



XXXIII Annual Meeting of the Division of Particles y Fields of the Mexican Society of Physics



APPLICATION OF A SOFTWARE ENGINEERING METHODOLOGY IN THE CONTROL SYSTEM DESIGN OF A SINGLE DETECTOR IN A HIGH ENERGY PHYSICS (HEP) EXPERIMENT

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CONTENTS

DETECTOR CONTROL SYSTEM (DCS)

OBJETIVE

SYSTEM MODELING

IMPORTANT ASPECTS IN DCS DESIGN

METHODOLOGY

CONCLUSIONS

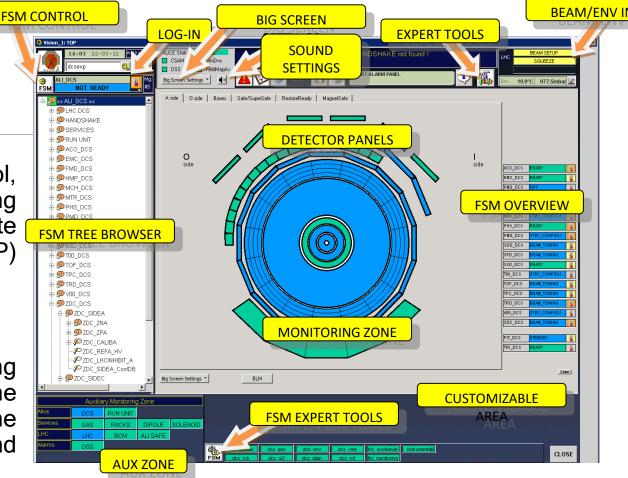




DETECTOR CONTROL SYSTEM (DCS)

The DCS allows the control, configuration and monitoring of the elements that integrate a High Energy Physics (HEP) experiment.

DCS oversees coordinating of all processes in the experiment, according to the status of the systems and subsystems;



- As well as monitoring data.
- Ensures safe, reliable, and uninterrupted operation of the experiment.



DETECTOR CONTROL SYSTEM (DCS)

Serves as an important communication exchange point, providing:

- a) Data for detector operation
- b) Physics analysis
- c) Safety systems
- d) External services (including the accelerator).

| Blobal Status | Show Synop | otics | | | | | | | |
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| VAM | Short Priority | PVSS Ack | ALARMS (Click in this column to a | Acknowledge) Alert text | Direction | Value | Time | | ㅋㅋ |
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| Alarms | W 40 | | DI SPD COOLING LINE 4 | Triggered | CAME | TRUE | 2010-03-16 19:10:0 | | - 21 |
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| Sensors | A 99 | | AL SPD COOLING PIPE 8 | Alarm | CAME | TRUE | 2010-03-16 19:10:0 | | |
| | A 99 | | AL SPD COOLING GENERAL | Alarm | CAME | TRUE | 2010-03-16 19:10:0 | 01.333 | |
| | W 40 | | DI SPD COOLING LINE 5 | Triggered | CAME | TRUE | 2010-03-16 19:10:0 | 01.333 | |
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| For the second s | mm, hodpusyo/ELBMS mm, hodpusyo/ | 66/4 60/4 | | MOD. 14 CHAIN TRI MOD. 14 CHAIN TRI MOD. 15 CHAIN TRI MOD.15 CHAIN TRI | PPE WENT PPE CAME WENT WENT PPE CAME WENT WENT | -0.069892 -0.069977 -0.068977 -0.026932 -0.026932 -0.029221 -0.02921 -0.02924 -0.029058 -0.029058 -0.029058 -0.028474 -0.028405 -0.028405 -0.028305 -0 | | $\begin{array}{c} 2123026 + 120.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 34.\\ 2123040 & 150.1 & 50.0 & 34.\\ 2123040 & 150.1 & 50.0 & 34.\\ 2123040 & 150.1 & 50.0 & 34.\\ 2123040 & 150.1 & 50.0 & 34.\\ 2123040 & 150.1 & 50.0 & 50.0 & 45.\\ 2123040 & 150.1 & 40.0 & 50.0 & $ | |
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| For the second s | mm, hodpusyo/ELBMS mm, hodpusyo/ | 6647 | | MOD. 14 CHAIN TRI MOD. 14 CHAIN TRI MOD. 15 CHAIN TRI MOD.15 CHAIN TRI | PPE WENT PPE WENT WENT WENT WENT CAME CAME CAME CAME | -0.069892 -0.069977 -0.068977 -0.026932 -0.026932 -0.029221 -0.02921 -0.02924 -0.029058 -0.029058 -0.029058 -0.028474 -0.028405 -0.028405 -0.028305 -0 | | $\begin{array}{c} 2123026 + 120.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 3 & 444.\\ 2123040 & 150.1 & 50.0 & 34.\\ 2123040 & 150.1 & 50.0 & 34.\\ 2123040 & 150.1 & 50.0 & 34.\\ 2123040 & 150.1 & 50.0 & 34.\\ 2123040 & 150.1 & 50.0 & 34.\\ 2123040 & 150.1 & 50.0 & 50.0 & 45.\\ 2123040 & 150.1 & 40.0 & 50.0 & $ | |



