EXCHANGE OF CRUCIAL INFORMATION BETWEEN ACCELERATOR OPERATION, EQUIPMENT GROUPS AND TECHNICAL INFRASTRUCTURE AT CERN

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Abstract

During CERN accelerator operation, a large number of events, related to accelerator operation and management of technical infrastructure, occur with different criticality. All these events are detected, diagnosed and managed by the Technical Infrastructure service (TI) in the CERN Control Centre (CCC); equipment groups concerned have to solve the problem with a minimal impact on accelerator operation. A new database structure and new interfaces have to be implemented to share information received by TI, to improve communication between the control room and equipment groups, to help post-mortem studies and to correlate events with accelerator operation incidents. Different tools like alarm screens, logbooks, maintenance plans and work orders exist and are in use today. A project was initiated with the goal to integrate and standardize information in a common repository to be used by the different stakeholders through dedicated user interfaces.

INTRODUCTION

The Technical Infrastructure service (TI) in the CERN control Center (CCC) is supervising the main technical systems at CERN 24 hours a day and 365 days per year in direct relation with CERN accelerator operation. Its mandate is to minimize the impact of technical breakdowns on accelerators and other important installations at CERN, to manage corrective maintenance activities and to co-ordinate interventions during major breakdowns.

Electricity distribution, cooling, ventilation, safety systems and lifts are some of the different systems supervised by the Technical Infrastructure service. Thousands of different types of equipment all around CERN are supervised in collaboration with different interlocutors: about fifteen equipment groups, accelerator operators, fire brigade, etc.

TI operators receive on average 50'000 phone calls, 1'000'000 alarms and create more than 10'000 work orders each year. These Work Orders (WO) are sent directly to the equipment group concerned by the problem for corrective maintenance, but if the event might interest CERN accelerator operation or other equipment groups; it has to be shared.

This paper presents the study phase of a project to rationalise data exchange between the actors described above.

DEFINITION OF AN EVENT

A TI operator has different ways to receive an event.

- An alarm is defined as an event that needs immediate operator attention and action. Alarms are generated by LASER [1], the LHC alarm service or directly by the Electrical Network Supervisor SCADA system [2] on a dedicated screen. In order to generate a useful work order, TI operators insert complementary information, like the context or equipment status.
- A phone call; a user will declare a problem where corrective maintenance is needed by an equipment group. The user will expect updates and follow-up of the resolution of his problem.
- A piece of information coming from accelerator operators declaring a degradation or a stop of the physics. In this case, the concerned accelerator operators would need to have details on the problem, its potential duration and up-to-date information on the progress of the stand-by intervention. Currently this communication is oral between the different CCC operators.
- Other event types might be added depending on the future needs, for example automatic event creation from supervision tools.

Different types of events

- Major Event: An event that impacts the accelerators operation by either stopping the beam or degrading it. Several operators in the CCC might be implicated, equipment groups might intervene in an emergency; reports and follow-up are necessary. See Figure 1.
  TI generates around 100 Major Events per year.
- Minor Event: An event that does not impact accelerator operation but requires equipment group intervention (emergency or not); reports and follow-up are necessary.
  TI generates around 200 Minor Events per year.
- WO using Infor EAM [3], the CERN work order creation tool: A work order declaration, done mainly by technical infrastructure operator in CCC and will send information to the equipment group concerned. It can be created in emergency or not depending of the work to be done and can,

in some case, require stand by intervention. The follow-up is internal at Infor EAM.

TI generates around 10'000 WO per year.

