Journal of Physics: Conference Series **664** (2015) 052037 doi:10.1088/1742-6596/664/5/052037

The ALICE Glance Shift Accounting Management System (SAMS)

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Abstract. ALICE (A Large Ion Collider Experiment) is an experiment at the CERN LHC (Large Hadron Collider) studying the physics of strongly interacting matter and the quark-gluon plasma.
The experiment operation requires a 24 hours a day and 7 days a week shift crew at the experimental site, composed by the ALICE collaboration members. Shift duties are calculated for each institute according to their correlated members. In order to ensure the full coverage of the experiment operation as well as its good quality, the ALICE Shift Accounting Management System (SAMS) is used to manage the shift bookings as well as the needed training. ALICE SAMS is the result of a joint effort between the Federal University of Rio de Janeiro (UFRJ) and the ALICE Collaboration. The Glance technology, developed by the UFRJ and the ATLAS experiment, sits at the basis of the system as an intermediate layer isolating the particularities of the databases.
In this paper, we describe the ALICE SAMS development process and functionalities. The database has been modelled according to the collaboration needs and is fully integrated with the ALICE Collaboration repository to access members information and respectively roles and activities. Run, period and training coordinators can manage their subsystem operation and ensure an efficient personnel management. Members of the ALICE collaboration can book shifts and on-call according to pre-defined rights.
ALICE SAMS features a user profile containing all the statistics and user contact information as well as the Institutes profile. Both the user and institute profiles are public (within the scope of the collaboration) and show the credit balance in real time. A shift calendar allows the Run Coordinator to plan data taking periods in terms of which subsystems shifts are enabled or disabled and on-call responsible people and slots. An overview display presents the shift crew present in the control room and allows the Run Coordination team to confirm the presence of both regular and trainees shift personnel, necessary for credit accounting.

1. The ALICE experiment operation

During the LHC run, the ALICE experiment [1] needs to be continuously managed by a trained team at the LHC P2 that operates 24 hours a day and 7 days a week. The ALICE experiment crew is generally composed by the people in charge of the so-called "General subsystems" assisted by the experts from the sub detectors teams that are remotely available by phone (on-call). However, sub-system on site shifts can be also requested.

The experiment operation is divided into different periods in which the composition of the shift crew may change. The shift plan represents a complex task that should respect several collaboration issues, institutes contributions and individual expertise. Specific appointments manage the shift schedule and guarantee that properly trained professionals execute each run in an accurate way. Moreover, the entire process has to be flexible enough to deal with exceptions and unforeseen situations. Warnings should be sent to the responsible team alerting about the occurrence of both incidents and achievements of each phase in order to organise the following stage.

The starting point is the definition of the general run coordinator and the coordinator of each ALICE subsystem. The ALICE Run Coordinator (RC) is in charge of defining the composition of the shift crew for each period and make sure that all ALICE institutions take shifts. He or she is responsible to define the run periods, the systems for which there will be an on-site or an on-call shifter and the credits associated with each shift position. System run coordinators (SRCs) and deputy run coordinators have special access only to the subsystems that they have been appointed to. The period run coordinator, directly defined by the Run coordinator, has the same privileges as the RC during the period they are associated with.

There are two types of shifts: regular and training. The regular shift leads to credits for the collaboration institutes account. A training shift corresponds to a simulation that is required before participating in regular and on-call shifts. Therefore, SRCs only allow members to take part in regular and on-call shifts once they have finished the class and the training in addition to a formal SRC approval. SRCs can create training courses to which ALICE members can subscribe. SRCs can also insert or remove candidates as well as update the course details. Automatic notifications will be sent to the list of people who attended the course to inform them about their granted permissions to be on-call, shifter or both.

Days are divided into 3 shifts of 8 hours and follow a rotational schema made of 2 mornings, 2 afternoons and 2 nights while on-call shifts are in 24-hour blocks. The RC publishes the overall schedule to the collaboration. In order to fulfil the requirements, every collaborator is requested to participate in the experiment activities via operational shifts. The due shift quota for each operational year for each institution is calculated according to the number of scientists in the group. Overbooking can occur when an institute exceeds the due number of credits. In such cases, institutes that have booked more then 100% of their credits can have their upcoming shifts replaced by other institutes that have less than 75% of quota.
An estimate of the due/achieved quota is made and presented to the ALICE collaboration every time a run period is accomplished at 30%, 60% and 100%. Notifications are sent to the group leaders of the institutes who have not achieved their quota at specific times of the operation run.