OBJETIVE

- Due to the relevance of the previously mentioned is important to:
 - Develop a standardized methodology to model the design and operation process of a control software.
 - Using software-engineering techniques.

□ This proposal uses Rational Unified Process (RUP) to model a control system of a detector considering the:

- Workflow of requirements,
- o Analysis
- o Coding
- Tests for all phases of this model;

Through application of associated UML (Unified Modeling Language) models.





SYSTEM MODELING

❑ This methodology to model a DCS is presented from point of view of the three main actors** (stakeholders) involved in the software development process of this system.

Applying five UML diagrams that contain the essentials of the system development.

□ It is worth mentioning that the actors that participate in the use cases can be people or subsystems (software, modules, logbook, web browser, etc.).





SYSTEM MODELING

□ Three main stakeholders defined are:

- *a)* Detector Expert (DE)
- *b) Expert of the Central DCS of the Experiment* (ECDCS)
- *c)* Operator of the Central DCS of the Experiment (OCDCS).

□ Finally, the models provide insight into system requirements can generate an abstraction to simplify and gather the most important characteristics of this system;

Despite huge conceptual and structural differences between one detector and another.





SYSTEM MODELING

Actors / stakeholders:

- Expert in the Detector (ED)
- Expert in the Central DCS (ECDCSC)
- Operator in the Central DCS (OCDCS)

For each actor were defined:

- General Characteristics
- Requirements Analysis
 - Functional → system should do (elements)
 - No Functional → system as a whole (Efficiency)

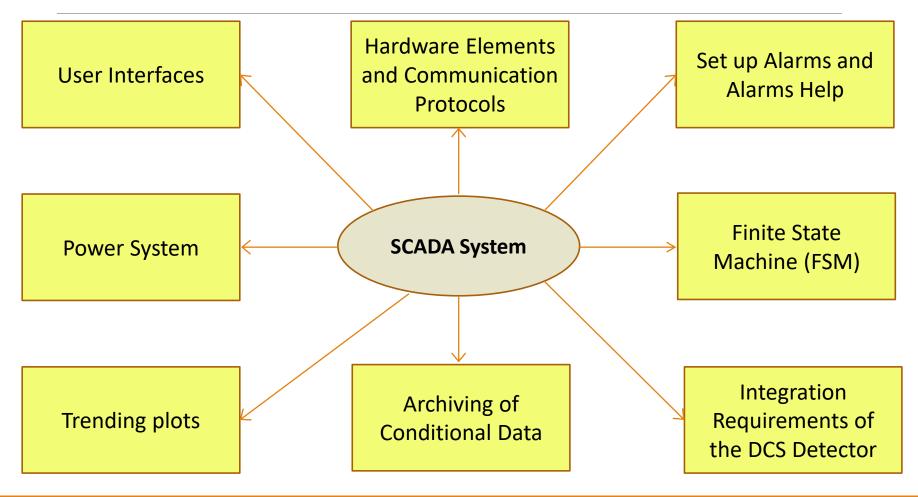
UML Diagrams

- Diagrams / Tables of Use Cases
- Context Diagram
 - Analysis Model
 UML Activity Diagrams
 - Design Model (Static Structures)
 UML Class Diagrams
 - Dynamic View
 - UML Sequence Diagrams
 - State Diagrams
- □ Tree Diagrams (Hierarchy of nodes)



