

Integrated Management System in a modern HOTLAB

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ABSTRACT

For the detection and control of nuclear fuel samples and monitoring with respect to criticality safety, the 1998 from PSI developed KBuch program has been used. In autumn 2011, a logic error was detected in the software during a routine booking with extraordinary nuclear fuel. This bug was reported to the national regulator ENSI and appropriate administrative measures have been taken to prevent the recurrence of the logic error.

ENSI additional requirement: "Given the fact that the logic fault is inherent and can't be resolved in the short term, effective measures to prevent future accounting errors must be taken to medium term. The software should be developed to state of the art as soon as possible".

Subsequently, a project was launched to update the used software as required.

In a first step a total situation analysis was performed. It was clearly seen that today's program KBuch has many interfaces to the QM system (users, facilities, containers, ...), as well to the present sample management software. Those interfaces have been identified to be potential sources of errors in the current situation.

The decision was taken at PSI to start a complete new development of the software instead of performing only an update of the existing program. This decision allows the development of the software to current state of the art, improves update capabilities in the future and allows the restructuring of the software (kernel, GUI, interfaces).

In spring 2013, five software companies were invited for bidding. From this call the company IQS Ltd. in Zofingen (CH) was chosen as a partner for the now following phases.

In summer 2013, the concept of the new planned program was presented successfully to the regulator.

The known potential of the standard software IQSoft from the chosen project partner IQS Ltd, leads to the idea of an integrated management system at PSI HOTLAB.

This presentation shows on basis of the IQSoft standard software the status of the actual project to an integrated management system in a modern HOTLAB

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1 Introduction

The department HOTLAB (AHL) of Paul Scherrer Institute (PSI) accounts, according to internal as well as external regulations, nuclear materials and moderators. The capacity of the HOTLAB is limited by various dispositions by the Swiss regulator ENSI (Eidgenössisches Nuklearsicherheitsinspektorat) and the Swiss Federal Office of Energy (SFOE).

For the detection and control of nuclear fuel samples and monitoring with respect to criticality safety, the 1998 from PSI developed KBuch program (Figure 1) has been used. In autumn 2011, a logic error was detected in the software during a routine booking with extraordinary nuclear fuel. This bug was reported to the national regulator ENSI and appropriate administrative measures have been taken to prevent the recurrence of the logic error.



Figure 1: Screenshot of KBuch software

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Subsequently, a project was launched to update the used software as required.

In a first step, a total situation analysis, looking into KBuch, the existing Software (IQSoft) used by the quality management system (QMS) as well as an activity and sample management software (HPI) developed and used by the AHL, was performed.

Among others the following conclusions have been drawn from this analysis:

- An update of KBuch will not end in a satisfying solution. A new program should be developed.
- The technical basis of the new program development is rather underpart. Today's database systems and development environments meet the requirements of AHL and the authorities.
- The calculation of the mass limitations of fissile material in KBuch is well documented and can thus be easily adapted and transferred to the new program solution.
- The mappings of processes within the software KBuch do not meet the requirements of the users.
- The first priority requirement of the users is good operability.
- The complexity of today's software requires comprehensive program testing and ongoing maintenance program.
- The search for customizable standard software, with appropriate knowledge of the developer should have the highest priority.

Furthermore, it was found that KBuch has many manually maintained interfaces to the QMS (users, facilities, containers, ...), and also to HPI, which are potential sources of error in the today's situation.

The decision was taken at PSI to start a complete new development of the software instead of performing only an update of the existing program. This allows:

- Migration of the software on a current standard software and hardware
- Improved update capabilities in the future
- Restructuring of the software (kernel, graphical user interface (GUI) interfaces)

In spring 2013, five software companies were invited for bidding. From this call the company IQS Ltd. in Zofingen (CH) was chosen as a partner for the now following phases.

The known potential of the standard software IQSoft [1] from the chosen project partner IQS Ltd, leads to the idea of an integrated management system at PSI HOTLAB.