The following sections describe the Glance technology and how the ALICE SAMS system has been developed to provide the needed functionality. The different aspects covered by the ALICE SAMS system are illustrated in detail.

2. The Glance Technology - System Design

The system was designed to couple with the pre-defined rules but at the same time offering some flexibility and allowing an easy enhancement. Therefore, it follows a model-view-controller architecture. The features were organised in roles and permissions, scheduling (courses, training and shifts), accounting and alerts. The system promptitude in terms of development, maintenance and deployment is accomplished through adaptable schemas within the database model. We use the Glance Technology to automatically generate a XML representation of the data set, previously selected from the repository, that contains the list of attributes, their types and related values, if any. From this description, a Web search interface is directly created. Insert interfaces can be developed from the high-level representation, associating with additional input

data validation functions. This schematic process facilitates and speeds up the implementation of Web systems, while supporting the maintenance since differences between the interface and the database are periodically verified.

The Federal University of Rio de Janeiro (UFRJ) and the ATLAS experiment designed the Glance technology that provides a generic mechanism for accessing any repository acting as an intermediate layer that isolates the particularities of the database from the application level. The Glance Retrieval Tool is an Application Programming Interface (API) that performs data retrieval and insertion/update in distinct and geographically spread repositories [2].

Each regulation change is reported in an issue tracking application. When the modification implies a code adaptation, the new software version is controlled by a version control system properly documented. After validation, the new release is deployed and published to the community.

3. The ALICE Glance shift accounting application

Following the success of the ALICE Glance membership system developed by the UFRJ and the ALICE team at CERN, the ALICE collaboration decided at the beginning of 2014 to build the new shift accounting system using the Glance technology.

The ALICE SAMS system was built from scratch although the developers have only taken into account a previous system functions that was related to the quota calculations and the general layout. In September 2014, the system was ready to be tested by the main users and properly structured to be adapted according to the evolving requirements.

The system has been developed using different technologies such as PHP [3], Python [4], Javascript/jQuery/Ajax [5], Google Charts [6] And Bootstrap[7]. The ALICE Glance technology is used to retrieve records from the database while the pages handling and their rendering are implemented in PHP on the server side, applying the necessary rules to provide the right functionality. Javascript and jQuery Framework are used to improve the user experience throughout the system. Aiming to facilitate the system usage, some other minor directives and input data validation functions on the client side were applied. On the server side, security is handled by a PHP implementation. All the CGI (Common Gate Interface) programs have been developed in Python as well as the communication with the database. Change requests are made via Ajax (insertion/updates) and the responses are promptly deployed to the interfaces after execution. Notifications handling and logging are done via Python CGI programs. Fig. 1 presents the system requests workflow.

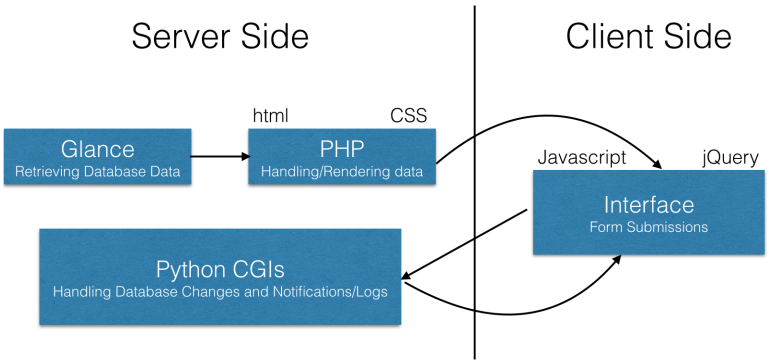

Figure 1. Glance requests workflow

The repository is a relational Oracle database designed to facilitate the data access, according to the experiment needs. A history model keeps track of all database transactions, storing every

modification held in each table. This is achieved by setting up triggers that control the changes performed by the system functions. Through Glance, the SAMS and ALICE Membership databases are connected and, therefore, specific data such as members contracts and personal information can be easily accessed.

The ALICE SAMS has been efficiently used since the restart of the experiment operation in November 2014 after the end of the LHC long shutdown 1. Today, the ALICE collaboration members use SAMS to book training classes, training shifts, regular shifts and on-call shifts. Run, period and sub system coordinators also access the system to ensure the coverage of the run period, organise training classes and grant permissions. Institute team leaders can follow their shift quota status and organise their team shifts.

