Standards InSide-Out

This subcommittee has both an ambitious and productive work program.

One of the highlights for me at the meeting was the progress that was made in conjunction with the TC69 ad hoc group on Big Data. An applicability analysis of the TC69 standards for Big Data was conducted and it was determined that almost a majority of the TC69 statistical standards are relevant to Big Data, even though they were not originally developed with massive data sets in mind. In fact, the entire suite of control chart and acceptance sampling standards apply to observational data and are scalable to arbitrarily large data sets. Future standards to address Big Data issues specifically are being anticipated (relative to validation, terminology and the computational ecosystem) and it is hoped to have a designated convenor for the ad hoc Group later this year (M. Boulanger is currently interim convenor).

Any US readers interested in contributing to international statistical standards work should contact Jennifer Admussen of ASQ at Standards@asq.org. Non-US citizen international experts should contact their country's official standards organization. By applying in the next few months, delegate status could be achieved to allow official participation in next year's meeting to be tentatively held in Cape Town, South Africa.

FEATURE

Agile Teams: A Look at Agile Project Management Methods

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Agile Project Management

Agile project management methods emerged from the software development community, but have migrated into many aspects of business and industrial project management. Software development and IT projects are often large and uncertain undertakings where planning is difficult, changes in scope are frequent, and customer requirements are unknown until solutions are released. Unfortunately, the complexities and uncertainties of these projects have led to historically high and costly failure rates (Charette, 2005). Most of us can recall large software releases that have resulted in customer backlash followed by numerous patches and updates. Recent approaches in software development have migrated to more evolutionary development cycles, where new releases incorporate fewer changes and are rapidly deployed, allowing for more flexibility and responsiveness to customer feedback.

In "Why Evolutionary Software Development Works," the author discusses research into successful software development projects, and noted that the best outcomes were obtained from an evolutionary development approach (MacCormack, 2001a). When companies first released a low-functioning version to select customers, obtained rapid feedback, and quickly incorporated that feedback into subsequent versions, success was much more likely. McCormack (2001b) noted four best practices for software development: (1) an early release of the evolving product design; (2) daily incorporation of new code and rapid feedback; (3) a team with broad-based experience; (4) major investment in the design of the product architecture.

In 2001, seventeen software developers who were passionate about evolutionary methods to software development joined together and wrote the Agile Manifesto (Beck et al., 2001) in which they described twelve principles of Agile software development. These include prioritizing customer satisfaction, having working software as the primary measure of success, working in cross-functional teams, attention to technical excellence, and periodically reflecting on team performance. Out of this manifesto grew the widespread implementation of Agile project management methods in software development and IT organizations. Many internet companies use Agile project management to accelerate time to market, manage changing priorities, and better align projects with business objectives (Version One, 2014).

Scrum Methodology

Agile is an umbrella term that describes a philosophy behind software or product development practice. Thus, if a team is using an Agile approach, they may be using one of a number of methodologies. The most popular is a process developed by Jeff Sutherland and Ken Schwaber known as scrum (Sutherland and Sutherland, 2014). The term "scrum" was borrowed from Takeuchi and Nonaka (1986) where they compared high-functioning teams to the scrum formation in Rugby. Merriam-Webster's defines a scrum as

> *a rugby play in which the forwards of each side come together in a tight mass and struggle to gain possession of the ball when it is tossed in among them (Scrum, 1986).*

The scrum methodology includes a few guiding principles. These include

- Divide and Conquer. Divide complex entities into simple pieces. This includes dividing large teams into smaller focused teams as well as large projects into small pieces that can be completed in a short period of time. These short time periods for task completion are a hallmark of the scrum method and are known as sprints.
- Inspect and Adapt. Once the small tasks are completed, rapid feedback is gained. Reviews are conducted to gain insight from stakeholders, and this feedback is quickly incorporated into the deliverable from the sprint. In addition, team members conduct a retrospective to discuss the process of completing the sprint. Simple, brief meetings are held to discover what worked, what did not work, and what plans the team has for improved team functioning.
- Transparency. Everyone involved in a project is aware of who is working on what and their progress. The scrum method uses shared visual tools to track the activities, making it easier to know the status of all parts of the complex project. These tools can be as simple as a whiteboard or wall divided into categories, with post-it notes containing small tasks. Figure 1 gives an example of a scrum board

There are many more aspects to the scrum methodology that can be found in, e.g., Schwaber (2004) and Sutherland and Sutherland (2014).

