ISBN: 978-3-95450-211-0 doi:10.18429/JACoW-SRF2019-TUP103

PANSOPHY DATA AS USED TO DEVELOP METRICS AND EVALUATE TRENDS ACROSS SRF PROJECTS AND FACILITIES TO FURTHER QUALITY IMPROVEMENT INITIATIVES

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Abstract

Pansophy, a JLAB SRF engineering data management system (EDMS), is composed of a collection of technologies that together provide for the collection, management and analysis of data for the production and testing of cavities and cryomodules. From its inception in 2000, when data collection was a priority for such projects as SNS, CEBAF 12GeV upgrade, LCLS-II, and in the future the SNS-PPU, the focus has turned to data analysis and reporting on quality metrics and key performance indicators (KPIs). Reporting enhancements include monthly quality metrics, project specific KPIs, and trending across projects. With the use of Pareto Charts to help analyze vendor quality and non-conformance, timelines of project and facility metrics, project managers and subject matter experts (SME) are able to look for trends and prepare further quality improvement initiatives for their projects.

INTRODUCTION

Pansophy is a web-based system that is composed of a series of technologies and programs, including extensive Microsoft Word macros, Adobe ColdFusion, JavaScript, and an Oracle database, that collects data produced during the manufacturing and testing of cavities and cryomodules. Pansophy development started in 2000 with the purpose of data collection for projects at Jefferson Lab. The first large-scale project that utilized Pansophy was SNS at Oak Ridge National Laboratory in 2004, shortly followed by Jefferson Lab's C50R project in 2007.

Since its inception, the focus of Pansophy development has shifted from data collection to data mining, to evaluating quality trends. The change in focus to data mining was introduced in the second version around 2011, which was used for projects such as C100, JLab's 12GeV upgrade, Renascence, FEL and other cryomodule (CM) upgrades. Quality metrics and trending evolved during the end of the 12 GeV upgrade and further by C75, a cryomodule refurbishment, and LCLS-II. Additional quality metrics and trends are being evaluated for future projects such as SNS-PPU and LCLS-HE. Pansophy gathers parameters ranging from receiving documents, serial numbers, leak check data, shipping criteria, assembly locations, inspection stats, and processing. A large amount of data is collected and archived to enable data mining into quality metrics, to ensure traceability and to evaluate trends within and across projects. Figure 1 depicts how many travelers are instantiated each year.

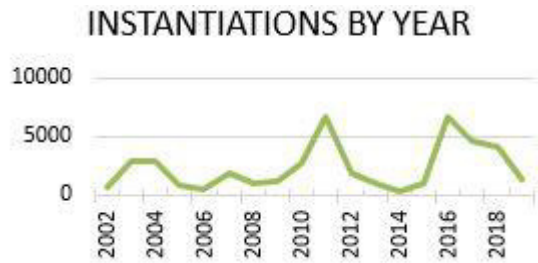

Figure 1: Number of travelers instantiated by year.

DATA COLLECTION & MANAGEMENT

Data Collection

Quality analysis and statistics at JLab are dependent on accurate data collection managed through our web-based system, Pansophy, using travelers authored by subject matter experts (SME).

Travelers, the base unit of Pansophy, start as an MSWord document housed in a template that is composed of a series of macros defined to aid the author by simplifying the construction. The SME in a particular area lays out the process to be completed and what data is to be collected. Once the SME has written the traveler, it is then sent to other SMEs for review and approval. After the SME approve and signs, the traveler is sent to the document coordinator for processing.

A wide variety of data is collected in Pansophy including receiving documentation that is collected in the inventory section of Pansophy, PRIMeS, test data sent from vendors, timestamps to document when a task was completed, file attachments to keep track of graphical results, cryomodule test results and cryomodule shipping documentation. Figure 2 shows how many travelers are instantiated by project, with LCLS-II having the highest amount.

