European Council for Nuclear Research

The European Organization for Nuclear Research

Summer Student Internship Program Report

CMS online Acc Control App option to create and modify E-groups for new subdetectors

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Summer Student Program 2024

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Acknowledgments

I would like to extend my heartfelt gratitude for being accepted into the CERN Summer Student Program 2024. This unique experience has been truly transformative, and the stimulating environment at CERN has deepened my understanding and passion for IT. Coming from a different background and aspiring to build a career in IT, this opportunity has allowed me to explore the practical implementation of technology in large-scale projects, which has been invaluable.

I am especially grateful to my supervisor, **Abdullah Tatari**, for his unwavering support and mentorship. He has taught me a great deal about reverse engineering, problem-solving, and analytical reasoning. His patience and belief in my capabilities have been instrumental in my growth during this program.

I would also like to express my sincere appreciation to **Zein Zebib** for trusting me with a design project and for the opportunity to contribute meaningfully. His willingness to help and his openness to answering all my questions, always with a warm smile, made a significant impact on my experience.

I extend my deepest thanks to the entire **CMS Central DCS** for welcoming me into the project and for giving me the chance to be among such a talented group of summer students. This experience has been unforgettable, and I will carry the lessons and memories with me throughout my career.

Finally, I would like to thank everyone who contributed to making my summer internship at CERN memorable and enriching. I enjoyed every second and will always cherish the friendships and knowledge gained during this remarkable journey.

Sincerely,

Houyem.

Introduction

CERN (European Organization for Nuclear Research) is the world's largest particle physics laboratory, located in Geneva, Meyrin on the near the French-Swiss borders. As a leading center for scientific research, CERN is home to the Large Hadron Collider (LHC), the world's most powerful particle accelerator, and hosts four major experiments: ATLAS, CMS, ALICE, and LHCb. These experiments are at the forefront of exploring fundamental questions about the universe, from the properties of subatomic particles to the forces that shape our world.

My summer student project at CERN focuses on improving the ACConf App for the CMS Sub-Detector. The main objective was to tackle the issue of missing e-groups within the ACConf App for the CMS Sub-Detector. This task required a thorough understanding of the application's architecture and functionality, as well as learning to code in Java to address the technical challenges effectively. Additionally, the project aims to enhance the application by enabling the automatic updating of admin groups once newly created e-groups are approved, reducing the need for manual intervention by the owner.

Furthermore, I developed a user interface for the CMS online test platform within the ACConf App, enhancing its accessibility and streamlining workflows for users. This report summarizes the work completed during my summer student internship.

I. Introduction of Compact Muon Solenoid

CMS, or the Compact Muon Solenoid, is one of the large, general-purpose detectors at CERN's Large Hadron Collider (LHC).

CMS acts as a giant, high-speed camera, taking 3D “photographs” of particle collisions from all directions up to 40 million times each second. Although most of the particles produced in the collisions are “unstable”, they transform rapidly into stable particles that can be detected by CMS. By identifying (nearly) all the stable particles produced in each collision, measuring their momenta and energies, and then piecing together the information of all these particles like putting together the pieces of a puzzle, the detector can recreate an “image” of the collision for further analysis.

CMS plays a crucial role in exploring fundamental questions about the universe, including the search for new particles and forces, the nature of dark matter, and the origins of mass.

