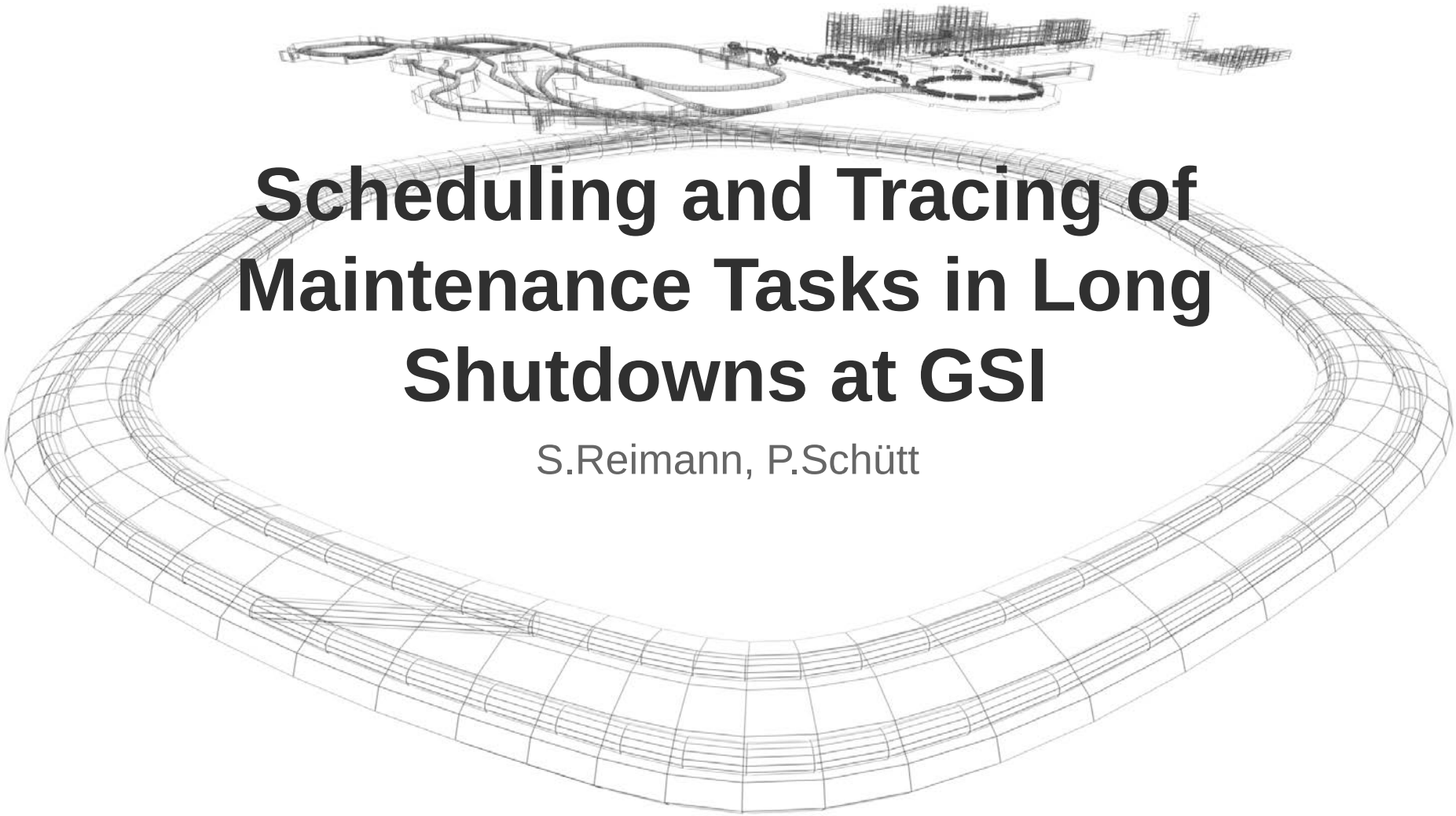
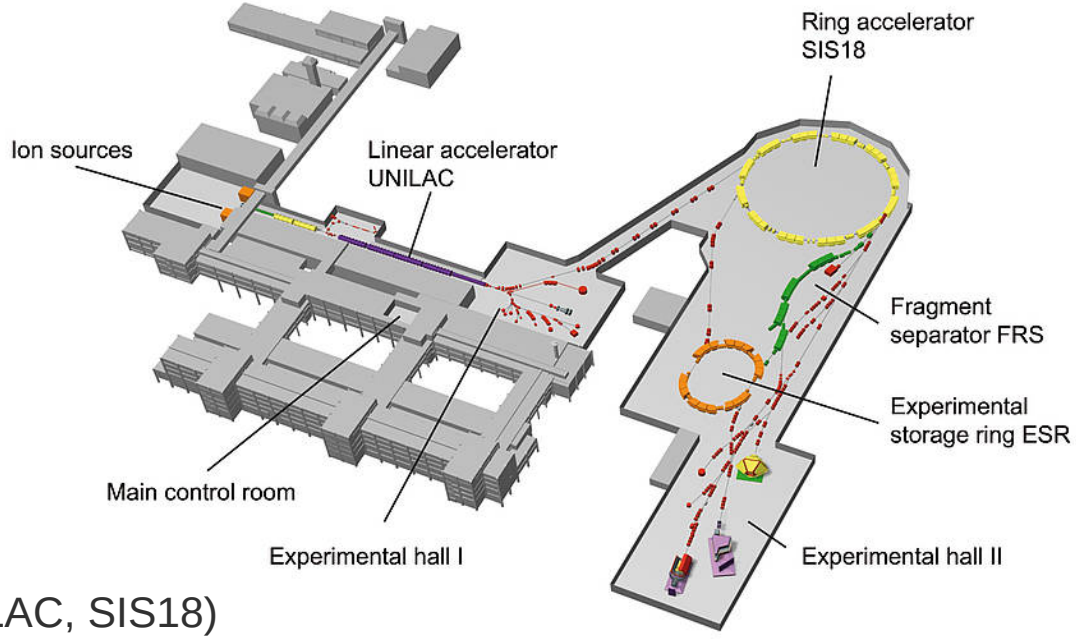


