Marco Streit :: Head of the Department & Facility Hotlab :: Paul Scherrer Institut

New integrated sample management software @ PSI Hotlab

Hotlab 2018, 17-19 Sept. 2018
A Software Project @ PSI Hotlab
- from 2012 up to today
• Need to bookkeep fissile material
• Software (KBuch) was developed in 1998
• Since 2006 need to bookkeep radioactive samples
• A separate database was developed called Hotlab Sample Information System (HPI)

In 2012 a logical error in KBuch during a special sample movement was recognized
Mixture of pure U-238 with Pu (U-235 = 0%)
• Recognized as not allowed fissile material
• But input into database possible
• -> No mass limitation
• -> Not included in criticality calculation
• -> Error!

Reported @ Hotlab 2014
In view of the fact that the logic error is inherent and can not be rectified in the short term, effective measures must be taken to prevent future errors. In the medium term, the software is to be brought to the state of the art.
Chosen Project Phases

1. Situation Analysis
2. Management decision
3. Choosing Software Developer
4. Concept for ENSI
5. Acceptance of concept by ENSI
6. Setting up specifications for engineering company
7. Realization
8. Test phase (incl. Acceptance by ENSI)
9. Data Migration
10. Acceptance test (incl. ENSI Inspection)
11. Commissioning
Situation Analysis (Summer 2012)

• Update of KBuch not satisfying solution
• Mass limitations well documented
• Highest priority of users: good operability

• Standard software should be prioritized
• New "KBuch" has to be released by ENSI
• Software HPI for bookkeeping activities has similar requirements
• Needs for management of orders/tasks/project steps is recognized

• As well KBuch as HPI have existing interfaces to QMS
• Decision for **new development**, this allows:
  – migration of the software to today's standard software and hardware
  – improved update options in the future
  – restructuring of the software (kernel, GUI, interfaces)

• In the spring of 2013, 5 software companies were invited to submit an offer for requirement specifications and to later implement the software.
• This call resulted in **IQS AG** as a project partner
• On the one hand
  an integral part of the existing QMS
• On the other hand, an independent program.

• The integration into the QMS is done:
  – to simplify the usability (same user interface),
  – to simplify the maintenance of master data (e.g. rooms),
  – to avoid errors by maintaining data in different places.

• Autonomy is important to ensure that:
  – the data is not manipulated by unwanted actions (errors),
  – any changes in the basic functionalities of the program are recorded,
  – IKB can be operated independently of other software.

• To meet these requirements, the new software will be modularly structured:
  – IKB = Innovative KBuch (fissile materials management) (to be released by ENSI)
  – APV = Order and sample management (radioactive and chemical sample management)
  – IKB + APV = IPV = Integrated Sample Management
Stellungnahme des ENSI

- **ENSI welcomes the fact that PSI has decided to redevelop the software, not just an error correction.**

- **ENSI also agrees with the modular design in parts of the program that are subject to release by ENSI and those are not.**

- **ENSI has the opinion that with the presented concept for the new development of the KBuch software, PSI will bring the program up to date with the latest technology.**
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11. Commissioning
- Elimination of the logical error
- Written based on old Kbuch specification and HPI specification
- Special project to get user input into specification
- 80 Pages which are updated during realization
- More than 1100 single requirements
Test Strategy

"Testing is a crossfunctional activity that involves the whole team, and should be done continuously from the beginning of the project."

"Any plan that defers testing to the end of the project is broken."

"Your deployment pipeline should have all these four types of tests."

Not much information regarding this type of tests in the book.

Integration test - test that ensure that each independent part of your application works correctly with the services it depends on.

Regression test? Not mentioned in the diagram, they are crosscutting category.

You're waiting too long for feedback.

6 weeks passes... when the feedback comes...

We need to make some corrections, we need another 3 weeks.

What?! Wasn't 90% done.

Wow, splendid!
Software engineering since 2015 up to today

- Monthly development meetings between PSI and IQS:
  - Project status
  - Exchange test scripts
  - Problems encountered
  - Clarify the short-term programming goal
  - Overall goal: the program structure should be as general (flexible) as possible
**Documentation for regulators release of IKB**
- Implementation instructions for acceptance test of IPV
- **User Manual Integrated Sample Management (IPV)**
- Software description Integrated Sample Management (IPV)
- Bookkeeping of nuclear materials and other radioactive sources in the PSI hot laboratory

**Additional documentation for IPV:**
- Situations analysis “KBuch - HPI – Auftrag”
- Event report Logic-Error of KBUCH
- Processing of ENSI request due to Logic-Error of KBUCH
- Situations analysis Project "Neues KBuch"
- Concept “Neues KBUCH - Innovatives KBuch (IKB)”
- Specification Integrated Sample Management (IPV)
- Test concept and test specification for acceptance of IPV
Rating of ENSI:

ENSIs rates the active participation of software users during the planning process to commissioning, their introduction during the testing phase and the documentation of the software in the user manual as positive.

Decision:

The ENSI grants the release for the innovative KBuch considering the request

Request:

The replacement of the old KBuch by IKB may not take place until all planned tests have been carried out satisfactorily and ENSI has confirmed this.
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- Commissioning
The aim of the final Software acceptance test

The test should demonstrate that:

− **specifications are fulfilled** by the developers,
− **calculations** performed by the software are **correct**,  
− **limitation** set in the program are **used** in the **correct** way by the software  
− **migration** of KBuch-database could be done smoothly,...