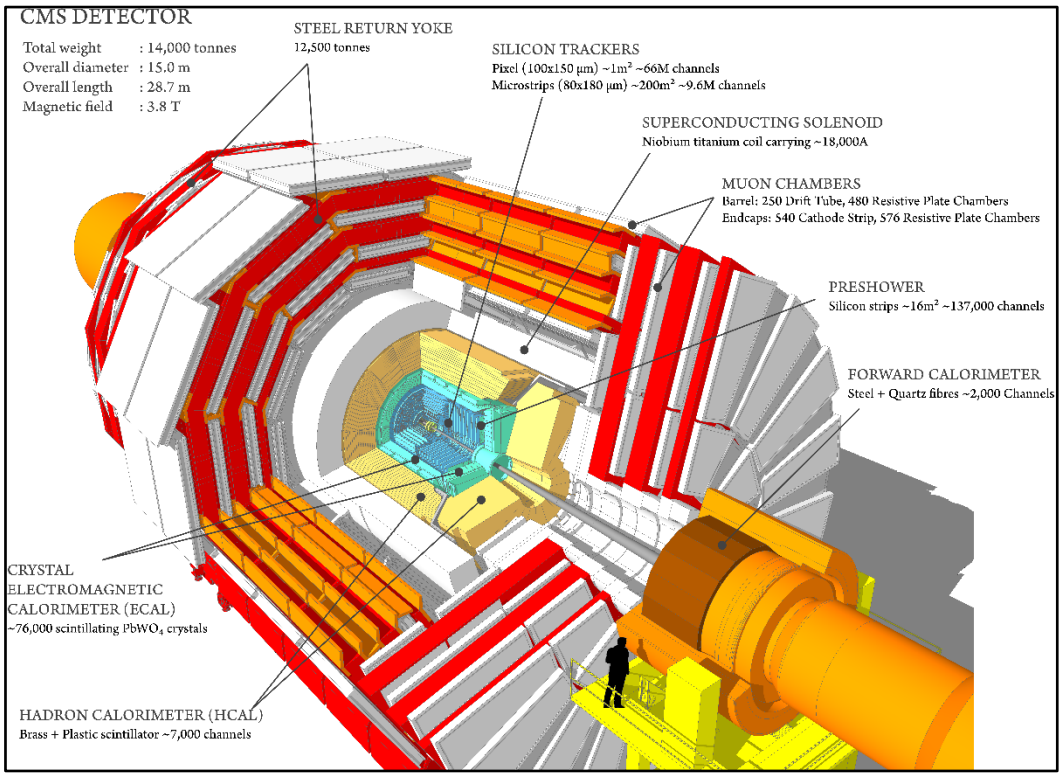


Figure 1 : Illustration of the CMS Detector. **Source :** CERN’s Website.

II. Project Process

The project process began with a learning phase, where I focused on understanding the existing codebase and the overall architecture of the ACConf App for the CMS Sub-Detector. This foundational step was crucial for identifying how to effectively implement the necessary changes.

Once I had a solid grasp of the code, I moved on to the development phase, where I implemented the required modifications, including resolving the missing e-groups issue and automating admin group updates.

After the coding was completed, the project entered the compilation and testing stages, ensuring that all changes were functioning as intended. The final phase involved thorough testing to validate the updates and completing the project to meet the set objectives.

