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The Need for Project Management in Science

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May 17, 2017

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This year marks the 47th anniversary of Apollo 13's return to Earth after its crew lost most of their water and oxygen supply in a technical malfunction 200,000 miles away from Earth.[1] [2] A few years earlier, such a malfunction would likely have been fatal for the astronauts. However, the investigation of the Apollo 1 tragedy three years prior to the Apollo 13 mission[3] and the subsequent incorporation of the findings into future spacecraft design[4] demonstrated that evaluation and improvement can yield better products and even save lives. Therefore, the U.S. space program, specifically Project Apollo, has been credited as the start of modern project management.[5]

Although science and project management may appear unrelated, the history of Project Apollo shows that they have always existed together in a mutually beneficial relationship. This paper will discuss the application of project management to scientific research and development, considering project management both as a personal skill and a well-defined discipline. It will cover scientists' potential critiques of formalized project management as well as the benefits of employing project management frameworks in scientific research projects. Finally, the paper will examine a case study and make recommendations for the continued use of project management in science. In comparing the benefits and shortcomings of project management in a scientific setting, it becomes clear that effective project management in science streamlines the research process and yields a higher quality product or caliber of research.

Scientists may assume that they already know how to manage their projects and yield high-caliber results.[6] Therefore, they may criticize formalized project management as a waste of time that adds more meetings to their schedules and cuts into the time they spend on research. Additionally, the competitive nature of science may make researchers territorial and resentful of what they perceive as encroachment by project managers. Furthermore, scientists, who are often highly specialized in their fields, may worry that project managers who are not experts in the same discipline may have unrealistic expectations for their research.[7]

[1] Lewis, R. (10 April 2015). Remembering Apollo 13, NASA's Most Famous 'Successful Failure.' NPR. Retrieved from http://www.npr.org/2015/04/10/398824586/remembering-apollo-13-nasas-most-famous-successful-failure

[2] NASA. (8 July 2009). Apollo 13. Retrieved from https://www.nasa.gov/mission_pages/apollo/missions/apollo13.html

[3] Byrne, B. (26 January 2017). 50 Years Later, NASA Creates Tribute to 3 Astronauts Who Died In Space Race. NPR. Retrieved from http://www.npr.org/2017/01/26/511660847/on-50th-anniversary-nasa-creates-tribute-to-apollo-1-astronauts

[4] Moskowitz, C. (27 January 2012). How the Apollo 1 Fire Changed Spaceship Design Forever. *Space.com*. Retrieved from http://www.space.com/14379-apollo1-fire-space-capsule-safety-improvements.html

[5] Morris, P.W.G. (2004). Science, objective knowledge, and the theory of project management. James Forrest Lecture. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.195.4725

[6] Portny, S.E. and Austin, J. (12 July 2002). Project Management for Scientists. *Science*. Retrieved from http://www.sciencemag.org/careers/2002/07/project-management-scientists

[7] Ernst, G. (2 May 2011). Project management as a bridge between roles in science and business. American Chemical Society. Retrieved from http://cenblog.org/just-another-electron-pusher/2011/05/project-management-as-a-bridge-between-roles-in-science-and-business/

Nevertheless, as the global population grows and the world faces increasingly complex science, technology, engineering, and mathematics (STEM) challenges, scientists find themselves addressing multifaceted research questions, which increases the scale of scientific projects and the demand for project management. Resources geared towards the scientific community include instructions on cultivating project management skills. The Howard Hughes Medical Institute created a guide for scientific management that included a chapter on effective project management.[8] *Science* and the *American Chemical Society* have published opinion pieces[9] and webpages[10] on using project management as a career development tool, yet, the focus on technical skills and career development often fails to acknowledge the benefits of working with project management professionals.

Project management as an industry fills the gaps where scientific research may fall short. It incorporates solutions to funding challenges, addresses coordination issues, and provides a framework that functions within the flexibility of STEM fields. As securing funding for scientific research becomes increasingly competitive, scientists must consider ways to gain an advantage. Project management bridges the gap between science and business, simplifying research questions into profitable products and solutions to attract investment. Additionally, as highly competitive grants such as those funded by the National Institutes of Health (NIH) often require interdisciplinary collaboration, project management professionals help navigate and strengthen the relationship between collaborators through communication and scheduling. Since collaborations may form due to convenience and need rather than compatibility, effective project management can determine a project's success.[11] Furthermore, project management encourages cooperation across a project, further contributing to its success. Due to the competitive nature of science, some researchers keep their ideas and data private to the detriment of the project as a whole. Project management unites researchers into a more cohesive team invested in the same outcome, empowering them to meet project deadlines and goals.

In addition to addressing issues arising from the funding process, project management allows larger projects to operate smoothly. Complex and often interdisciplinary scientific projects require the coordination and oversight of project management. Large projects require researchers to work on multiple sections concurrently. While researchers may focus on the small but important scientific details of their work, project managers can help them prioritize and streamline the process. The main project management framework, *A Guide to the Project Management Body of Knowledge* (*PMBOK Guide*) describes this work pattern as a project with an adaptive life cycle. In the adaptive life cycle

[8] Howard Hughes Medical Institute and Burroughs Wellcome Fund (2006). Making the Right Moves A Practical Guide to Scientific Management for Postdocs and New Faculty. *Project Management* (125-142). Retrieved from https://www.hhmi.org/sites/default/files/Educational%20Materials/Lab%20Management/Making%20the%20Right%20Moves/moves2_ch7.pdf

