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PLAN ANALYTICS FOR ENHANCED UNDERSTANDING OF RUN3 AND LS3 ACTIVITIES AT CERN

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Abstract

Designed as an internal tool at CERN, PLAN has a pivotal role in the centralization and macroscopic aggregation of technical interventions and optimisation of the activities planned within the accelerator complex.

As part of the broader strategy to enhance tool utilisation and extract valuable insights, a substantial endeavor was undertaken during RUN3 to develop and disseminate analytics derived from tool-generated data. These analytics are seamlessly accessible via a Flask application, crafted primarily using Python® and the Bokeh library, JavaScript, HTML, and CSS. Hosted internally at CERN through OpenShift®, it is containerized through Docker®, and subject to continuous integration via GitLab®.

These analytics serve a versatile purpose, encompassing the quantification of activities, identification of resource constraints across departments and groups, and the provision of insights into various facilities, projects, and more. Moreover, they play an instrumental role in identifying bottlenecks and critical milestones in planning timelines. These analytics are designed to provide management and other stakeholders with essential insights, ultimately contributing to wide-ranging improvements across CERN.

INTRODUCTION

The PLAN tool contains comprehensive data encompassing activities such as maintenance, upgrades, and installation of equipment and systems throughout the entire CERN accelerator complex [1]. These activities occur during programmed stops (Technical-Stop, Year-End-Technical-Stop, Long-Shutdown) and throughout the operational run. Initially conceived to streamline activities during LS1 [1, 2], PLAN has since become the chosen framework for coordinating tasks spanning first LS2 [3], and now RUN3, and LS3 [4–6]. The activity data includes crucial details such as the group and person responsible for the activity, associated facility, project, and activity status. It also provides periods, indicating the activity's planned start and its duration. Each activity is also assigned a priority level corresponding to its overarching objective. Additionally, the PLAN tool allows to request support from other groups, vital for successful execution. This is referred to as contributions. A representation of a PLAN activity and its corresponding data and contributions can be seen in Figure 1.

The data in PLAN is systematically organized into tables, providing users with an overview of activities categorized under various properties. The necessity for an analytics application, known as PLAN Analytics, arose from the imperative need to extract valuable insights from these datasets. This tool was conceptualized to meet the requirements of both PLAN users and CERN management, enabling to derive meaningful insights and optimize internal processes. PLAN Analytics is accessible to individuals associated with PLAN, including management and other stakeholders invested in the activities declared within the system. This application fills a crucial gap by providing a comprehensive overview of, and insights derived from the data, facilitating efficient resource management and informed decision-making within the CERN accelerator complex.

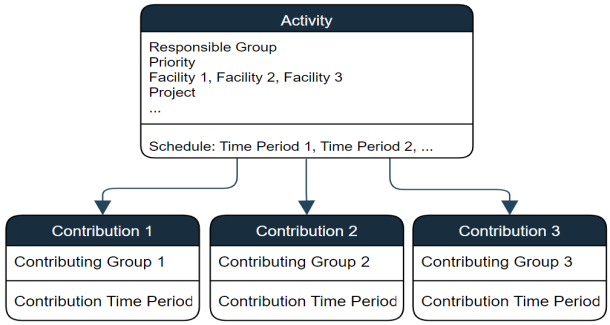

Figure 1: Illustration of an Activity in PLAN and its corresponding Contributions.

OBJECTIVES AND SCOPE

To deliver these essential insights and enhance the efficiency of identified stakeholders, the development of the PLAN Analytics application was initiated. The aplication was created with the following primary objectives:

- Enhance transparency and facilitate knowledge transfer regarding the data available in PLAN, providing stakeholders with a comprehensive understanding of declared activities.
- Simplify comparisons for stakeholders managing activities in various tools or systems, ensuring accuracy and cohesion across different platforms.
- Streamline resource management by enabling easy identification of resource availability issues and workloads across different groups.
- Empower management and other stakeholders with informed analysis capabilities, allowing to analyse activity and contribution distributions and the evolution of data, based on parameters such as group, facility, project, and time period.

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The primary focus of the application is to generate graphs, tables, and analytics essential for stakeholders for reporting purposes and for identifying areas that require attention, especially concerning resource availability and activity distributions across for instance time periods, groups and statuses. Additionally, the application aims to simplify the daily tasks of colleagues responsible for planning and scheduling across different facilities and projects by providing an intuitive platform to examine and extract insights from relevant PLAN data.