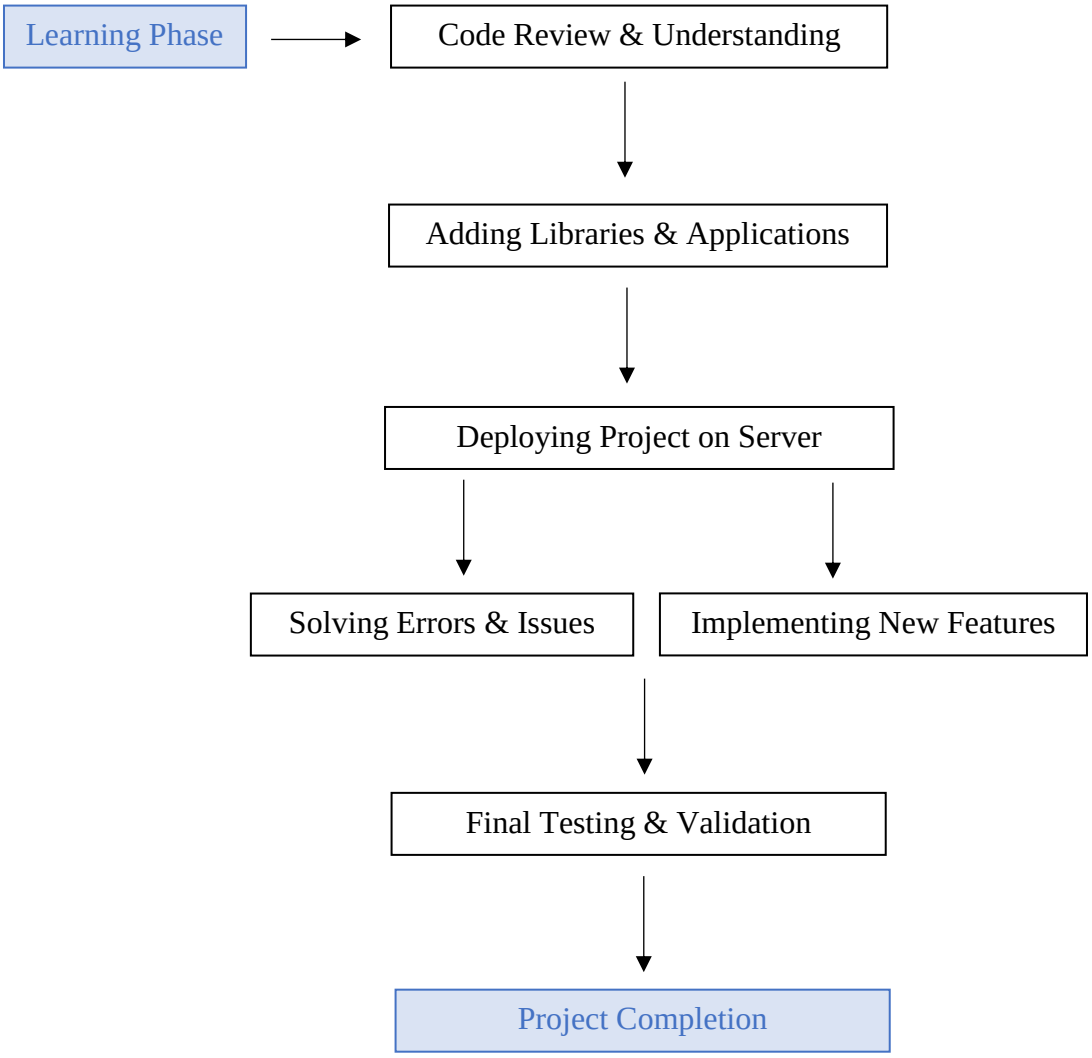


Diagram 1 : The General Project Process.

III. Tools & Technologies

In this project, I utilized a range of tools to ensure efficient development and design processes. GitLab was employed for version control and collaboration, allowing me to push my project while integrating existing code from a previous application. For the development work, Oracle's JDeveloper was used extensively to build and manage the project. The design phase involved Figma, where I designed the CMS engagement template.

I utilized React in conjunction with the Material UI library to create a modern interface for the subdetector Egroup on the CMS online test platform. Visual Studio Code (VS Code) served as the primary IDE for coding, providing an efficient and flexible environment for React development.

Tool Name	Logo
GitLab	
JDeveloper	
Figma	
Material UI	
React	
VScode	

Table 1 : Tools & Technologies used.