2 Situation of the QM-System

The development of the historically common QM system of AHL and the Laboratory of Nuclear Materials (LNM) was described in [1]. This common QMS system has different interfaces (Figure 2) to various PSI systems and different organizational units.

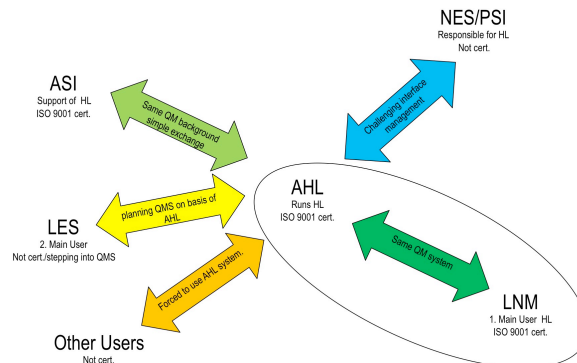


Figure 2: Interfaces of AHL QMS

2.1 Organizational structure

AHL and LNM are part of the Nuclear Energy and Safety (NES) department of PSI, which both have no certified QM system. This situation increases the workload to the system, as e.g. official PSI documents have to be integrated in the system by the QMS manager manually.

AHL runs the HOTLAB and LNM is the main customer of the lab, but there are also some other customers without a QMS. This situation increases the workload too, as e.g. these users, mainly PSI employees have to be integrated into the system.

Luckily the irradiation protection department (ASI) at PSI has certified QMS and is even an accredited laboratory for dosimetry. ASI themselves are also using IQSoft as management software so the exchange between the two systems is relatively easy.

2.2 Management tools

Looking at this complex situation it is no wonder, that there are many different tools are used at PSI for managing purposes. The following description gives just a taste of the situation.

AHL, LNM, ASI and some other units at PSI are using IQSoft as managing software for their QM system, but the degrees of utilization are totally different.

PSI finance services and human resources introduced SAP in 2012 as management system. In this system the personal data of all employees are managed.

The site group of AHL used the software SAMA for dispatching and scheduling the maintenance work since 1990 [1].

Since 1998 the HOTLAB uses the special designed software Kbuch for accounting fissile material and ensure the mass limits concerning criticality.

Another software was introduced in 2006 for managing all samples and partly orders (HPI) in the HOTLAB as well as calculating the total activity inside the rooms and the whole HOTLAB.

In all these tools you have common data, e.g. employees, users, rooms, partly sample data and many other data, which are duplicated due to the complex system setup.

2.3 Reporting lists

At certain points different institutions (regulator, customers, PSI departments, ...) are requesting information in form of lists or special reports. As there are many different databases (IQSoft, SAMA, KBuch, HPI, SAP, ...) it gets more and more complicated to ensure correct information be distributed to those institutions.

3 Integrated Management System

Beside the normal development of the existing QMS the focus of the last years was set to reduce as many interfaces in the given situation as possible and to increase the usability of the total system as much as possible.

3.1 Interface for employee data

Historically the employees of interest for the QMS have been managed manually. If there was any change, it was administered by the secretary of the AHL or LNM. As the same data were managed by other departments of PSI too, it was additional work with a potential source of errors. The decision was taken to program a software interface to import the data into the QMS. This is a non standard module of IQS Ltd. which was set up to adjust the data of PSI telephone book with the QMS database.

3.2 SAMA Integration

Due to a special requests of the regulator in 2012 to classify and report all safety relevant components of the HOTLAB, the decision at AHL was taken to integrate the since 1990 used SAMA maintenance program including all historic data into IQSoft database. The Idea was to create the requested report from one single database (see also chapter 3.4).

It was recognized that the workload of this migration will be high, so this project was performed together with an IT student performing a 6-month traineeship at the HOTLAB.