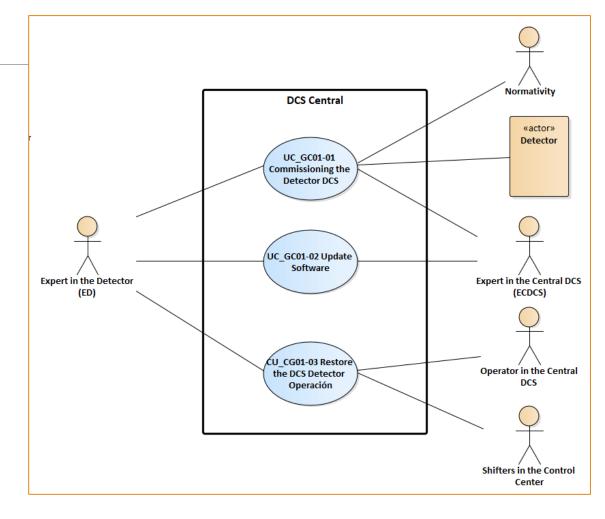


IMPORTANT ASPECTS IN DCS DESIGN



General Characteristics

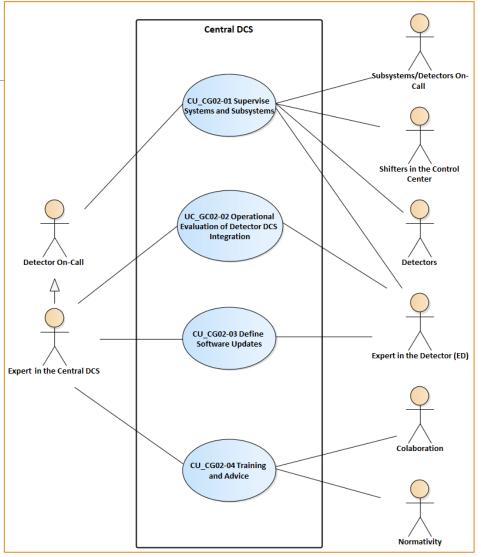
Actor: Expert in the Detector (ED)





General Characteristics

Actor: Expert of the Central DCS of the Experiment (ECDCS)

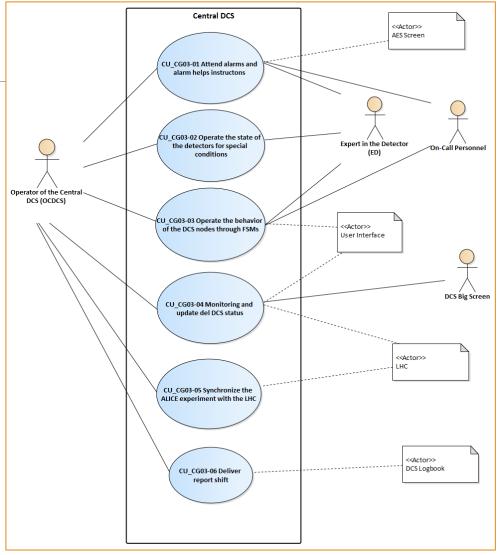






General Characteristics

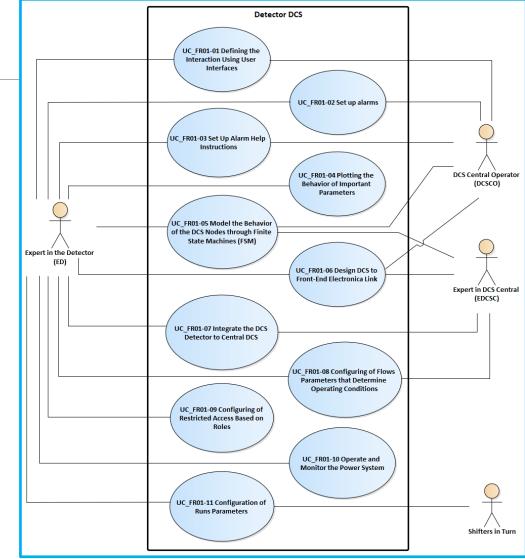
Actor: Operator of the Central DCS of the Experiment (OCDCS)





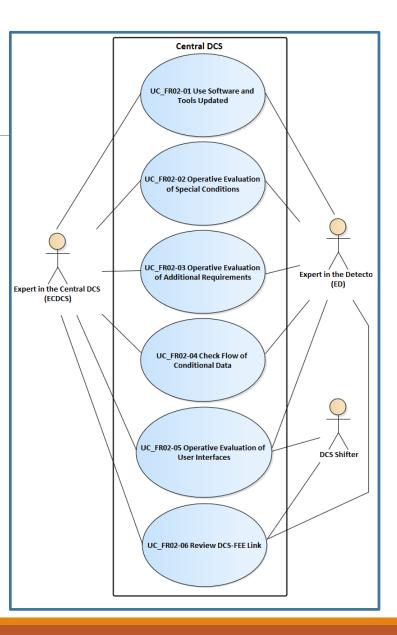
METHODOLOGY Main Software Requirements

Actor: Expert in the Detector (ED)