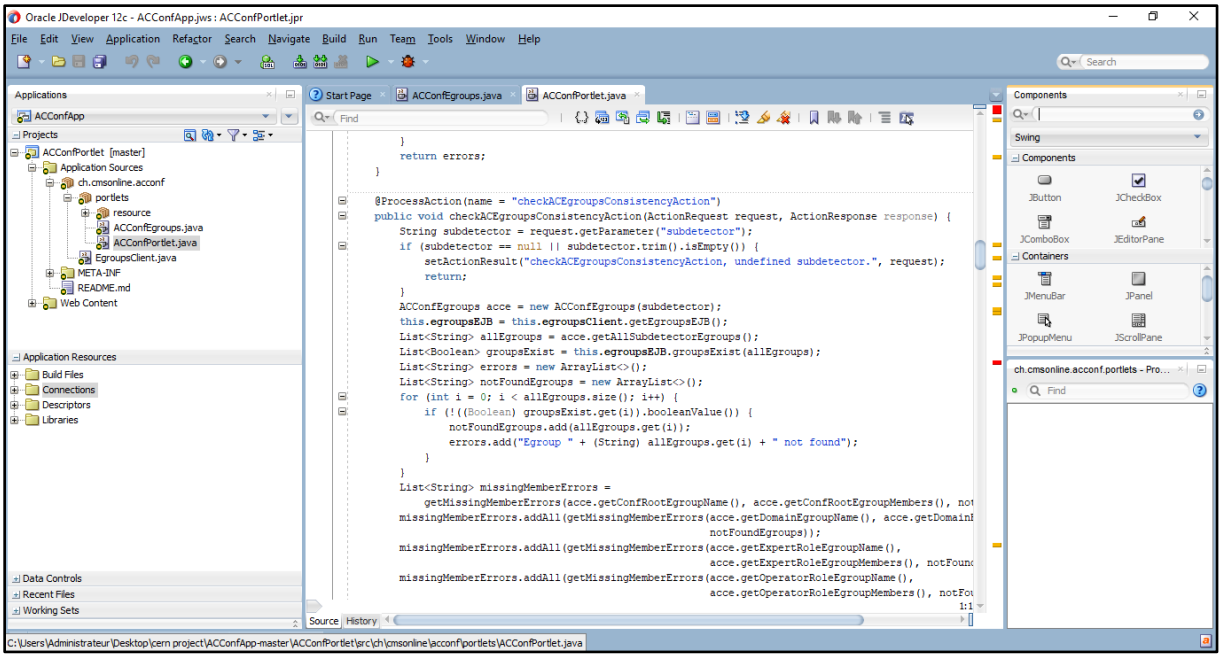


Figure 2 : Image of the Acconf App Interface in JDeveloper.

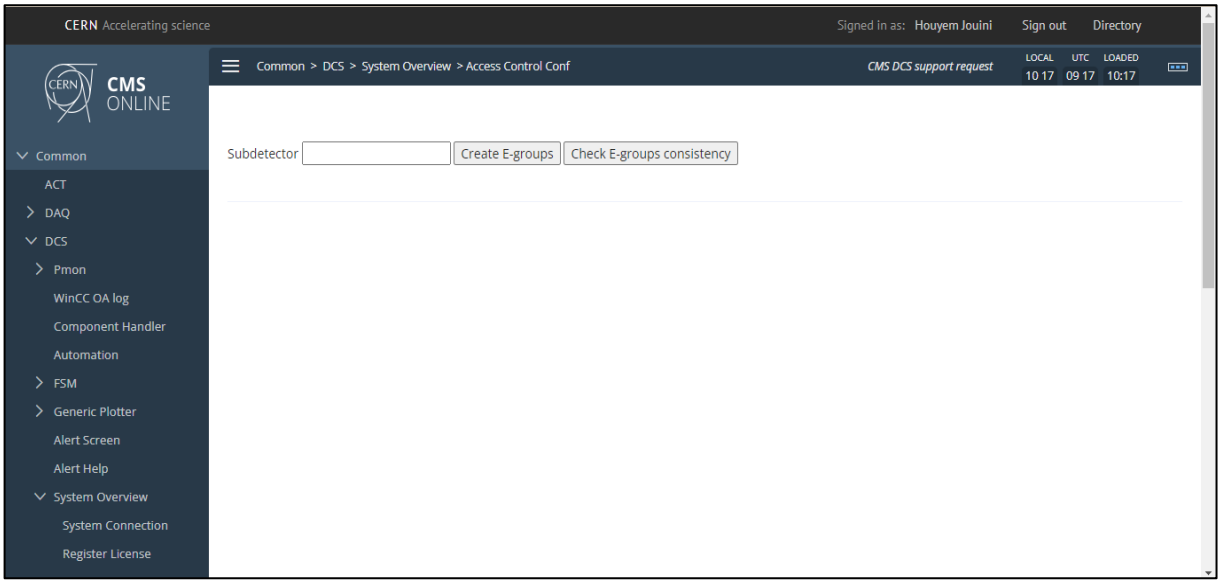


Figure 3 : Image of the Acconf App Interface in CMSonline.

The user interface for the CMS online ACConf App was developed using Visual Studio Code, leveraging the Material UI library and React. This approach was chosen to create a professional and modern look, aligning with current design standards. By using Material UI, the interface not only provides a clean and consistent user experience but also ensures that the creation of e-groups is intuitive and accessible, enhancing the overall functionality of the application.