First analysis of the situation showed that:

- only a minor part of SAMA was used the last 20 years,
- the used functionality of SAMA is also available in IQSoft,
- the database of SAMA could be exported,
- the setup of the database of SAMA and IQSoft allows a migration.

The amount of data to be migrated was:

- 82 addresses,
- 378 components,
- 33585 journal entries.

All data from SAMA had to be manipulated to fit the requirements of the IQSoft-database. Manly the ID's of single entries and their linkage in different tables have been checked and changed.

After preparing all these data a test of the planned migration using a parallel test-database of IQSoft was performed. No major problems have been identified. At this stage all users have been informed about the migration and to a due date a backup of both databases was done and the real migration was performed. From this date we run the systems in parallel, to ensure that IQSoft works the same way SAMA did. After one month AHL took the decision to terminate the use of SAMA and informed the regulator about the situation. ENSI was supporting the decision and after 4 month of parallel use, SAMA was shut down definitely.

3.3 Integrated sample and order management (IPV)

Based on the situation analysis done for KBuch, it was decided that the new developed software shall be an integrated part of the QMS on one hand, but on the other it has to be a standalone program, as request from the regulator.

The integration into the QMS will be carried out to:

- simplify the usage (same GUI),
- simplify the maintenance of master data,
- avoid errors due to maintenance of data at different locations (e.g. personal data).

The independency as standalone program on the other hand is essential to ensure that:

- data are not manipulated due to accidental actions of users,
- any changes in the basic functions of the program are logged,
- the new software can be operated independently of other software.

Furthermore, it has been shown during the situation analysis, that there are numerous overlaps and interfaces between the applications KBuch, HPI and IQSoft.

In order to ensure both, integration as well as independence, the concept is based on establish different modules.

The new “innovative KBuch” (IKB) will be a module of an integrated sample management system (IPV), which also includes a module for order and sample management (APV) and will use a part of the existing QMS, but IKB will also work as standalone software if it is necessary.

Figure 3 shows the conceptual structure of IPV showing IKB, APV and the QMS modules in the IT environment of PSI HOTLAB. All program modules will run on a virtual server in the server park of the PSI to ensure high IT security.