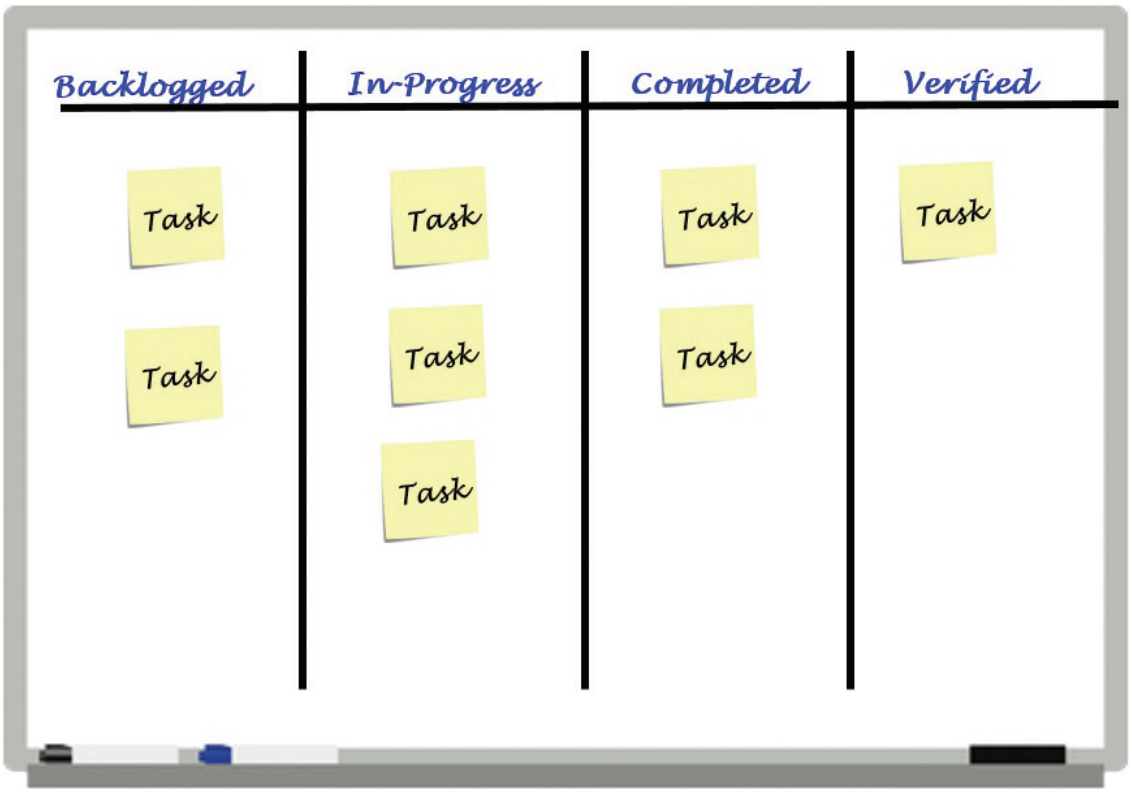

Figure 1: An example scrum board

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When Agile Works Best

Agile project management is the most applicable when a project is unstructured and the outcome is unknown or unknowable. An often used analogy is an artist developing a painting such as Da Vinci and the Mona Lisa. Using a traditional project management approach, the artist would be required to conceive of the entire completed work prior to painting. Then he would complete sequential portions of the painting as illustrated in Figure 2.

For many projects, it is difficult or impossible to know what the outcome will be at the onset of a project. Planning and budgeting are difficult, and the project scope and outcomes evolve as the team members gain more information and knowledge. Continuing with our Mona Lisa example, Figure 3 illustrates an Agile approach to creating the masterpiece.

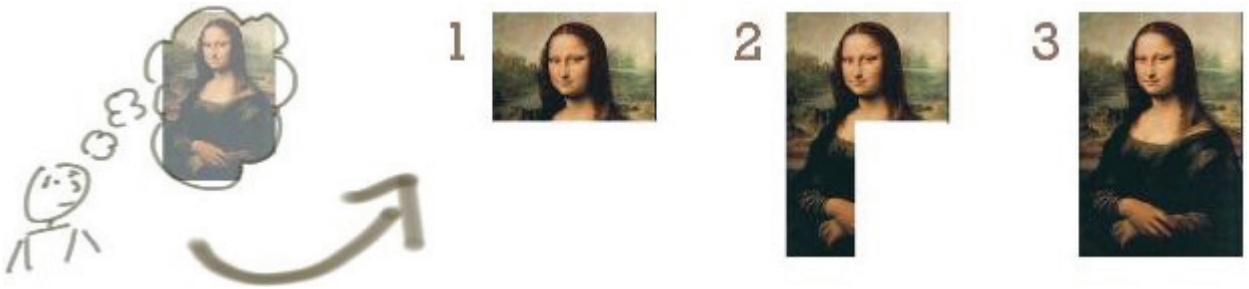

Figure 2: Traditional Project Management. Reprinted with permission from Patton (2008), Illustration is based on concepts originally presented in Armitage (2004)

Figure 3: Agile Project Management. Reprinted with permission from Patton (2008), Illustration is based on concepts originally presented in Armitage (2004)

Is Agile New?