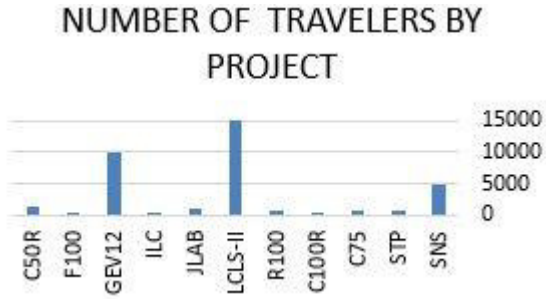

Figure 2: Number of travelers instantiated by project.

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Data Management

Data Security and History The large amount of data collected in Pansophy calls for extensive data management. At the bottom of each traveler page is a "Submit to Database" button. This button enters and secures the data into the database while, simultaneously retaining it on that page of the traveler. Each time the submit button is clicked, a new line entry, with a modification date and modification user, is entered into the traveler database table. Previous entries are obsoleted, not deleted or overwritten. This allows the opportunity to view data that may have been accidentally deleted by the user and a timeline can be built with all previous data.

Timestamps The use of timestamps helps keep track of when a process was performed and can later be used to measure the length of time it takes for a task to be completed. The timestamps in a traveler have a "Now" button that the user can easily click and it will insert the current date and time, and when immediate data entry isn't available, the user can type the date the task was performed.

Consistency To ensure consistency across projects, serial number acronyms are universally predefined, e.g., cavity serial number is always CAVSN and field probe feed thru is FPFTSN. Serial numbers are used to ensure traceability of a part throughout the cryomodule assembly process. They are loaded into the database through PRIMeS and attached to a specific project with a project code, i.e., L2PRD, so part serial numbers are unique to the project they belong to. This system prevents the user from mistyping a serial number into a traveler resulting in a disruption in the traceability of a part.

PRIMeS

The Production and Research Inventory Management System (PRIMeS) is a unique inventory system that combines the features of a library system, quality control system, and job box functions.

Project parts are delivered to inventory and entered into PRIMeS. In PRIMeS, parts are identified by project, drawing, and acronym. This is the only place where serial numbers are hand typed into Pansophy. As part of the receiving process, the serial numbers are inserted into a data table and made available to travelers in the form of a select box. PRIMeS is the starting point for traceability.

PRIMeS also maintains a record of the inspection status for parts. This ensures that only qualified parts are selected for issue to assemblies.

QUALITY METRICS & TRENDS

A metric should include a need or purpose, provide useful relevant information. Metrics should be measurable with reasonable accuracy and reflect the true status of a project [1]. SRF at JLab started the mining of data for measuring quality metrics in 2014, with the majority of the focus being on the non-conformance of parts and the timeliness, completeness, and accuracy of data collection. Though the reports that are generated in Pansophy are available for all users to view, they were originally created for team managers, group leaders, and project specific managers to easily track their progress. For certain projects, such as LCLS-II, specialized reports are sent out weekly to compare progress to the previous week. Separate reports are created for monthly quality board meetings that display the status of active projects.

When a user is inserting data into a traveler and there is a part with a non-conformance, i.e., dimensional issues, scratches, test failures, etc., the user will generate a non-conformance report (NCR). To allow for project specific metrics to be measured, NCRs are available for each project in its project area. Together with the data collected in travelers, NCR data allows for a vast variety of graphs, tables, and grids to be generated for incorporation into summary reports.

Reports

Project Open and closed by project shows the number of travelers in a project exist for a specific traveler ID and how many of those are opened and closed. This report is also available for NCRs.

Month Travelers and NCRs open and closed by month show how many travelers or NCRs were opened and closed in a month.

Classification NCRs by classification is a pareto chart that groups NCRs by their categories, i.e., scratches, dimensional, VTA RF performance, etc., to show the primary causes of non-conformance.

Timelines The timeline chart groups the amount of time from the instantiation of a NCR to the initial disposition, from initial disposition to rework, and from rework to final disposition of the part. The chart also visually color coordinates stacks by disposition, whether it be Use As Is, Reject, Return To Vendor or Hold, giving immediate feedback to SMEs on part NCR resolution and Vendor quality.