- Impact request: A request needed to intervene inside CERN accelerators. It is mainly used for corrective and preventive maintenance but is also needed for urgent stand-by intervention.
- Note / ongoing work: A log and a transfer of information between operators about the current state of systems.
- Elogbook entries: A list of events concerning accelerator operation. These events are entered manually by accelerator operators or generated automatically by supervision programs, like a sequencer or beam dump. This information might be interesting for different users and will have to be integrated in a shared place.
- Stand-by intervention: For the moment, stand-by interventions, following or not a WO creation, are based on phone calls. We identified a need to log all this information (time, duration, person and group concerned, actions, consequence, follow-up, etc.) in the purpose to facilitate communication, to share information and to make statistics.
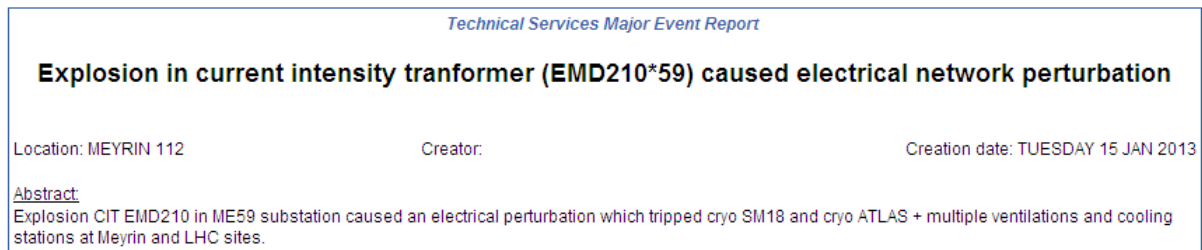

Figure 1: An example of major event report header.

DIFFERENT USERS AND STAKEHOLDERS

Some users are already identified, these are mainly people who will immediately be informed when an event occurs but this list is not definitive/exhaustive. New users might be added with no impact on existing ones. See Figure 2.

- TI operators: The technical infrastructure operators, mainly in charge of corrective maintenance 24 hours a day, 365 days per year will be the main user of the system by creating more the 10 000 events per year.
- Accelerator operators: The accelerator operators in charge of delivering good quality beam for physics will be a frequent user of the system; their elogbook tool might automatically introduce events in to the system.
- Cryogenic operators: The cryogenic operators in charge of maintaining the LHC cryogenic elements cooling and distributing liquid helium will also be a user. They will create a few events per year to inform accelerator operation, their specialists and follow their intervention team.
- Fire brigade: The fire brigade operators in charge of urgent and non-urgent interventions will share some of their events created by their own existing tools.

Some key stakeholders are already known and their needs are currently being defined:

- Equipment groups including stand-by services: Each equipment group wants to be informed of any event on their equipment. They need a precise description of the event from the operator in charge and information of emergency or criticality to initiate a stand-by intervention or not.
- Maintenance management project (MMP) [4]: MMP project needs a central tool to follow an event from creation to the return to a nominal mode in CCC.
- Infor EAM: Infor EAM is the main tool used at CERN to create work orders and to transfer them to the concerned equipment group. Infor EAM needs some mandatory information to create work orders. The Infor EAM database will be the core database to store data related to equipment group and link to Impact.
- Availability working group (AWG) [5]: this working group will need to have a complete list of accelerator stops with some details like duration, faulty device and service concerned.
- Statistic officer: The operation group statistic officer will need to have post mortem information to create yearly statistics on events with different criteria.
- Departmental Safety officer: DSO would like to be informed of event creation linked to safety matters.
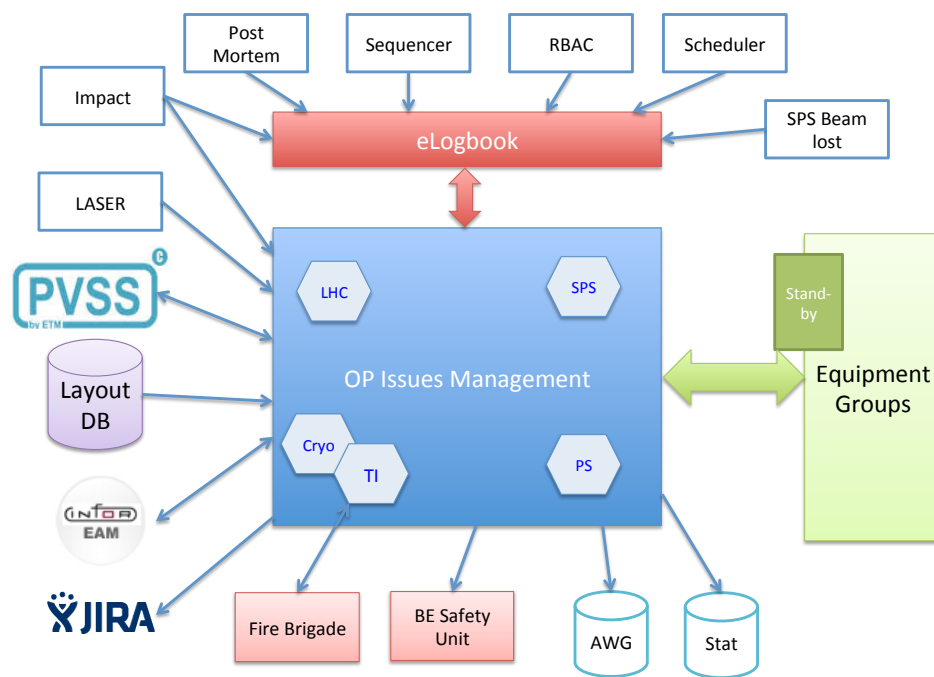
Figure 2: OP Issues management context.

