

Experiences from Using a Shift Reporting Tool in Addition to the Electronic Log Book at the Heidelberg Ion Beam Therapy Center

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 - ▶ first *heavy ion gantry*, rotatable by 360° (operational since 2012),
 - ▶ station for QA, research and development.

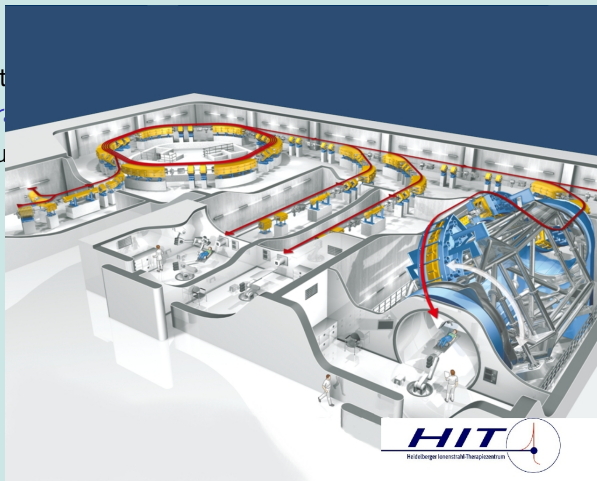


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- ▶ Using raster scanning technology for therapy.
- ▶ Nearly 1000 patients per year!

Pictures



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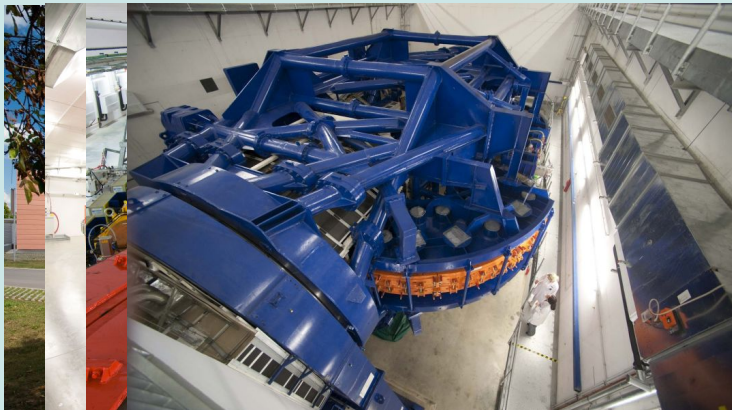


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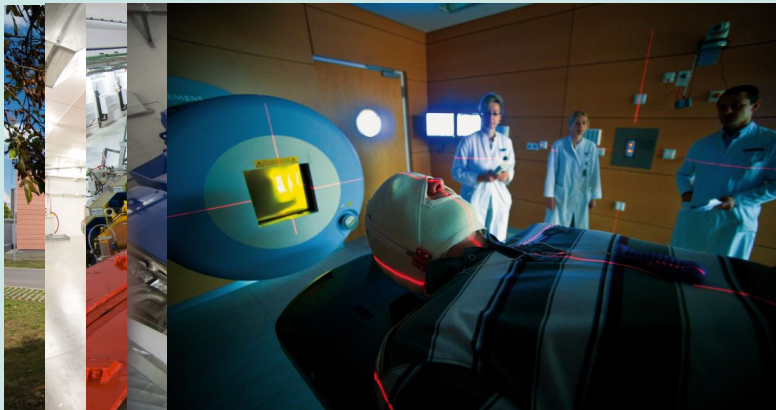


Pictures





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Accelerator Environment

- ▶ Accelerator supports *multiplexed* operation:
 - ▶ arbitrary source/destination (*virtual accelerator*),
 - ▶ beam properties from *MEFI* space: 255 **E**nergie values,
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- ▶ Proprietary *Accelerator* and *Therapy Control Systems*, Windows based, Oracle DB.
- ▶ Device controller settings stored in Flash memory (for therapy) or RAM (experiments).
- ▶ Library of Ion Beam Configurations (LIBC) as interface between ACS and TCS, defining catalogue of available energy, focus and intensity settings and notifying about changes (possibly) affecting therapy, checked on every beam request.