[9] Kashyap, M. (31 May 2002). Project Management for Scientists, Part 1: An Overview. *Science*. Retrieved from http://www.sciencemag.org/careers/2002/05/project-management-scientists-part-1-overview

[10] American Chemical Society. (n.d.). Project Management. Retrieved from https://www.acs.org/content/acs/en/careers/college-to-career/chemistry-careers/project-management.html

[11] Spencer, D. et al. (2011). Special Theme: Project Management in E-Science: Challenges and Opportunities. *Computer Supported Cooperative Work* 20: 155-163.

model, multiple parts of the project can overlap or occur simultaneously, depending on what the research question and goals demand.[12]

Finally, the flexibility of project management compliments the shifting goals and research questions in science. Although some scientists may balk at formal project management methodology for fear that it will limit their productivity, the goals, timeframes, and budgets developed with project managers are organizational tools that provide room for reevaluation. These aspects of project management do not limit science, but instead allow for projects to be completed successfully.

However, project management does not always equate to immediate success. The decades-long Chesapeake Bay cleanup efforts demonstrate both the need for more effective project management as well as the willingness to constantly reevaluate progress. Overfishing, agricultural runoff, and sewage disposal plagued the Bay, decreasing fishery yields and causing algal blooms that destroyed the Bay's productivity. On December 9, 1983, the governors of Maryland, Virginia, and Pennsylvania, the mayor of the District of Columbia (D.C.), and the U.S. Environmental Protection Agency (EPA) administrator formally agreed to collaborate on Bay cleanup and restoration efforts. Although they set concrete goals for decreasing pollution, the increasing population in the Chesapeake watershed combined with industry opposition rendered these goals unfeasible. Unwilling to lose funding for cleanup, the EPA used computer-modeled projections instead of water quality measurements to show the Bay's potential to meet the pollution reduction goals. These projections overestimated the progress of Bay cleanup, and, despite decreasing pollution, EPA continuously fell short of its mitigation goals.[13]

On May 12, 2009, President Obama issued Executive Order (EO) 13508, Strategy for Protecting and Restoring the Chesapeake Bay Watershed. This EO created the Federal Leadership Committee for the Chesapeake Bay to oversee various individual projects that contribute to the larger cleanup goals. It also required annual updates on the progress of Bay cleanup efforts.[14] Consequently, on June 16, 2014, representatives from six states, D.C., the federal government, and the Chesapeake Bay Commission signed the Chesapeake Bay Watershed Agreement, which developed detailed work plans and additional measures for Bay cleanup.[15] [16] [17] Although the Bay cleanup and recovery efforts are far from complete,[18] the progress that various projects have made is due not just to science but to

[12] Rowley, J. (1 February 2013). 5th Edition PMBOK Guide—Chapter 2: Project Life Cycle Types. Retrieved from https://4squareviews.com/2013/02/01/5th-edition-pmbok-guide-chapter-2-project-life-cycle-types-predictive-iterative-agile/

[13] Fahrenthold, D.A. (27 December 2008). Broken Promises on the Bay. *Washington Post*. Retrieved from http://www.washingtonpost.com/wp-dyn/content/article/2008/12/26/AR2008122601712.html?sid=ST2008122601782

[14] Exec. Order No. 13508, 3 C.F.R. (2009). Retrieved from http://executiveorder.chesapeakebay.net/EO/file.axd?file=2009%2f8%2fChesapeake+Executive+Order.pdf

[15] Chesapeake Bay Watershed Agreement. (2014). Retrieved from http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf

[16] Chesapeake Bay Program. (n.d.). Chesapeake Bay Watershed Agreement. Retrieved from http://www.chesapeakebay.net/chesapeakebaywatershedagreement/page

[17] The Chesapeake Bay Program Principals' Staff Committee. (15 August 2014). Letter to The Citizens of the Chesapeake Bay Watershed. Retrieved from http://www.chesapeakebay.net/documents/90_Day_Letter_All_Signatures_FINAL.pdf

[18] Chesapeake Bay Foundation. (n.d.). The History of Chesapeake Bay Cleanup Efforts. Retrieved from http://www.cbf.org/how-we-save-the-bay/chesapeake-clean-water-blueprint/history-of-bay-cleanup-efforts

the project management techniques that facilitated coordination from a wide range of Chesapeake Bay stakeholders.

The successes and shortcomings of the Chesapeake Bay cleanup highlight the importance of effective project management in science. Project management addresses “big picture” concerns and shapes expectations by setting feasible goals and demonstrating concrete progress towards them. EO 13508 and the Chesapeake Bay Watershed Agreement more accurately gauged the necessary oversight for the Bay cleanup projects, ensuring more unified efforts and equitable work distribution. As the Chesapeake Bay cleanup progressed, it followed the core principles of effective project management, including developing clear outcome measures and predicting and addressing potential setbacks. Improved project management in the Bay cleanup allowed multiple actors and stakeholders with different priorities to work towards the same goal—an adaptive life cycle process based on constant reevaluation. In the future, further application of project management frameworks will guide Bay pollution mitigation efforts and result in more demonstrable success.

The Chesapeake Bay cleanup efforts could not have achieved their successes without the incorporation of project management skills and formalized project management. Project management as a skillset and as a discipline should be consistently applied to the scientific research process with scientists cultivating their own skills while also considering the benefits of collaborating with project management professionals. Although some scientists may be skeptical of the role project management in their work, it is an integral component of successful scientific research. Actively including project management principles and hiring project management professionals results in completed projects, timely results, and high quality products and outcomes.