3.1. Classes and shifts

The ALICE experiment crew consists of 4 different general shifts:

- The Shift leader (SL) is responsible for the experiment operations and ensures that the daily program is respected.
- The ECS (Experiment control system) shifter is in charge to operate the data acquisition, the central trigger and the high level trigger systems according to the instructions received from the shift leader.
- The DCS (Detector control system) shifter ensures safety and reliable operation of the experiment.
- The DQM (Data quality monitoring) and Offline shifter monitors the quality of the data and performs offline operations during data taking.

ALICE members who want to book shifts for a given general system should pass a series of training steps. First, they need to attend a training class and then, each of them should work with the already-qualified shifter at the experiment area in order to hands-on experience. The ALICE SAMS supports the management of different shifter "qualification" steps following a pre-defined workflow. Fig. 2 shows the calendar from which the candidate shifter can subscribe to training classes. To build the calendar, a specific API is responsible to handle the data that comes from Glance and generate an interactive HTML (HyperText Markup Language) table in a calendar format. This table captures the user actions in the client-side through pre-defined events that trigger responses for each level of system permissions. The Run Coordinators of each sub system can confirm the class attendance by selecting the attendees at the training session from the list of subscribed people. Before the class, the parameters associated to the training sessions such as time, maximum number of trainees and general info can be modified by the sub system Run Coordinator and the concerned people can be notified via email. The functionality just described is shown in Fig. 3 and can be achieved by an left-click event of an expert user such as Run Coordinator and System Run Coordinators. This event trigger a Bootstrap model that manage the classes attributes.

Fig. 4 shows the interface from which the shifter can book the selected shift block. The different colours allow coordinators to check the qualification status of the shifters. In particular, ALICE members belonging to institutions in under-booked status have the right to override the shift of members in over-booked institutions. In the example in Fig. 4, each colour represents a different shift status for instance, dark blue blocks represents the shifts that can be overwritten. All cells of the table have an ID corresponding shift information stored into the database. The data is queried from different tables to populate all cells according the stored data.

Everyday the system provides an overview of the shift crew present at the experiment area. The shift leader confirms the presence of the shifter that will trigger the transfer of the shift credits to the institution the shifter belongs to. The interface showing the shift crew is presented in Fig. 5. The system provides a function that automatically sends an email to the selected