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- ▶ Linux server with electronic logbook (Wordpress), subversion repository

Tasks for an Electronic Shift Reporting Tool

- ▶ Quality Assurance for Medical Therapy:
 - ▶ Operator applies changes to physical device settings and saves them to Flash memory.
 - ▶ Medical physics expert is notified about a device settings change, but doesn't see what changed
 - ▶ MPE has to decide on tests needed for approval for therapy
→ input from operator needed.
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- ▶ Quick lookup of contact data for on-call staff.



Technology

- ▶ *CherryPy* as Python-based web application framework
- ▶ The report is a single HTML page built from a template with the *Jinja 2* template engine.
- ▶ Desktop-like look and feel, event handling by using *jQuery*.
- ▶ Dynamic content loaded asynchronously with *AJAX*, result received as JSON
- ▶ Object relational mapping to the accelerator control system database with the *SQLalchemy* toolkit (cx_Oracle as backend driver).



Contents of a shift report

- ▶ Names of operators, on-call staff (contact data and report form for call details when clicking), radiation protection officer.
- ▶ Messages from ACS: device errors and interlocks, beam request failures, process data without limits (e. g. data from vacuum sensors, cooling water temperature, room temperatur).
- ▶ Changes of therapy relevant settings.
- ▶ Intensity adjustments necessary after daily qa by changing quadrupol (most common device changes)

Use Case 1: Change of Device Settings

- ▶ Operator is adjusting the $k \cdot L$ value of quadrupol R2QT12 for some MEFI combinations.
- ▶ After transferring the changed control values from RAM to Flash, a notificaton is written into LIBC.
- ▶ LIBC change triggers the shift report tools to parse the changelog of physical device settings stored from the DSM (daty supply module) server.
- ▶ Table of old and new set values written into shift report.

Use Case 1: Change of Device Settings

Morning

Afternoon

Night

General

LIBC-Changes

Intensity Adjustment

Errors/Interlocks

QA Protocols

Protons

Intensity index	R2QT12	
	new	old
1	-2.85	-1.3
2	-3.1	-1.65
3	-2.0	-1.9
4	-2.31	-2.32
5	-2.45	-2.48
6	-2.56	-2.55
7	-2.7	-2.65
9	-3.23	-3.0

Carbon

Intensity index	L2QT12	
	new	old
1	-1.8	-0.8
5	-2.35	-2.1

Use Case 2: Device failures

- ▶ When a device fails, operators are always in hurry.
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- ▶ When a device fails, operators are always in hurry.
- ▶ Previously: Operators just made screenshots from the error messages and put them into the electronic logbook, sometimes decorated with some text, sometimes not.
- ▶ Now the shift report tool parses the error logs of the ACS, tries to find errors that are *possibly* noteworthy (filtering out many irrelevant errors, e. g. some magnets are in error state if the therapy room is open).
- ▶ Operator decides if the error is really noteworthy and adds it to the shift report, adding some details (e. g. down time of the accelerator), and optionally adding a detailed description that is injected into the electronic logbook.



Use Case 2: Device failures

► **Shift Report**

10.09.2013

► **Morning** Afternoon Night

General LIBC-Changes Intensity Adjustment **Errors/Interlocks** QA Protocols

01.09.2013 15:07:24	S0MU1	ANA Int Nr.7 PE ip2> ANA Int Nr.6 PE ip1>	<input type="button" value="add to report"/>
01.09.2013 17:40:39	S0MU1	DIG Int Nr.13 Schutzschalter / Schutzschalter ausg DIG Int Nr.12 H2O Netzgerät / Kühlwasserdurchfluss	<input type="button" value="add to report"/>

Add note to report

Title

When

Text

DIG Int Nr.13 Schutzschalter / Schutzschalter ausg;
DIG Int Nr.12 H2O Netzgerät /
Kühlwasserdurchfluss; DIG Int Nr.11 Temp.
Kühlbank / Übertemperatur Wass; DIG Int Nr.10
Temp. Trafo / Übertemperatur Transfo

Down time (min.)