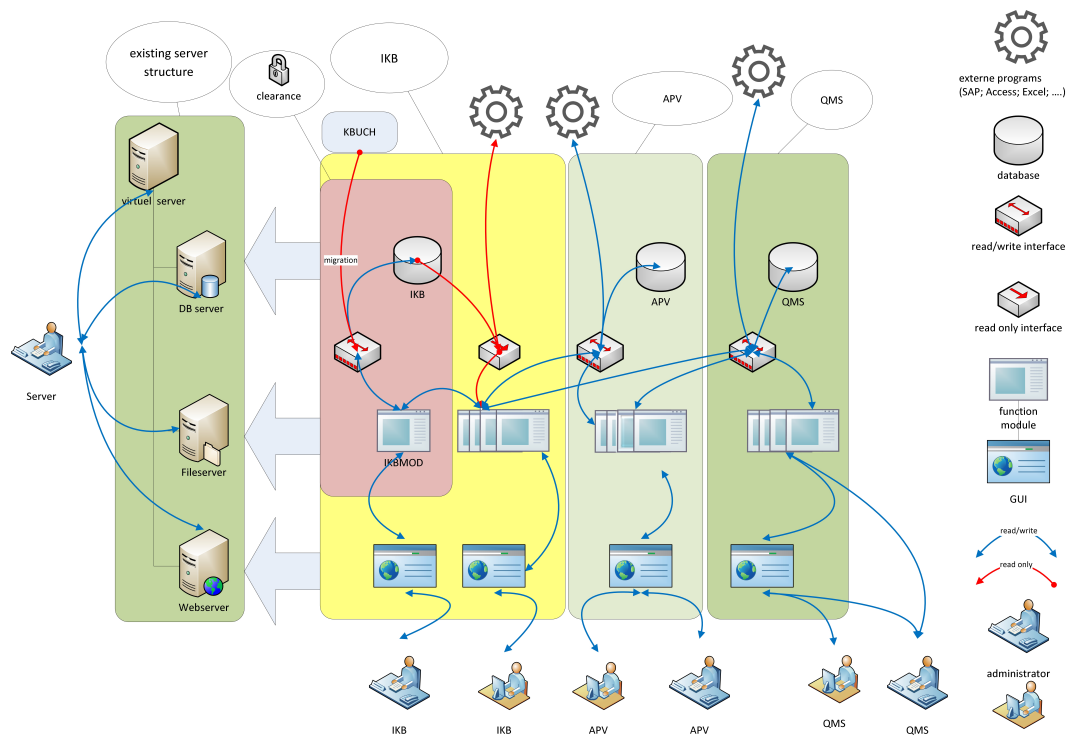


Figure 3: Conceptual structure of IPV showing IKB, APV and the QMS modules in the IT environment of PSI HOTLAB.

IPV will consist of:

- a special database for IKB (release from ENSI required)
- a database for all other data
- an encapsulated function module IKBMod (kernel) implemented to secure safety-related calculations and sample manipulation (clearance from ENSI required)
- expanded functional modules for user-friendly design of the application IKB
- function modules for order and sample management (APV)
- graphical user interface for data maintenance
- the database management system (standard product)
- various interfaces to migrate or export data.

3.3.1 Database management system

A standard Microsoft SQL server database will be used as a database management system in a standard Microsoft server environment.

The database will be divided into a part which has to be released by the regulator ENSI for a certain set of data and a database which is without release duty by the regulator for all further sample data.

In the daily operation a backup of the database will be done offline and the database will be operated in a "non archive mode". This means that the data entered during a day could be lost.

There will be a test-database containing the same data as the productive one to allow the users to perform tests under real conditions. The data of the test environment will be replaced in a weekly rhythm with the data of the productive database.

3.3.2 The Kernel - IKBMod

Both IKB as well as APV include basic functions, which must be carried out similarly in both. This includes all types of movements as well as the basic functionality in manipulating the samples. As these basic functions also contain relevant calculation methods for the mass limitations of fissile material this basic function will be coded in a special module (working title IKBMod), which needs the clearance of the regulator. IKBMod will be an integrated part of IKB. The basic calculations of the mass limits are taken from the current system and will be enhanced to ensure that the logic error of 2011 will not happen again. In addition plausibility checks right from the beginning will be implemented to detect input errors of the users and to ensure correct calculations. Further, already observed adjustment requests to the basic functionalities will be added.

3.3.3 Advanced function modules of IKB

Advanced function modules will use the basic functionality of the kernel IKBMod to perform more complex operations (e.g. creation of a cutting plan). Communication with the database is done exclusively through the functions of IKBMod.

The advanced function modules of IKB will allow combining data from IKB, APV and the QMS for evaluation purposes, without manipulating the existing safety relevant data in IKB.

3.3.4 Function modules of APV

The function modules of the order and sample management (APV) will allow the data maintenance of samples and orders, which are not in the IKB part of the IPV application.

The function modules of APV will allow combining data from IKB, APV and the QMS for evaluation purposes, without manipulating the existing safety relevant data in IKB.

3.3.5 Interfaces

The graphical user interface will be in the look and feel of IQSoft web modules (Figure 4), which have been presented in detail [1]. In addition it is very important to easily identify the current workspace or the currently used database (test or production-database) for example by different colors, to enable the user to switch between the test environment and the production system and ensure that the user knows directly which system he is using.