DATA TO BE SHARED IN A COMMON PLACE

A large amount of data can be attached to an event. The core information is related to the event itself (start date, end date, source, etc.) but complementary details are needed. These details are coming from different sources: static databases, supervision programs, central alarm systems, accelerator operations and equipment groups. An event can also be linked to one or several other events.

A common place to store all this information is today mandatory to avoid duplication of data and keep event data such as configuration at the time of the event, context, measurements etc.

An Oracle database designed to accept current and future event types is being studied. Major events will be the first prototype with this new database structure.

Each user will be able to extract his needed information and use them as he likes.

Data structure is common, user interface is specific.

All different systems will be able to communicate with each other using this common place; all the links around one event will be stored and possibly used by different programs. Existing tools have to stay identical but interfaces, database APIs, etc. have to be created to insert, store and publish interesting data.

FUTURE USAGE OF THIS DATA

Several usages of this detailed information are foreseen; this list is not exhaustive:

- User interface type logbook to insert, complete, follow and close events; Each section will have to provide predefined information in order to close an event with all the relevant data useful for the future
- Dashboard or up-to-date read-only information for selected event types or purposes (ex. all major events during last month or a list of events with safety concerns for DSO, etc.)
- Tool to contact expert or stand-by person with relevant information via email or SMS
- Post mortem retrieval information for beam statistics and equipment availability during physics.

Some of these future usages already exist but data sources are multiple and inconsistencies or unavailability of data are often seen.

CONCLUSION

In the CERN operations group, the need to store all relevant information concerning events in a common place is obvious. All the existing programs will continue to have their own purpose but they will publish their crucial information to be shared between the different accelerator operations, equipment groups and technical infrastructure at CERN. A flexible database structure, including unique identifier, core data and links within programs, will allow inserting already known or future event's types. Several user interfaces could be created for each specific requirement.

REFERENCES

[1] Laser, The LHC alarms service, http://laser-alarms.web.cern.ch/laser-alarms/

[2] Jean-Charles Tournier et al. "New Electrical Network Supervision for CERN: simpler, safer, faster and including new advanced features" Icalepcs 2013.

[3] Pedro Martel et al. "AN EQUIPMENT HUB FOR MANAGING A SMALL TOWN AND A COMPLEX MACHINE - IPAC 2013 poster session" https://edms.cern.ch/document/1284234/1

[4] Pierre Bonnal et al. "Maintenance Management Project – Concept Report" https://edms.cern.ch/document/1173942/1.0

[5] Availability working group : https://espace.cern.ch/LHC-Availability-Working-Group/Meetings/SitePages/Home.aspx