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Lessions Learnt

Operators were quite reluctant (additional work, do we need more formal stuff?) But they realized that in fact the tool saves time.

Issues:

- ▶ What is an error? Some devices change to error state (and cause stop of the beam) if some beam parameters are without limits. Operator: It's an error, so I add it into the shift report. Device maintainer: The device does exactly what it's supposed to do, it's a design feature, not a device failure.
- ▶ What is down time? A device may fail for some time without stopping the beam. Is down time defined as the duration of device failure or the time no beam was available?

Lessons Learnt (Cont'd)

- ▶ What happens if nothing happens? A shift of therapy, not a single device failed, no adjustments . . . , the shift report is empty (besides just mentioning who was in charge).
You can't be everybody's darling. "Don't send me shift reports that are empty, that's spam" vs. "Why don't I get a shift report? The information that *nothing* happened is as important that something happened."



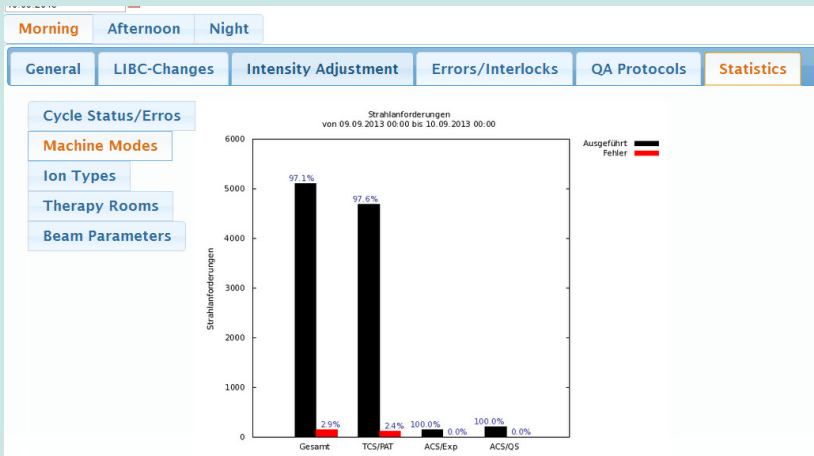
Behind the scenes

Things done without intervention by the operators:

- ▶ Tracking of MEFI control values checksums for some devices in SVN
- ▶ Tracking of physical set values in RAM (not relevant for therapy but helpful for machine adjustment, cf. Michael Galonska's talk)
- ▶ Statistics, statistics, statistics.

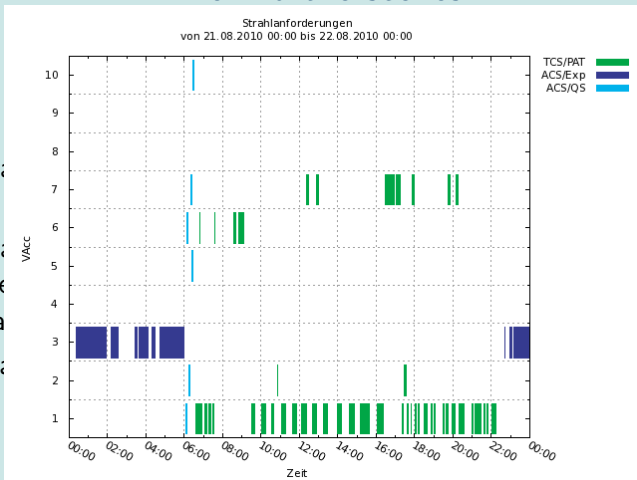


Behind the scenes



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Summary

- ▶ Filtering information from the ACS database saves a lot of time where things to be reported had to be looked up in long error logs and alarm message lists, previously.
- ▶ People get used to everything ... at last.
- ▶ Plans:
 - ▶ Define filters to get rid of “error” messages that are generally unwanted.
 - ▶ Improve statistical capabilities.
 - ▶ Per-user configuration who’s happy to get “empty” reports and who isn’t.