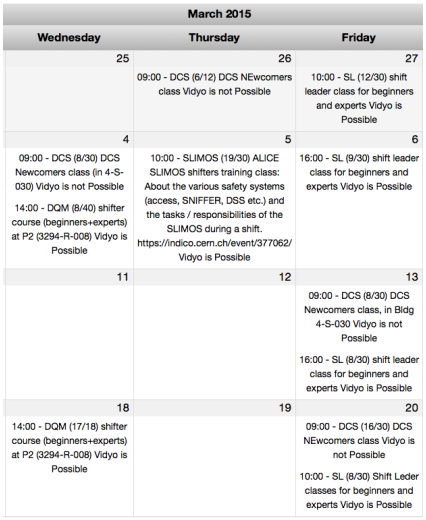

Figure 2. Training classes calendar

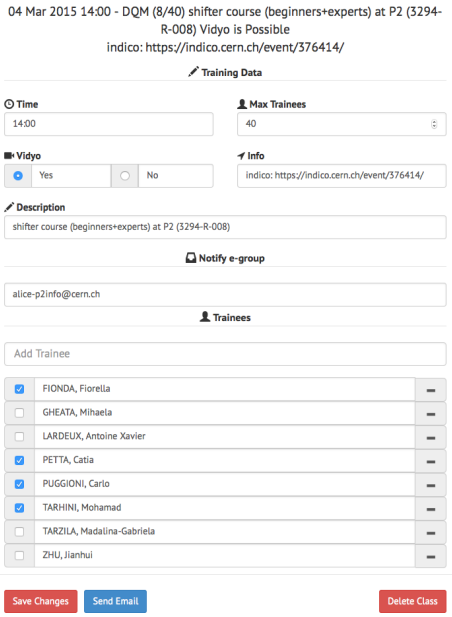

Figure 3. Training class management

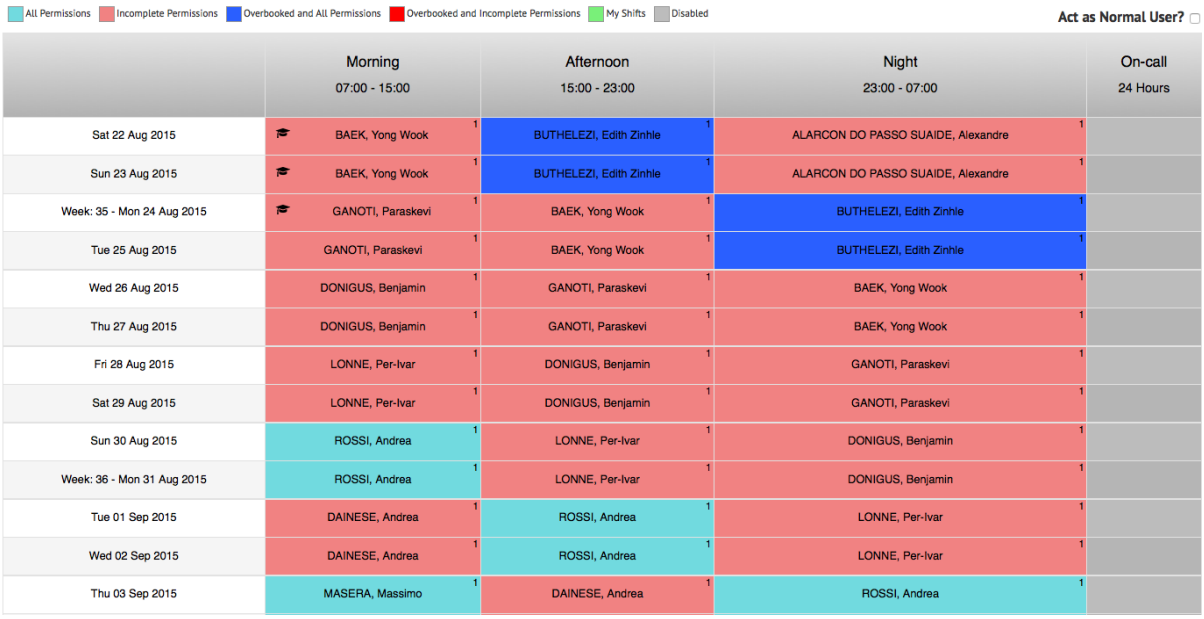

Figure 4. Shift booking interface

people for announcements. By making use of Bootstrap's grid system, the interfaces can be accessed in different screen sizes. In addition, the datepicker jQuery plug-in can be used to display shift crews at any time of the Run. Furthermore, the e-mail feature provides the communication with the shift crew, or part of them, using the local e-mail client without any overload at the server-side.