These specific reports are shown in Fig. 3.

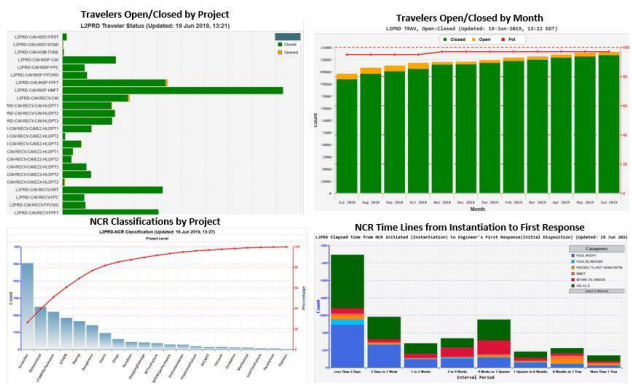

Figure 3: Travelers Open/Closed by Project, Travelers Open/Closed by Month, NCR Classifications by Project, NCR Time Lines.

Trends Across Projects

Pansophy is built to make it easy for a user to mine a variety of data and import into Excel for analysis. A great use of this feature is to compare results across projects. For

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example, data collected from cavity vertical RF tests across all projects can be pulled to compare such things as field emission (FE) onset or Qo. The closure rate of NCRs or the number of NCRs per product or vendor gives insight for both the current project and comparison or upfront feedback for future projects.

The total number of cavity RF tests performed is measured against the number of planned tests and opportunity tests, with the goal of achieving a 75% completion of planned tests. Racking the completion of panned tests gives information on the throughput of the Vertical Test Area (VTA) and gives insight to areas that improvements can be made to make better use of the facility.

Additionally, facility quality metrics such as particle counts in the cleanroom and the ultra-pure water (UPW) system are matched against processing techniques by overlaying the timestamps in travelers. The overlaying aids in troubleshooting through an understanding of the clean room and UPW quality at the time assemblies were being completed. This is beneficial to help improve both how assemblies are performed and the quality of the facility.

Lessons Learned

When a project is finishing up, project managers and SME get together to review all of the project specific reports to see what can be improved to help the productivity of future projects. This includes changes in the reporting process is done in Pansophy, to technical specifications for vendors, to how parts are serialized for congruency. The lessons learned report completed for the 12 GeV upgrade project [2], brought the recognition of the importance for quality metrics. Although the LCLS-II project is still underway, work on lessons learned is already in progress. SMEs have been providing feedback on vendor quality, project management, and ways to further the use of Pansophy data. LCLS-II has reinforced the importance of data collection.

CLOSING REMARKS

Pansophy is continuously growing to help improve the way in which data is collected, mined, and reported. Accurate entry of data and timestamps can have a major impact on the quality metrics being monitored. To aid in this area, automation of data entry from test and facility equipment, macro enabled data collection and processing, and ease of access and usage of Pansophy are being investigated. Additional quality metrics are being vetted by the quality board members for future projects. Lessons learned, adequate procedures, and solid data collection and reporting will push Pansophy into preparedness for the next generation of projects. The past and future of Pansophy is demonstrated in Fig. 4.

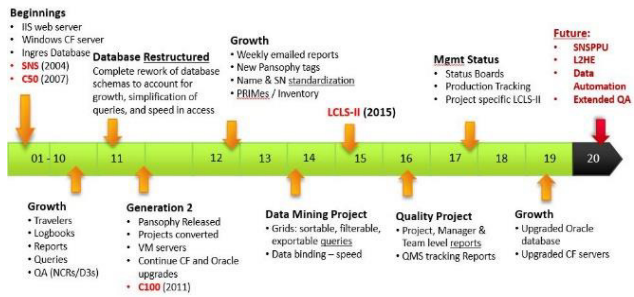

Figure 4: Pansophy timeline.

ACKNOWLEDGMENTS

Authored by Jefferson Science Associates, LLC under U.S. DOE Contract No. DE-AC05-06OR23177. This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics.

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