AGILE: HIGHER EDUCATING STEM COLLEGE STUDENTS

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Abstract

The general consensus is that the demand for science, technology, engineering and mathematics (STEM) workers has and will continue to increase in the foreseeable future. However, the misalignment between what employers need and what skills are taught and delivered has been expressed as a critical problem for U.S. competitiveness.[i] *Exposure during those formative college years to a broader application of the tenets of the Agile methodology which is gaining significant traction in industry and government, holds the promise of better preparation of those entering the workforce. This approach may be a pivotal element of a solution to higher educate STEM students.*

Majoring in STEM – Necessary, but not Sufficient

While the statistics vary, the general consensus is that the demand for science, technology, engineering and mathematics (STEM) workers has and will continue to increase in the foreseeable future. This is good news for students who have endured the rigor of college level study to earn STEM degrees. However, the lack of alignment between what employers need and what skills are taught and delivered has become a critical problem for U.S. competitiveness.[ii] Project based learning has emerged as a promising educational approach to mastering skills for the workforce. In fact, there are universities that have completely abandoned their traditional lecture-based pedagogy.[iii] Also topping a list of the Five Ways to Better Prepare Students for Careers is "teamwork". These components – project based learning and teamwork - considered together yield statements such as "Employers want people who understand how to manage a project, how to deliver a product on time and on budget, and how to work in teams with little or no oversight".[iv]

Agility

Enter stage left, Agile. Agile is a movement that proposes alternatives to traditional project management.[v] With its roots and typical use in software development, it is now being considered as a methodology that when adopted in a manner that emphasizes its core principles, can help businesses better respond to unpredictability. The original Agile Manifesto adheres to twelve (12) principles[vi] some of which can be extended and/or converted for a broader application to science and technology project management. Such an extension with a minor allowance for the possible need for remote communications (reference 6.) follows in summary form:

1. Priority is satisfying the customer through early and continuous delivery of *versions of the system.*
2. Welcome changing requirements, even late in development. (no change)

3. Deliver *working versions of the system* frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Business people and developers must work together daily throughout the project. (no change)
5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done. (no change)
6. The most efficient and effective method of conveying information to and within a development team is *temporally synchronized, preferably* face-to-face conversation.
7. Working *(sub)system(s)* is the primary measure of progress.
8. Agile processes promote sustainable development. (no change)
9. Continuous attention to technical excellence and good design enhances agility. (no change)
10. Simplicity--the art of maximizing the amount of work not done--is essential. (no change)
11. The best architectures, requirements, and designs emerge from self-organizing teams. (no change)
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly. (no change)

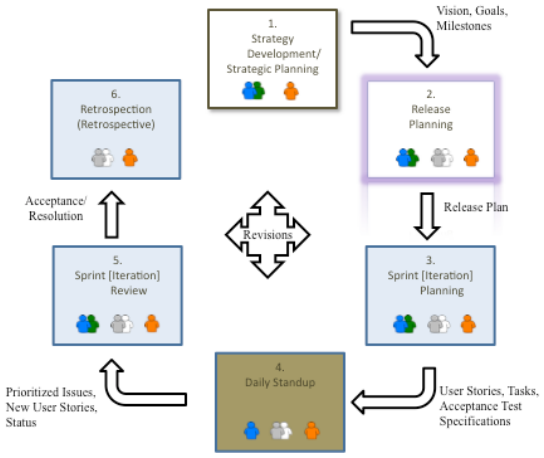
Even a cursory understanding of the broadened principles lends to a creditable argument that communicative, self-organizing, self-managing and frequently engaged teams are likely to make a major contribution to innovation in the workplace. This is a prescription for circumstance essential to successful science and technology projects.

Putting it Together

There are a number of implementations and practices of the Agile methodology that emphasize iterative development, collaboration, and accountability of each member of the team to the team itself. The list includes, but is not remotely limited to: Disciplined Agile Delivery (DAD), Dynamic Systems Development Method (DSDM) and its Alternative, Agile Unified Process (AUP), and multiple renditions of Scrum. The jewel is not in examining the detailed differences of and between the frameworks. But, rather to examine the underlying Agile principles within the context of preparation of STEM college students for the workforce. Hence, for the purpose of raising the contextual point, let's review components of "a" Scrum framework. The presented framework is not intended to reflect any pure or sanctioned modified version of Scrum.

Three Scrum roles are the Product Owner(s), Scrum Development Team and the Scrum Master. The Product Owner is responsible for the vision and is the final arbiter of the system requirements. A STEM student exposed to the conceptual process either as the visionary or interpreter of another's vision becomes familiar with the transition of an idea to a plan. They are also privy to the dynamics of competing stakeholder interests and how related issues are weighed and incorporated into the system. The Scrum Development Team is cross-functional and may include members with varying subject area expertise, implementation practitioners such as systems engineers, software developers and/or others with specialized business analysis skills. They are expected to form a self-organizing and self-managing unit without externally defined roles. [vii] STEM students engaged as a Scrum team would be afforded the opportunity to hone skills such as negotiation and collaborative productivity. Moreover, they may better appreciate the important balance struck between autonomy and accountability to the overall team. The ScrumMaster facilitates the process and addresses impediments to the team progress. Students acting in this role or observing a Scrum Master can exercise creativity in problem solving and working through others to achieve a greater good. There are also identified techniques that are associated with being a SrumMaster that a student may add to their skills portfolio that has value in other professional arenas.

For further examination of added value of exposure and practice of Agile, consider six generic activities and meetings associated with the development of a system are depicted below in a loose logical order. The Strategic Planning activity facilitates STEM student active participation in the articulation of a vision, project goals, and milestones.



The development of the Release plan familiarizes STEM students with Agile components such as themes, epics, user stories, and the backlog. Sprint Planning engages the STEM student in identifying and quantifying a potentially shippable system "increment". [viii] Active participation in both the Release and Sprint Planning meetings provides insight into the interaction between all three (3) roles and negotiation between the Product

Owners and the Development Team. The Daily StandUp, which typically occurs for 15 minutes or less each day, highlights the continual accountability of each member to the team as a whole as a routine characteristic. The Sprint Review provides an opportunity for STEM students to engage in the assessment process as either the reviewer who ultimately determines if the increment is done, or as the ScrumMaster who assists the Product Owner in converting their feedback into modification of the backlog. STEM student participation in the Retrospection (or Retrospective) or reflection on the process and the overall productivity of the team may prove to be a significant experience in that it involves self-assessment of behaviors and fusion of other observations for improvement and adaptability in subsequent iterations.

Higher Educating STEM College Students

The promise of "higher educating" STEM college students through exposure to the tenets of Agile outlined above is boundless. Furthermore, herein lies an opportunity to address voids in STEM college level preparation expressed by employers. The Agile methodology may be infused and/or incorporated at different points or phases of the undergraduate and graduate matriculation. Traditional inclusion in the curriculum via course(s), electives, as part of capstone experiences, and/or through other experiential activities such as internships are all possibilities. Consistent with the spirit of Agile, the exact implementation is flexible and adaptable to the particular higher education environment.

The scope of this writing is providing a competitive advantage and workforce readiness for STEM college students. However, the idea of infusing the tenets of Agile into all college student preparation for the workforce – not just science and technology project management - holds significant promise as well.

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[viii] Ibid