METHODOLOGY Main Software Requirements

Actor: Expert of the Central DCS of the Experiment (ECDCS)

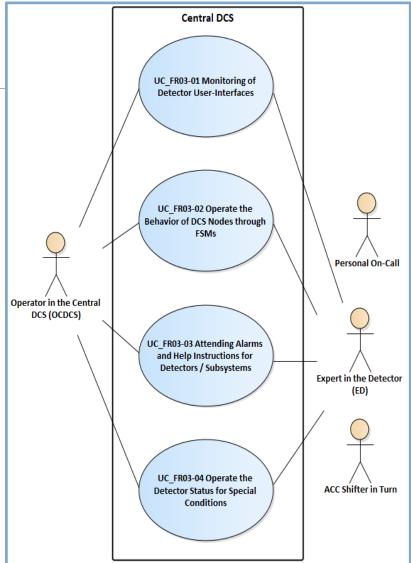






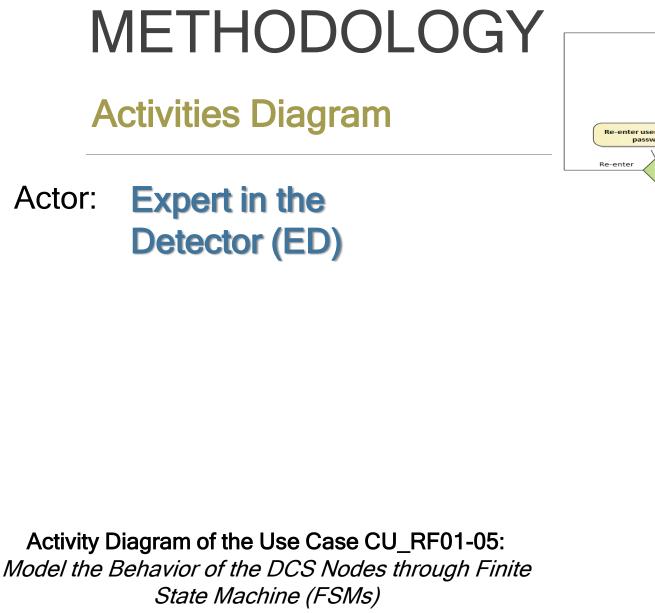
METHODOLOGY Main Software Requirements

Actor: Operator of the Central DCS of the Experiment (OCDCS)