No. The principles underlying Agile draw heavily from project management methods that have been around for decades including Lean, Six Sigma, and Total Quality Management.

Agile vs. Lean. The underlying principles of Agile project management seem to draw heavily from the Lean philosophy which focuses on creating better customer value while minimizing waste. Both Lean and Agile emphasize fast deliverables. The emphasis of Lean is on reducing waste and unnecessary steps; however, Agile emphasizes breaking large tasks into small ones and delivering in short sprints. Both Lean and Agile use some sort of an action loop. In Lean, this is the build-measure-learn cycle, while Agile's scrum methodology uses an iterative sprint approach. In addition, both Lean and Agile were developed in specific functional areas (manufacturing and software development, respectively), but their implementation quickly spread to other functional areas. Interestingly, many practitioners and consultants have substantially blurred the lines between the use of Lean and Agile methods, using an Agile approach for smaller, more focused teams, and using a Lean approach to integrate their projects into enterprise level solutions (Woods, 2012).

Agile vs. Six Sigma. The underlying philosophies behind Agile and Six Sigma differ quite a bit. Six Sigma is a set of data-driven methodologies (statistical and graphical tools as well as project management approaches) designed to reduce variation in a well-defined process. Fundamental to the Six Sigma approach is the DMAIC (Define, Measure, Analyze, Improve, Control) cycle. Like both Lean and Agile, organizational commitment is required for success, particularly from top management and project champions. Six Sigma emphasizes clear measurable objectives and decision making based on verifiable data. Compared to Six Sigma, Agile methodologies appear loose and unstructured. Agile enthusiasts, however, argue that the Agile approach encourages innovation and creativity while strict adherence to structured problem solving approaches such as Six Sigma stifles innovation and creativity. Agile methods are evolutionary and are most applicable for unstructured projects when the outcome is difficult to imagine. Six Sigma, on the other hand, works well in a more structured environment (e.g. manufacturing), when improvement of a specific process is the goal of the project.

Design for Six Sigma (DFSS) is a process methodology that is related to Six Sigma, and is more readily applied in service industries. DFSS emphasizes using a Six Sigma tools for designing products or solutions. The structure behind DFSS project management varies quite a bit across applications and industries. Although both DFSS and Agile are methodologies for designing products and solutions (rather than improving existing processes), the underlying principles differ fundamentally. DFSS emphasizes designing quality into a product and getting it "right the first time." Agile, on the other hand, emphasizes an "inspect and adapt" approach where small releases are delivered, inspected, modified, and rereleased. To many traditionalists, the Agile approach may seem ill-advised when compared to the DFSS "right the first time" methodology. However, we suggest that both methods have their place, and the use of one method in some circumstances does not negate the use of the other in another circumstance. If a product or process can be well-defined, there is a suitable history detailing customer expectations, and the goal and specifications are known in advance, a structured DFSS methodology will work best. If, however, the product or process is difficult to define, there is limited customer history, and specifications are undefined, incorrect, or have changed dramatically, Agile methods will prove more flexible and prevent time wasted building a perfect solution to the wrong problem.

Total Quality Management. The philosophies underlying Total Quality Management (TQM) are generally attributed to Deming's work, including his 14 Points and System of Profound Knowledge (SoPK) (see, e.g., Deming 1986). Miller and Krehbiel (2016) provide a detailed comparison of Agile methods to Deming's 14 points and SoPK. We will not replicate this comparison here, but simply restate their main conclusions.

The Agile philosophy underscores several of the 14 Points, but remains silent on others. Through its focus on iterative development and inspect/adapt approach, the Agile philosophy addresses points #3 (Cease dependence on mass inspection) and #4 (End the practice of awarding business on the basis of price tag). Through its focus on cross-functional teams, iterative development, retrospective evaluation, and transparency, the Agile philosophy addresses points #8 (Drive out fear), #9 (break down barriers between departments), #12 (Remove barriers that rob people of pride of workmanship), and #13 (Encourage education and self-improvement).

Miller and Krehbiel (2016) noted that in comparison to the TQM philosophy, Agile is weak in a systems focus and understanding of variation in a system. However, they noted that Agile methods were particularly strong in terms of promoting interactions among people and understanding the need for intrinsic motivation.