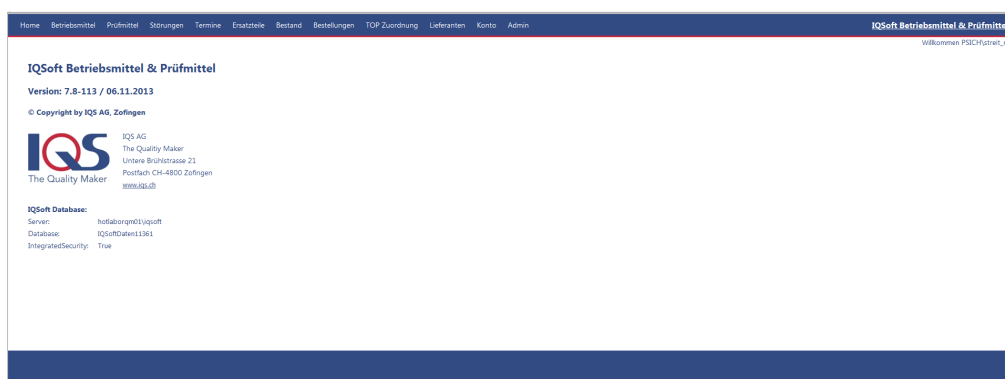


Figure 4: Screenshot of IQSoft BMPM web module

In addition IPV will contain various defined interfaces, e.g. various prints as well as data formats defined by the authorities as well as total or partial export to MS Excel, which simplifies the maintenance and further processing of data.

3.4 Report creation

The main advantage of a common database used in a QMS is the possibility to create different reports. In case of IQSoft many standard reports needed for the daily work and the certification are integrated in the software. But in the special case of nuclear facility many different reports are needed.

3.4.1 Data processing

A real advantage of IQSoft is the open database on the used MS SQL server. For the administrator it is no problem to program requests or procedures on the server level to provide needed tables or calculation results. With this, it is even possible to create analysis of data, which were not designed to interact with each other.

3.4.2 Reports on the web

With the PSI intranet, it is possible to show data from an SQL query directly integrated in the webpage. This is used to easily access data like room information, employee information, telephone numbers, status of equipment.

3.4.3 Reports in MS Office

With Microsoft Office it is possible to link documents like Excel files, Word files to an SQL database and use the data from there. This enables our system to create a new dimension of flexibility. Starting from serial letters, special lists up to complicated graphical analysis, everything you could do with MS Office is possible with the data of the QMS.

3.4.4 Reports for classified components

As mentioned before AHL got a request to report all safety-classified components of the HOTLAB to the regulator. For this a special format is requested. Looking into the details the decision was taken to set up a special Access-module to combine the data processing on server level, with additional processing in Access, to establish a user-friendly reporting system for this request. After the setup it was seen that this reporting system could also be used to fulfill some other needs and it was and is still further developed.

4 Results and Outlook

To summarize the status of the work it could be mentioned, that:

- the integration of the SAMA System was done successfully and enables the system to fulfill requests from the regulator;
- setting up a defined interface module to adjust the data from PSI telephone book reduces dramatically errors in the database and the work load of the secretaries;
- the new possibilities to create different reports with the above mentioned tools enables AHL to easily create reports and working documents based on the needs of the regulator, customer or employee;
- realisation of integrated sample and order management will increase the value of the system fundamentally.

Performing those changes in the system reveal some interesting points:

- most people think quality management is equal quality assurance,
- the acceptance of quality assurance is divergent, depending on the situation of the person,
- acceptance of the used tools to run the QMS depends of the usefulness of them to each single person.

5 Conclusions

The QMS of AHL and LNM is developing into the direction of an integrated management system by adding functions to the system which are facilitate the daily work. Not all of the above presented measures are nessacary to have a certified QMS, but they support the acceptance of the system and the tools.

As quality management itself is a process, which could be continously improved, the development of a quality management system will never be completed.

6 Acknowledgement

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7 References

- [1] R. Zubler, M. Streit, C.Kost, M. Kiel; „Quality Management in a HOTLAB – Challenges & Solutions”; HOTLAB 2014, Baden (CH), 2014