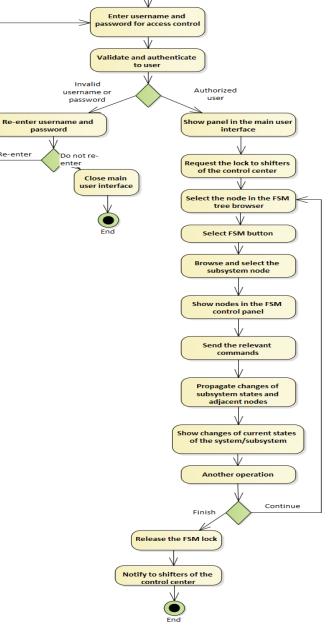








XXXIII RADPyC

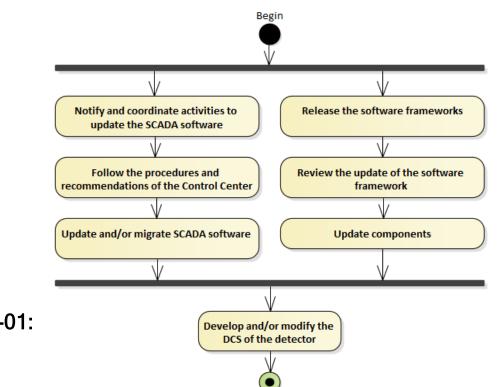


Begin



Activities Diagram

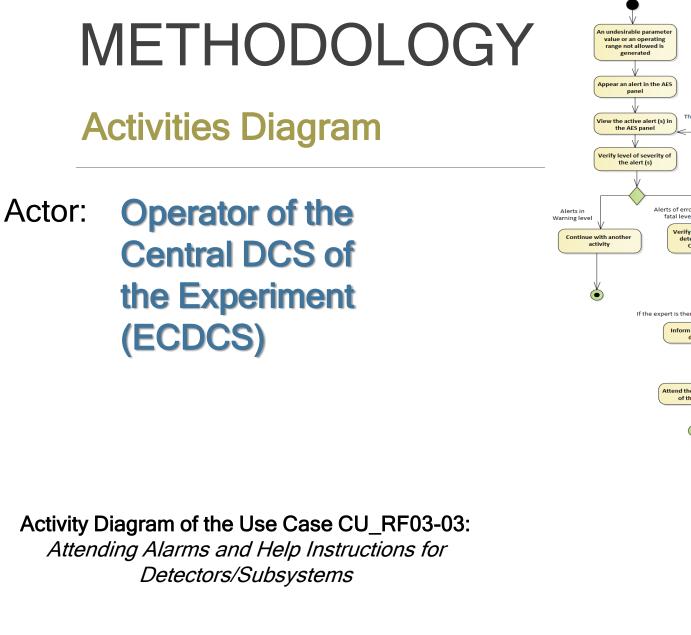
Actor: Expert of the Central DCS of the Experiment (ECDCS)

