Subject Matter Expert (SME) to act as a "customer surrogate," and keeping the customer in the loop so he/she can participate when time allows.

*Plan Forward:* The improved requirements development guidelines are being deployed and trained. The plan is to continue to monitor escapes to determine if these changes have led to measurable improvements or if further improvements are needed.

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