... so that the software finally could be **released by the regulator**.

700 single tests (just for IKB)

They are not so much different, however they have different path to acheive the same goal of providing quality to the stakeholders!
Migration of KBuch data

• Data structure was known due to the description of the KBuch

• Data structure was however incompletely documented:
  – Functionalities were not documented correctly and only became apparent on the data structure
  – Structure IKB had to be extended to prevent loss of information during the migration

• Additional (personal) data (excel lists) were found

• Data had to be adjusted manually:
  – Inconsistent KBuch data was detected and cleaned up
  – No easy control before and after migration
Inspektionsbericht

Acceptance test of innovative KBuch (IKB)

ENSI performed an inspection to check the results of the system tests carried out in recent months and the migration of KBuch data.

Furthermore, ENSI has followed the on-site acceptance tests.

This included the preparation, the execution of the tests and the verification of the results.

Rating of ENSI:

ENSI rates the inspection with normality.
Chosen Project Phases

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11. Commissioning
Commissioning

• Last Update before commissioning

• Update of the documentation for the release IKB:
  – User Manual Integrated Sample Management (IPV)
  – Program description Integrated Sample Management (IPV)
  – Accounting of nuclear materials and other radioactive sources in the PSI hot lab
  – Specifications of Integrated Sample Management (IPV)

• Application for shutdown KBuch by PSI:
  – Shutdown KBuch at end of August 2017
  – Going live at the first of September 2017

• ENSI gave approval to shutdown of KBuch
Secret Insight IPV
User administration
### Sample Information (Editable)

**Sample: 3962**

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<tr>
<th>Number</th>
<th>6000_C</th>
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<tr>
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<td>Responsibility</td>
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<td>Real location</td>
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<tr>
<td>Fissile material unit</td>
<td>Standardhotzellen in der Hotzellenkette</td>
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<tr>
<td>Description</td>
<td>Reststück</td>
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**Ref. Sample**

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<td>Project</td>
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**Fuel Rod**

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<td>Burn up [GWd/tU]</td>
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<td>Gamma activity [Bq]</td>
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**Rod no.**

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### Sample: 3962

**Number**: 6000_C

**Name**: [Redacted]

**Responsibility**

**Real location**: Hotzelle 4

**Fissile material unit**: Standardhotzellen in der Hotzellenkette

**Description**: Reststück

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## Sample Information III (Calculated by IKB)

### Sample: 3962

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<tr>
<td>Responsibility</td>
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<tr>
<td>Real location</td>
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<tr>
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<td>Standardhotzellen in der Hotzellenkette</td>
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<td>Description</td>
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### Calculation Type

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<td>Mass restriction factor</td>
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<td>Mass restriction</td>
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Sample Movement

Movement request: 227

Source
- Real location
- Fissile material unit

Target
- Real location
- Fissile material unit

Information
- Created by
- Created at 9/14/2018
- Modified by
- Modified at 9/14/2018

Samples
- 121

Movement
- Type: Transfer
- Limit eingehalten: checked

Approvals
- KMP: approved 9/14/2018
- Real location: approved 9/14/2018
Cutting plan – function to simplify procedure
Summary & Outlook
Challenges of the project

- Equal understanding of the individual specifications (internal / external)
- Knowledge transfer (implicit nuclear / physical / chemical knowledge)

Resource problem:
- PSI: Major infrastructure project in 2015 binds many internal resources
- AHL: Restructuring of AHL in 2015&2016 binds internal resources
- IQS: Unplanned high order situation in 2015&2016 (also from AHL side)

Additional requirements due to:
- changed boundary conditions (safeguards)
- undocumented software changes (old Kbuch)
Highlights of the project

- **Partnership** with IQS AG
  -> positive feedback for other projects on the Management system
- **Working method** is perceived as very pleasant by the participants
  (Time for open, solution-oriented discussions with the developers
  leads to a better understanding of the challenges on both sides)
- Program functionality of IPV found its way to **standard product** IQSoft
- **Positive feedback and interest** from foreign hot labs (e.g., NRG)
- **ENSI release** of the software and **inspection with normality**
Lessons Learned of the project

• More than **1100 single requirement** specifications
• Each requirement leads to minimum one single test script
• Test scripts lead to uncovering poorly formulated requirements
• Misinterpretation of requirements were detected

• **Migration was underestimated:**
  • incomplete documented data structure & additional (personal) data
  • not documented functionalities

• **Discussion** with the developer leads to a **better understanding of the needs** on both sides.

• **Early integration of regulator** in the process clarifies the procedures
• Further development of APV
• Migration of radioactive samples database
• Further development of user-friendliness of IPV
• Including special functions (reactor, waste, ....)

• Marketing?
  – Decision: no active marketing
    (except @ hotlab meeting)
  – Open for requests
    (just contact me)

• Development of a strong Integrated Management System (IMS) @ PSI Hotlab
PSI Hotlab – Your Partner for Radioactive Materials Examinations
Thank you for your attention!

CAUTION
YOU HAVE REACHED THE LAST SLIGHT OF THIS PRESENTATION!

Wake up! – return to work!
There is nothing more to see.