The Power of the Post-It

Organizations have had differing levels of success in integrating the problem solving methodologies discussed above. Each of the methods shares several common traits, but they all differ to some degree in their underlying philosophies and how they are implemented. We see tremendous value that can be gained by the use of Agile methods along with existing project management frameworks. Although Agile lacks a systems focus, the Agile principles apply directly to managing smaller projects within enterprise-level initiatives. Analytics and data science projects are often exploratory in nature, require cross-functional teams to work together, and the scope is often developed through team discovery. Thus, we see Agile methods as particularly suited to moving analytics and data science projects forward, preventing backlogs and roadblocks that can occur due to uncertainty and poor communication.

Agile Teams: A Look at Agile Project Management Methods

We believe that analytics and data science projects can produce higher-quality deliverables by using scrum methodologies. As noted earlier, three of the guiding principles of scrum are *Divide and Conquer*, *Inspect and Adapt*, and *Transparency*. Dividing complex projects into sprints, i.e., simpler pieces that can be completed in a short period of time by smaller focused teams, produces preliminary results quickly (*divide and conquer*). Once the smaller pieces are completed and results shared with the larger team and other stakeholders, the rapid feedback on the newly discovered knowledge can help guide the next step of the discovery process (*inspect and adapt*). At all times, everyone involved in a project needs to be aware of who is working on what and their progress (*transparency*).

In our opinion, one of the most valuable principles of the scrum methodology is that of transparency. Visual project management tools such as the scrum board (see Figure 1), when used and maintained, provide a central source of communication for a team. In our experience, the use of post-it notes on a scrum board for brainstorming necessary tasks, determining the level of time or expertise involved in completing the tasks, and tracking team progress is a surprisingly powerful tool in breaking down barriers and roadblocks. Those who have facilitated process improvement teams have likely used a similar approach to project management for many years. As with many methodologies and even entire fields, these tried and true methods have been tweaked and rebranded. For better or for worse, the branding of Agile project management is a highly desired skill set in many industries.

Through our work with students on experiential learning projects in analytics and data science, we have seen the "power of the post-it" quickly transform teams from frustration, duplicated efforts, and miscommunication to well-functioning and successful teams. Our Center for Analytics and Data Science at Miami University is embracing many of the Agile philosophies. We teach these along with project framing, statistical, and technical skills related to data. It is an understatement to say that our students are highly sought after and have no difficulties attaining employment upon graduation. Lessons of teamwork, project management, communication skills, and importance of transparency and reproducibility are invaluable to our future analytics workforce. Although the Agile principles do not provide a comprehensive system-wide framework for quality improvement, they do promote innovation, responsiveness, and transparency in solving unstructured problems. We believe Agile methods can be important tools in the toolbox of many industrial statisticians.

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Timothy C. Krehbiel is Professor of Management in the Farmer School of Business at Miami University. He has won numerous teaching awards including MBA Professor of the Year on three different occasions and the prestigious Instructional Innovation Award from the Decision Sciences Institute. Dr. Krehbiel's current research focus is on quality management systems and methodologies including Lean, Agile, and Six Sigma. His work appears in numerous journals including ASQ's *Quality Management Journal* and *Quality Progress*, and he has co-authored three statistics textbooks: *Basic Business Statistics*, *Statistics for Managers Using Microsoft Excel*, and *Business Statistics: A First Course*. Dr. Krehbiel earned his PhD in statistics from the University of Wyoming and is a Senior Member of ASQ.

Dr. L. Allison Jones-Farmer is the Van Andel Chair of Analytics, the founding director of the Miami University Center for Analytics and Data Science, and a Professor in the Department of Information Systems and Analytics at Miami University in Oxford, Ohio. Her research focuses on developing practical methods for analyzing data in industrial and business settings. She is on the editorial review board of Journal of Quality Technology, a former Associate Editor of Technometrics, and was recently awarded the Lloyd Nelson Award (2014) for the paper in Journal of Quality Technology with the most immediate impact to practitioners. Dr. Jones-Farmer enjoys developing innovative curricula and teaching analytics and statistics to both undergraduate and graduate students. She is the 2005 recipient of the Colonial Company Teaching Excellence Award, the 2008 recipient of the MBA Teacher of the Year Award, and the 2012 recipient of the Outstanding Teaching Award at Auburn University. Prior to joining Miami University of Ohio, Dr. Jones-Farmer served on the faculty at University of Miami in Coral Gables, Florida, and at Auburn University in Auburn, Alabama. She is a Senior Member of ASQ.

Ellis R. Ott Scholarship Winners

Andy Walter has been teaching high school mathematics and coaching high school football for 10 years. He has taught Advanced Placement Statistics for 7 years, and has served as an AP Reader for two. He is currently pursuing a Master's in Applied Statistics through the University of Kansas. His research interests are statistics education, education policy, and public policy. He and his wife Elizabeth live in Prairie Village, KS.

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