# Facilitating the Advanced Photon Source Upgrade Project

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April 29, 2022

# ABSTRACT

*The Advanced Photon Source Upgrade (APS-U) project is a massive undertaking that includes replacing and upgrading the electron storage ring. Designed in the 1980s, the once revolutionary system has become outdated and improvements must be made to keep the APS a pioneer in research and technology. Complications arise around the logistics behind tracking and managing the thousands of components necessary for the upgrade project. The Argonne Component Database (CDB) is an inventory management system that works to facilitate the APS-U, but manually interfacing with CDB via the web user interface is slow and lacks quality assurance. With command line tools, engineers are able to automate tasks by to increase operational efficiency while also ensuring a level of quality assurance by bypassing the existing web interface. In addition to system-level functionality, materials during this transition often have discrepancy logs tied with both CDB and the eTraveler database. While existing functionality exists on a web interface, the lack of clarity and control given to management operators requires a systemic overhaul and is done so using Python scripts and Excel. Lastly, during the physical upgrade of the APS-U project, there will be a need to visualize inventory data and status updates over the twelve-month period. By utilizing open-source geographic information systems (GIS) tools, management will be able to tie in geographic information with installation progress for various materials and keep up to date with the physical integration of the APS-U project.*

# INTRODUCTION

The APS at Argonne National Laboratory is a large synchrotron which was brought into operation in 1995. With the discovery of a more efficient synchrotron design, the 26-year-old synchrotron is going to be torn up and replaced with the improved design. The device being as large as it is, however, it is a massive endeavor to replace the whole machine. Any project of this scale requires precision and efficiency from the engineers and technicians in charge. The logistics of the APS-U require the implementation of manufacturing methodologies employed by some of the most efficient companies in the world such as the Toyota Production System also known as LEAN manufacturing.

Figuring out and employing the methods that can be used to maximize efficiency in the APS-U involves understanding LEAN manufacturing techniques and applying them to every aspect of the project. With as big of a project as the APS-U is, all BoMs require consistent nomenclature such that any engineer or technician can look at the BoMs and be able to find the exact part necessary in the CDB as well as in the warehouse. Additionally, to reduce the likelihood of mistakes in the assembly process, jigs were designed with LEAN manufacturing in mind. Safety is also of top priority and thus attention was directed to the storage ring where bending magnets turn the electron beam along the circular pipeline. The points that the beam turns and an X-ray beam is released were modeled to ensure that, as the bending magnets decay, the beam does not go down the wrong pipe to ensure the safety of the workers downstream.

# DEVELOPING COMMAND LINE SCRIPTS FOR AUTOMATION

# EXPORTING DISCREPANCY LOGS

# UTLIZING GIS TOOLS FOR INVENTORY VISUALIZATION

# CONCLUSION

The APS-U is a large project that will not be complete during my time at the laboratory, but the work that I have done during my 10 weeks will have an impact for roughly the next 25 years when the APS is upgraded again. Employing LEAN manufacturing techniques will make it so that when the assembly stage begins next year, the technicians will have no problems in the assembly process and the jigs that were designed and the BoMs uploaded to CDB will assist greatly in minimizing mistakes and creating a more efficient assembly process. The vacuum chamber that was modeled using the cross sections will also ensure that the danger of the electron beam going down the wrong pipe can be avoided as that could be catastrophic for the scientists and engineers downstream. Overall, I have learned a lot about cooperating with engineers and making decisions in a complicated environment such as a large-scale engineering project like APS-U. The skills I have gained in this area are extremely transferable and will help me in my career by enabling me to be a more effective communicator and get my ideas heard to push forward projects such as this one.

# ACKNOWLEDGEMENTS

Project Supervisor:

John Quintana

Engineers Involved in the APS-U:

Oliver Schmidt, Mark Erdmann, Aleksandar Stankovik, Ned Arnold, Jeremy Nudell, William Jansma