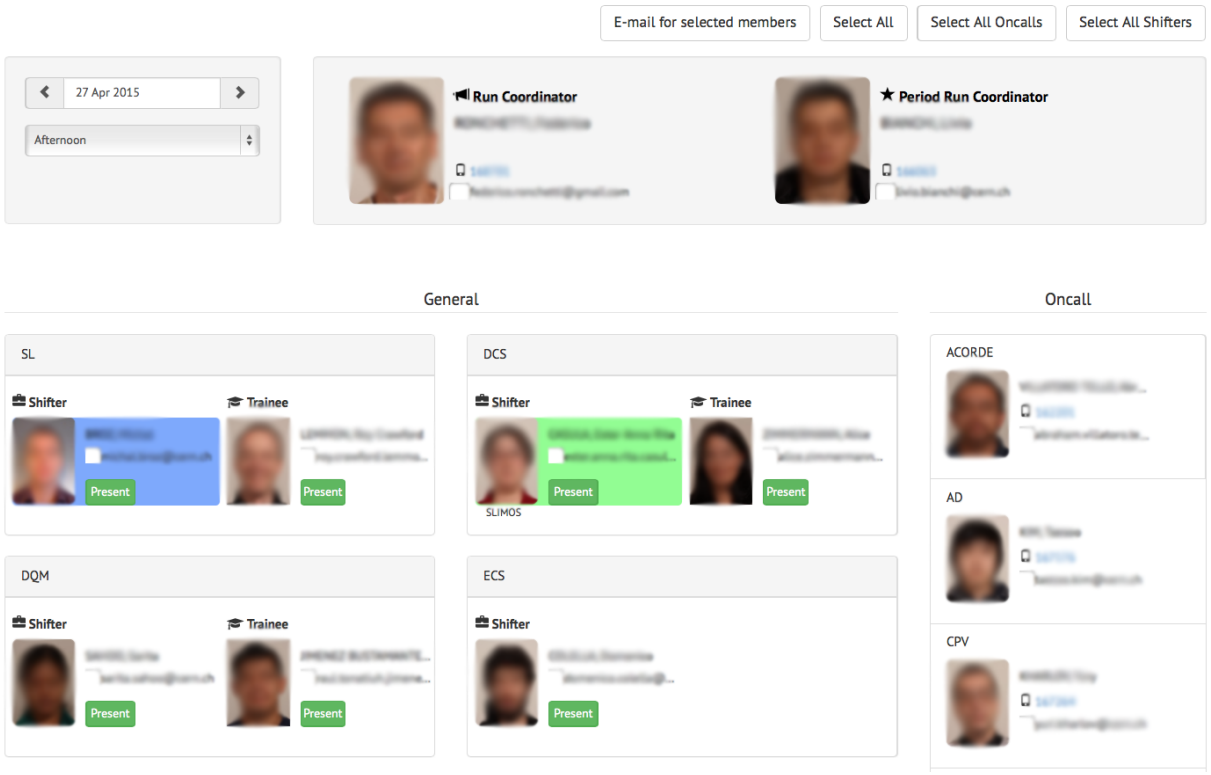

Figure 5. Shift crew

3.2. Run definition and management

The ALICE SAMS allows the ALICE Run Coordinator to define the data taking run into specific periods and, in each of them, enable general and sub system shift positions during a specific period. It is also possible to assign different credit weights to the shift positions according to the particularities of each specific period. The Run Coordinator can also assign a Period Run Coordinator (PRC) to the entire interval (usually one month long) composing the periods. Fig. 6 shows the run management interface where the Run coordinator can enable/disable shifts for each run period and assign the Period Run coordinators.

According to the applied settings, an Ajax request will be sent to the server to execute the correspondent CGI. After that, the system automatically calculates the total shift quota for all periods and the entire run through a math algorithm that considers all defined information as well as the individual quota that the ALICE institutes have to fulfil to be considered in good standing.

Shift credits are then shown in the Web interface through tables, pie charts and histograms, using the previously submitted data in (Fig. 6). These data are handled and manipulated in order that the Google Charts API can build the charts using SVG (Scalable Vector Graphics). Fig. 7 shows the shift distributions as an example of system graphical overview.

3.3. User profile, Institutes shift quota and integration with the ALICE Glance membership system

The ALICE SAMS features a user profile where all taken and booked shifts are listed as well as the permissions for each subsystem. Every ALICE member can use the profile interface as an agenda with all the appointments concerning shifts and as shift credit accounting.