The PLAN Analytics application was to be developed using free and open-source resources, emphasizing accessibility and cost-efficiency. Its user interface was to be designed to offer intuitive options, ensuring that users can easily create the analytics they need while providing a seamless and positive user experience.

Users should have independent access to analytics and insights directly within the PLAN Analytics application. Moreover, the option to share these insights should be seamlessly integrated, allowing users to download PNG files of the specific analytics they create. This approach underscores PLAN Analytics' specific objectives, highlighting its pivotal role in enhancing transparency, precision, operational efficiency, and informed decision-making for all stakeholders involved.

SYSTEM ARCHITECTURE AND DESIGN

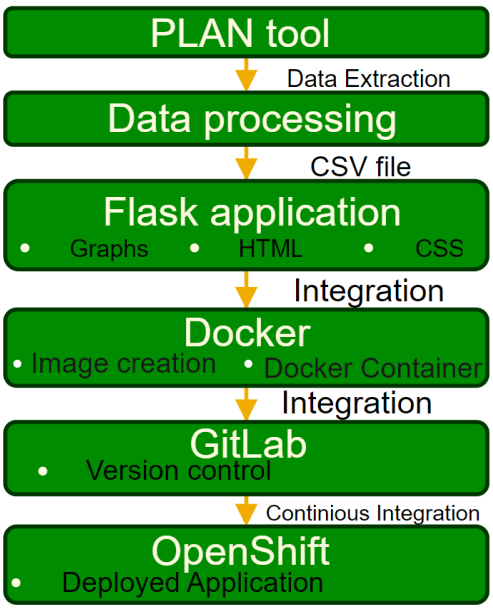

Figure 2: The comprehensive system architecture of the PLAN Analytics application.

Aligned with the defined objectives of the application, the development process commenced. Through iterative testing and evaluation of various methods and alternatives, a structured setup was established, illustrated in Figure 2. This process of extracting extensive data on planned activities from the PLAN tool and visualizing its insights in PLAN Analytics begins with data extraction, generating CSV files. These files undergo initial processing, primarily involving the division of cells containing multiple data points. For instance, activities can be associated with numerous time periods and different facilities, necessitating careful handling. This processing step occurs externally to the analytics application, reducing the data processing load within the application itself.

These processed CSV files are then read by the application, which is a FLASK application — a Python framework for creating web applications. This FLASK application consists of:

- One main application file, written in Python.
- A separate Python file for each graph or table displayed in the application.
- A separate HTML file for each page in the application.
- One CSS file.
- One Python file for loading necessary Python libraries, reading the PLAN data, and globally used functions.
- Two text files, one specifying requirements, and one Dockerfile.
- Two YAML files, one for Docker-compose and one for GitLab CI.

In essence, the FLASK application is developed using a combination of Python, JavaScript, HTML, and CSS. Python serves as the core programming language, handling the primary functionality of the application. HTML is employed to display the generated graphs and tables, while CSS is used for formatting the style and design elements of the web pages presenting the analytics. JavaScript plays a vital role in incorporating interactive functionalities, such as button-click events. Additionally, JavaScript is an essential component in the generation of graphs and tables using the Python library Bokeh. Bokeh is extensively used throughout the application to generate interactive visualizations and analytical graphs from PLAN tool data. Its selection stems from its customization options and user-friendly interface, allowing detailed data tailoring through interactive menus, such as drop-down menus. This allows users to precisely select the data they want to visualize from the available options, enhancing their overall experience and customization abilities.

Following containerisation through Docker and synchronization with GitLab, the FLASK application is deployed internally at CERN using OpenShift, a platform-as-a-service, ensuring accessibility for relevant stakeholders. Seamlessly integrated updates and refreshed data files are incorporated into the application via a Continuous Integration (CI) setup with GitLab, maintaining the application's currency and responsiveness.

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FIRST EVALUATION AND INSIGHTS

This application is currently undergoing initial evaluations before a broader promotion effort is launched. Given that the application is built upon graphs, tables, and analytics that were previously manually extracted based on specific requests, there is a strong belief that the stakeholders will appreciate the newfound ability to independently generate the analytics they require. An example of a frequently requested graph and its integration in the PLAN Analytics application can be seen in Figure 3.