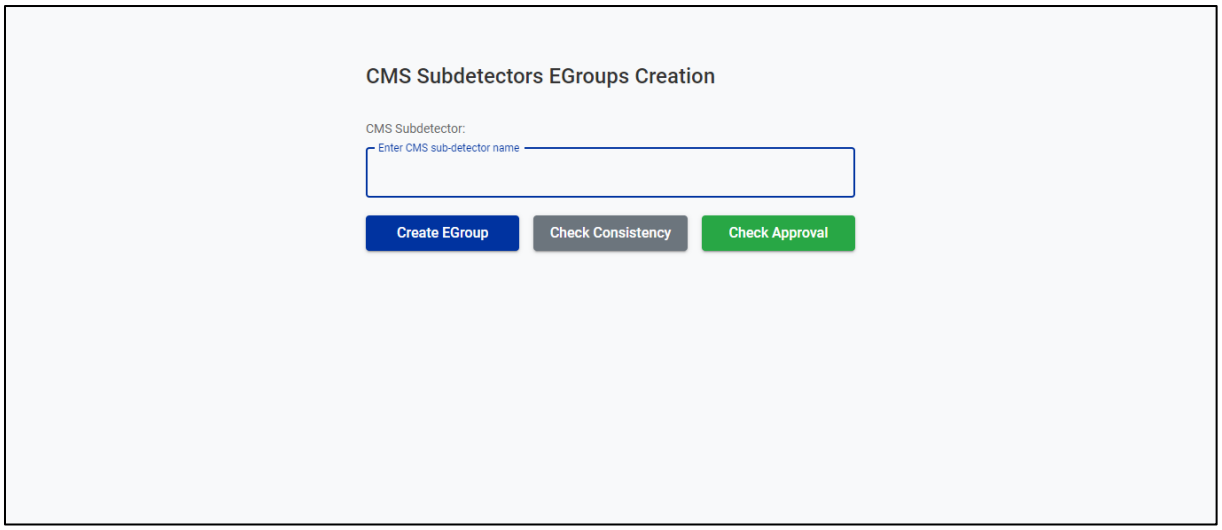


Figure 4 : Image of the User Interface for the Acconf App.