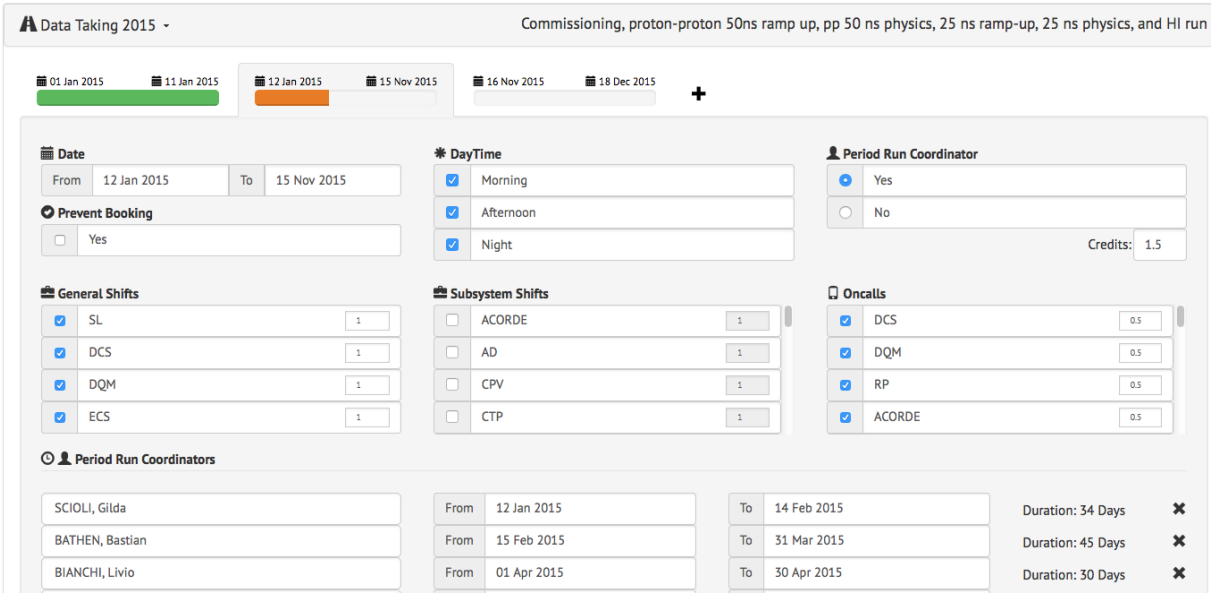

Figure 6. Run management

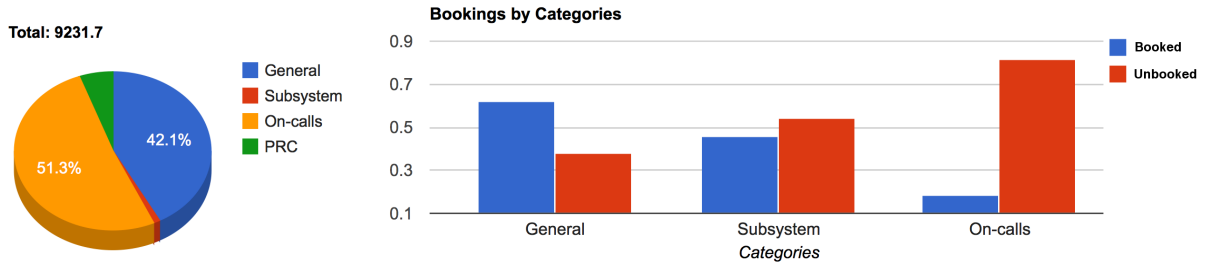

Figure 7. Shifts distribution

In order to assign shift credits to the correct institution, the ALICE SAMS has to interface with the ALICE Glance membership management system. The two systems share the same database, and this allows an easy integration between the information concerning the ALICE collaboration members and the data related to the experiment operation. With an automatic assignment of the shift credit to the ALICE institution, it becomes very easy to obtain an overview of the shift status for each institute as shown in Fig. 8. To speed up the process of displaying the percentages in Fig. 8, instead of getting the information of each institute within a loop, the functionality retrieves all needed attributes from the database. Then, some logical methods are responsible to create an associative matrix that contains the complete statistics of each institute to be displayed in a HTML table.

The ALICE SAMS integrates with the ALICE Glance membership system also to recuperate the information concerning ALICE members appointments. In this way, the system automatically recognises the Run Coordinator after login, for instance, and all the other ALICE members belonging to the experiment operation management. The Web application contains pages where all members of the experiment coordination are listed along with their contact details.

The ALICE Run Coordination is in charge of following this up and contacts the team leaders to inquiry on the shift planning status. In addition, the system automatically notifies team

Institution	Due	Done	%	Booked	%	Progress
2015 - Alessandria - Turin	353.6	130.5	37%	254.5	72%	
2015 - Bergen	294.6	26	9%	107.5	36%	
2015 - Bologna - Centro Fermi - Salerno	353.6	237.5	67%	344.5	97%	
2015 - Lyon IPNL - Lyon CCIN2P3 Cluster	88.4	59	67%	60.5	68%	
2015 - Mexico	279.9	77	28%	117	42%	
2015 - Munster - Tubingen - Worms	88.4	98	111%	98	111%	
2015 - Rome - Frascati	162	20	12%	124.5	77%	
2015 Daresbury - Liverpool	73.7	12	16%	62	84%	
AM - Yerevan	29.5	0	0%	12	41%	
Amsterdam - Utrecht	191.5	48.5	25%	179.5	94%	
Bari	162.1	126	78%	130	80%	
CH - Geneva CERN	795.6	212	27%	290.5	37%	

Figure 8. Institutes overview

leaders at specific times of the year about their current shift quota status.

4. Conclusion

Glance automatically generates a XML representation of the saved data, speeding up the interface coding. Besides that, Bootstrap supports the design of the interfaces, facilitating the implementation of highly interactive interfaces that present processed records and attributes stored in different databases.

The ALICE SAMS is currently used by all the members of the ALICE collaboration who participates in the experiment operation as well as by the run, period and sub system coordinators. It has been successfully used since the restart of the operation in November 2014 and has evolved by integrating new functionalities that allow a more dynamic use of the system. It is a complete system that provides all the functionality to manage the experiment operation personnel as well as the follow up of institutes credit quota achievement.

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