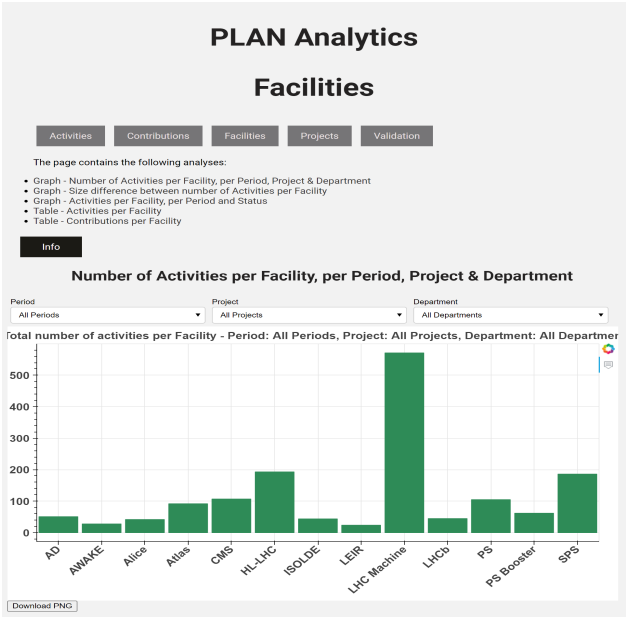

Figure 3: A screenshot of the PLAN Analytics application, displaying a selection of facilities.

During the initial tests of the application, users expressed the need for more extensive options and possibilities to specify the exact data they wish to analyze. This feedback highlighted the desire for users to have the ability not only to specify parameters for the existing graphs but also to define additional properties related to the activities or contributions they are interested in exploring.

FUTURE DEVELOPMENTS AND ENHANCEMENTS

Based on user feedback and other insights, various potential enhancements for the application are currently under consideration and being implemented. The primary focus of these enhancements is to increase the modularity of options and possibilities in the application, allowing users higher flexibility in specifying the analytics they wish to explore. This effort involves the exploration of new graphs and tables for inclusion in the application, as well as a thorough review of the existing graphs and tables to identify areas where additional modularity can be incorporated. Careful adjustments are made to prevent overloading the application, ensuring it remains responsive and avoids prolonged loading times, which could adversely affect the user experience.

Addressing a current challenge of the application's heaviness, efforts are underway to improve loading times. Although caching and lazy loading have been introduced as partial solutions, the loading time of graphs remains a concern, particularly during the initial load. Enhancements are sought to create a more responsive application, enhancing user experience and making the application more resilient to network limitations.

Looking to the future, one significant enhancement involves the implementation of an API to directly access PLAN data. Once this API is integrated, PLAN Analytics can be regularly updated, potentially on a daily basis, without the need for manual extraction, preprocessing, or data-loading components. The logic needed to establish this connection is already in place within the application and can be activated as soon as the API becomes available, marking a significant step toward real-time data updates and ensuring the application remains up-to-date and responsive to evolving user needs.

CONCLUSION AND IMPLICATIONS

The PLAN tool serves as a comprehensive repository of key data concerning activities inside programmed stops within the CERN accelerator complex. The creation of an analytics platform to disseminate this vital information to stakeholders holds significant importance. The current iteration of the PLAN Analytics application offers PLAN users, management, and other stakeholders essential insights into the data available within PLAN. These analytics encompass the visualization of activity distribution across key factors such as facilities, projects, and time periods. Users are empowered to interact with and specify the analytics they wish to investigate. The application presents these analytics in an accessible manner, enabling users to effortlessly share these insights through easily extractable graphs and tables.

Ongoing updates are driven by user feedback and usage patterns, ensuring continuous refinement. One challenge faced by the application is the heaviness of the graphs, currently being addressed for improved user experience. Adapting and enhancing the tool through an iterative approach guarantees the evolution of analytics, the website's structure, and its functionalities to better cater to user needs.

In summary, PLAN Analytics represents a pivotal leap forward in increasing transparency, precision, operational efficiency, and allowing informed decision-making for all stakeholders involved in the intricacies of the CERN accelerator complex. By providing a user-friendly interface, empowering users to explore specific analytics, and fostering information sharing, this tool serves as a beacon of progress in PLAN data communication. While adapting to user feedback and emerging needs, PLAN Analytics is gradually becoming an important asset, improving communication of PLAN tool data and streamlining activity knowledge across CERN.

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