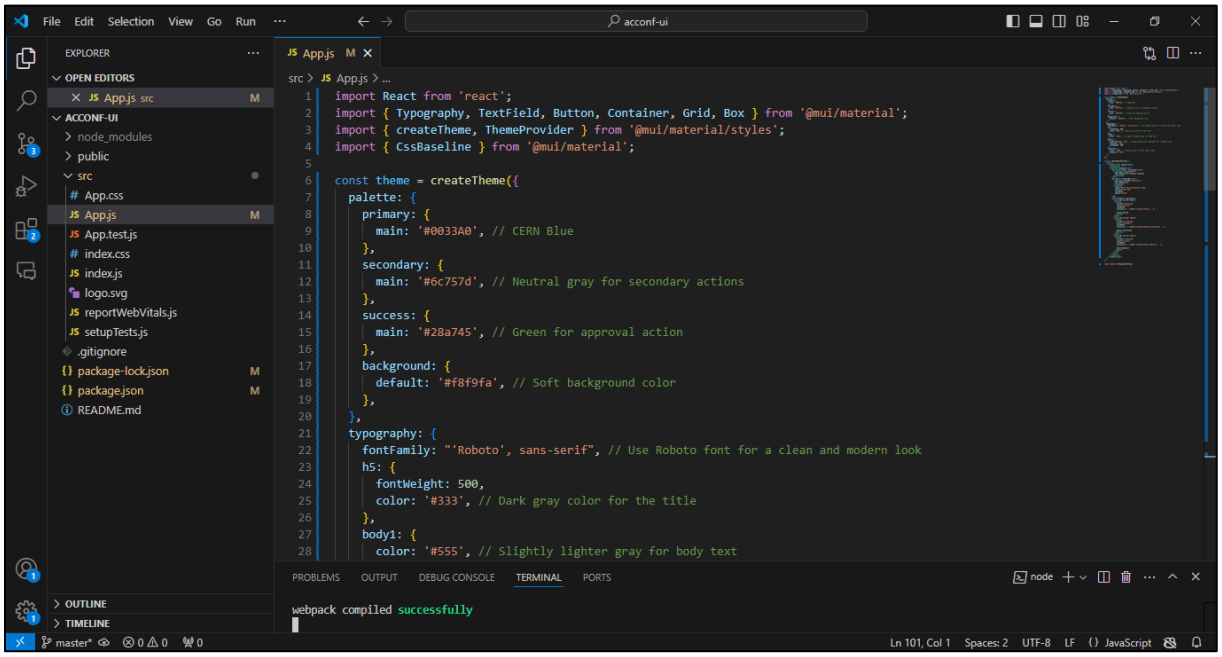
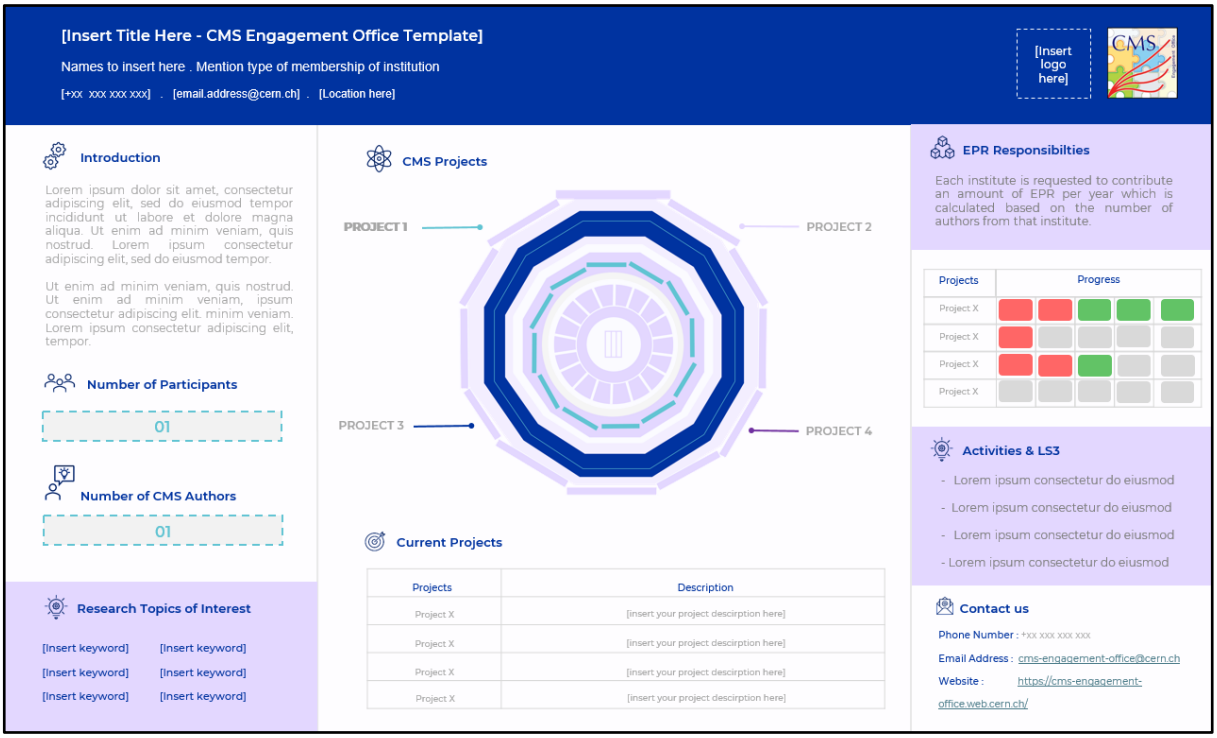


Figure 5 : The Code Snippet for the User Interface.

IV. Design Project

For the CMS engagement office, a streamlined template has been designed for distribution to partner institutions. This template aims to simplify the information-gathering process by providing a clear, structured slide where institutions can easily input their details. The purpose is to ensure that all necessary information is collected efficiently, facilitating smoother communication and consistency across engagement efforts.