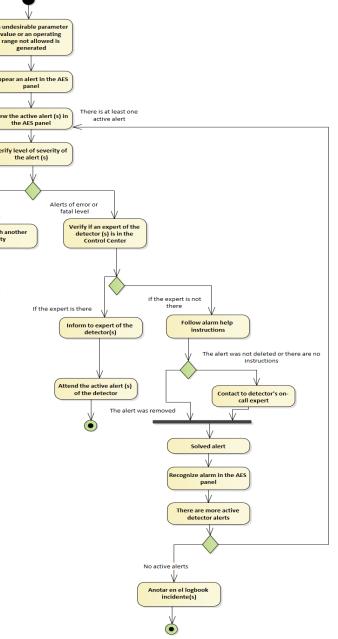


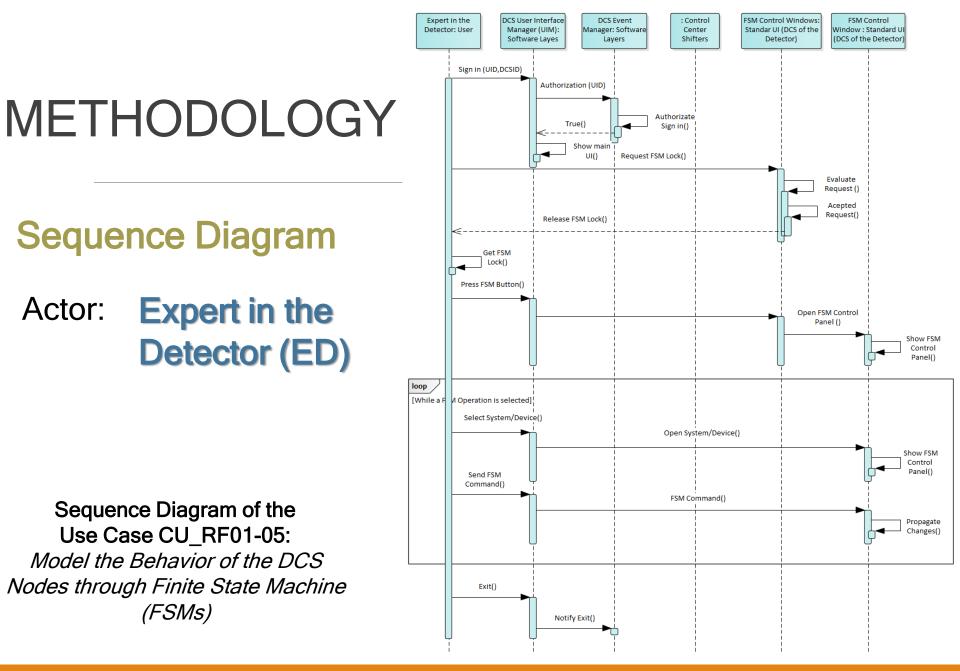
Fnd

Activity Diagram of the Use Case CU_RF02-01: Use software and Tools Updated

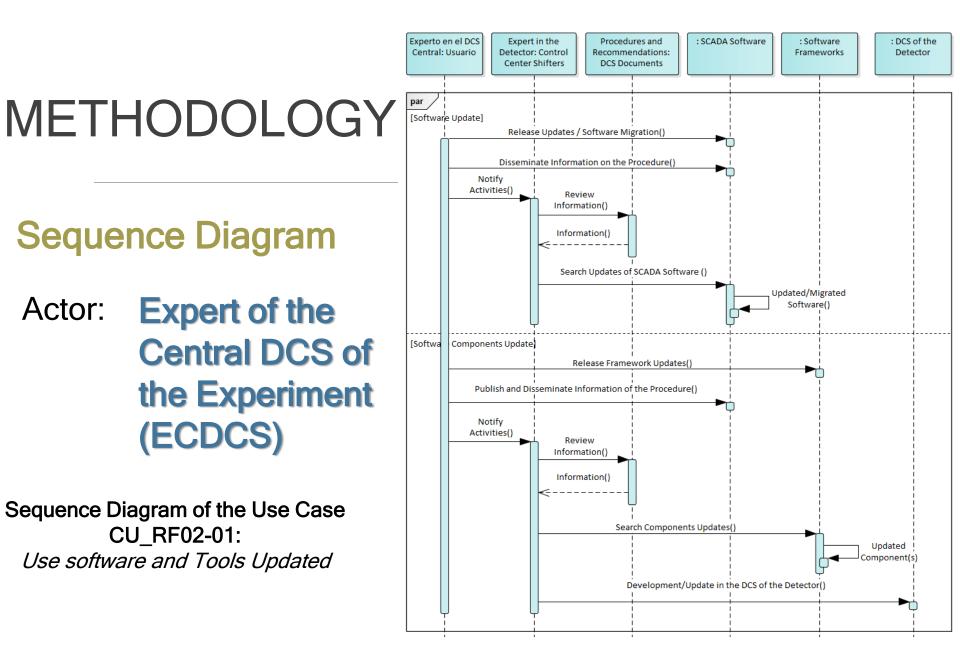


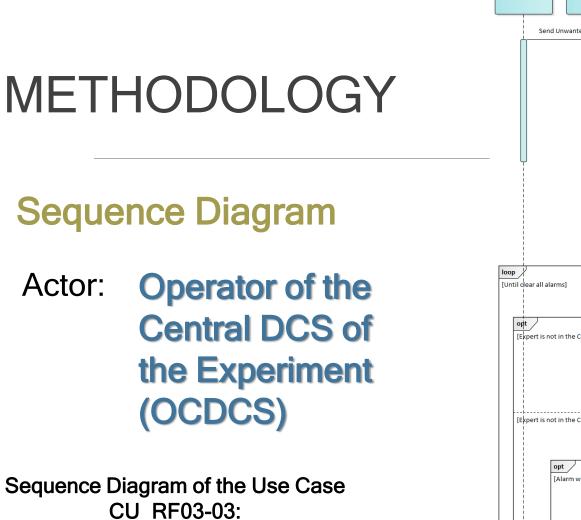




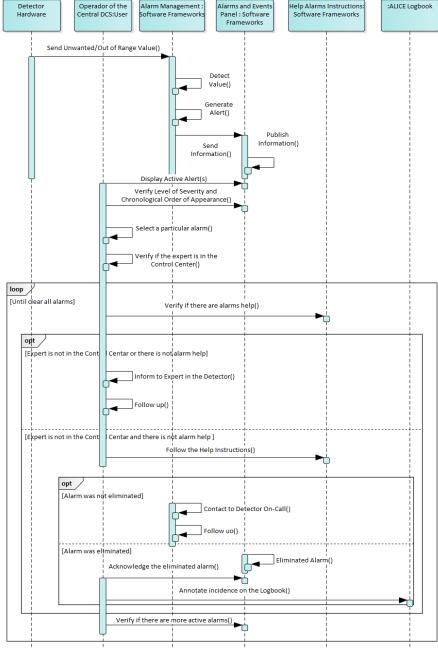








Attending Alarms and Help Instructions for Detectors/Subsystems



Conclusions

- It is important the definition and documentation of the design process, commissioning and operation of a detector control system (DCS) in high-energy experiments in a general way, especially for the staff that initiate in these interest topics (detector on-call, DCS shifters, members of a detector collaboration, etc.).
- □ The design of this methodological analysis of the DCS of the ALICE experiment for what will be LHC Run-3 is being finishing.
- □ This analysis is expected to be applied in the development of the control system for new FDD detector in the new LHC run in ALICE.





Thanks!