This approach not only saves time but also enhances the clarity and organization of the data received, allowing for more effective collaboration.



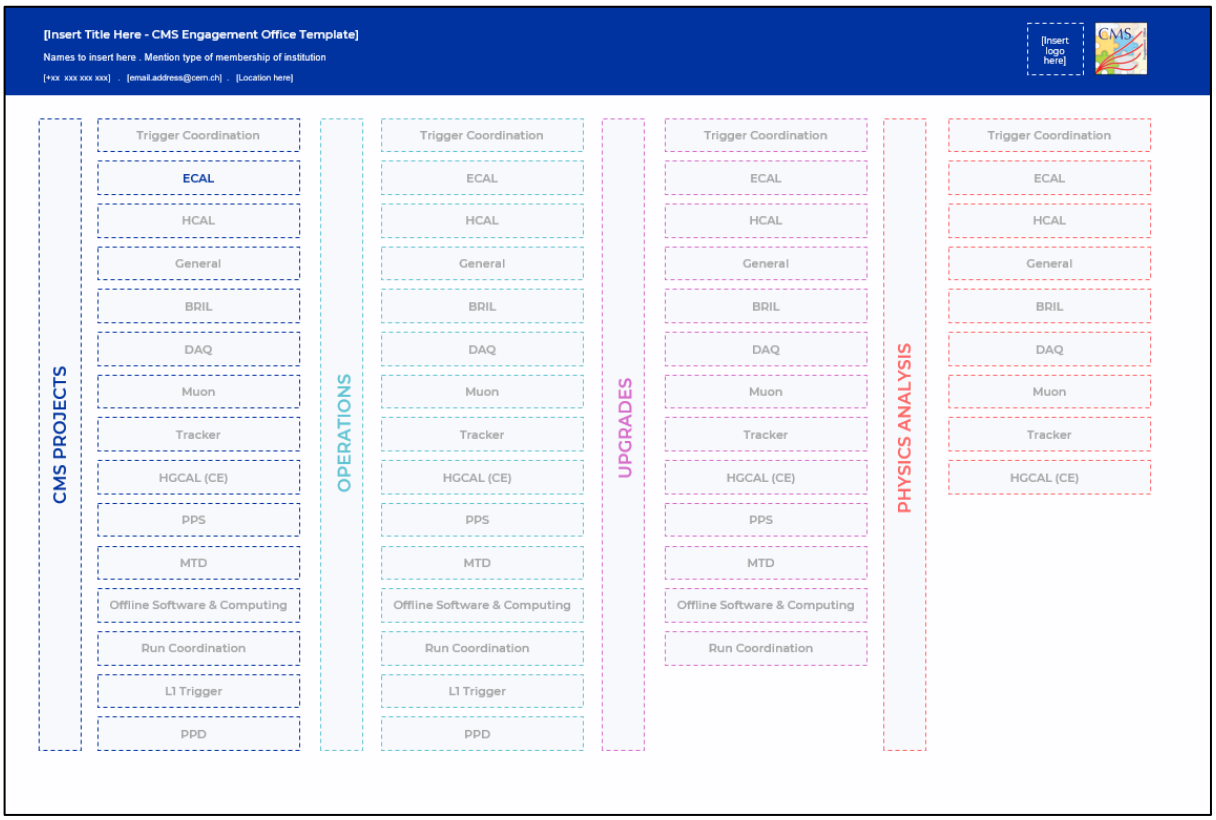


Figure 6 : The Engagement Office Template.

Conclusion

During my 8-week summer student internship at CERN, I worked on several key projects aimed at improving the efficiency and usability of tools within the CMS collaboration.

My main focus was on resolving a critical issue related to the creation and management of e-groups on the CMS online platform, including addressing the missing e-groups. Additionally, I contributed to the development of a new user interface for the ACConf App, using React and Material UI to create a modern and professional look.

Beyond this, I also designed a template for the Engagement Office to streamline communication processes with partner institutions. These efforts not only enhanced the functionality and user experience of the tools but also provided me with invaluable technical experience and the opportunity to make meaningful contributions to CERN's ongoing research efforts.