Scheduling and Tracing of Maintenance Tasks in Long Shutdowns at GSI

S.Reimann, P.Schütt

GSI Helmholtzzentrum für Schwerionen-forschung - Overview

- Located in Darmstadt/Germany
- established in 1969
- Employees: 1350
- Guest Scientists: 1200
- 350 Ph.D. students
- Budget: 108 M€



- 2 Heavy Ion Accelerators (UNILAC, SIS18)
- 1 Experimental Storage Ring (ESR)
- The Fragment Separator (FRS)

also known for

- super heavy elements 107-112 discovered at SHIP/GSI: Bohrium, Hassium, Meitnerium, Darmstadtium, Roentgenium und Copernicium
- PHELIX petawatt Laser
- heavy ion cancer therapy → technology transfer to Heidelberg, Marburg, Shanghai

GSI Helmholtzzentrum für Schwerionen-forschung - Overview

- Maximum Energy
  - UNILAC: 11,4MeV/u
  - SIS18: 2GeV/u

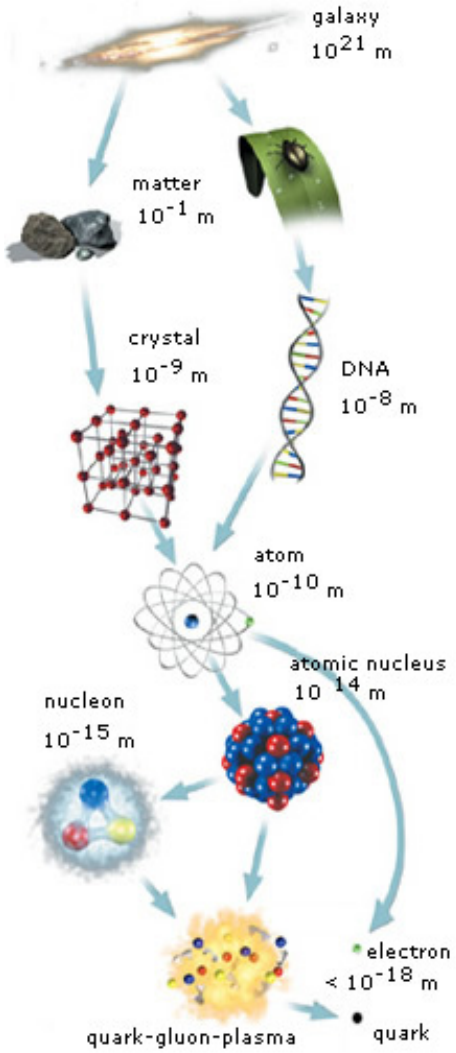
- Accelerated Elements
  - everything from p^+ to Uranium
  - many different isotopes and charge states

- 3 Ion Sources Terminals
  - 1. PIG - Penning Ionization Gauge or MeVVa (High Current Injector)
  - 2. ECR - Electron Cyclotron Resonance Source (High Charge State Injector)
  - 3. one of [MUCIS, CHORDIS, VARIS] (High Charge State Injector)

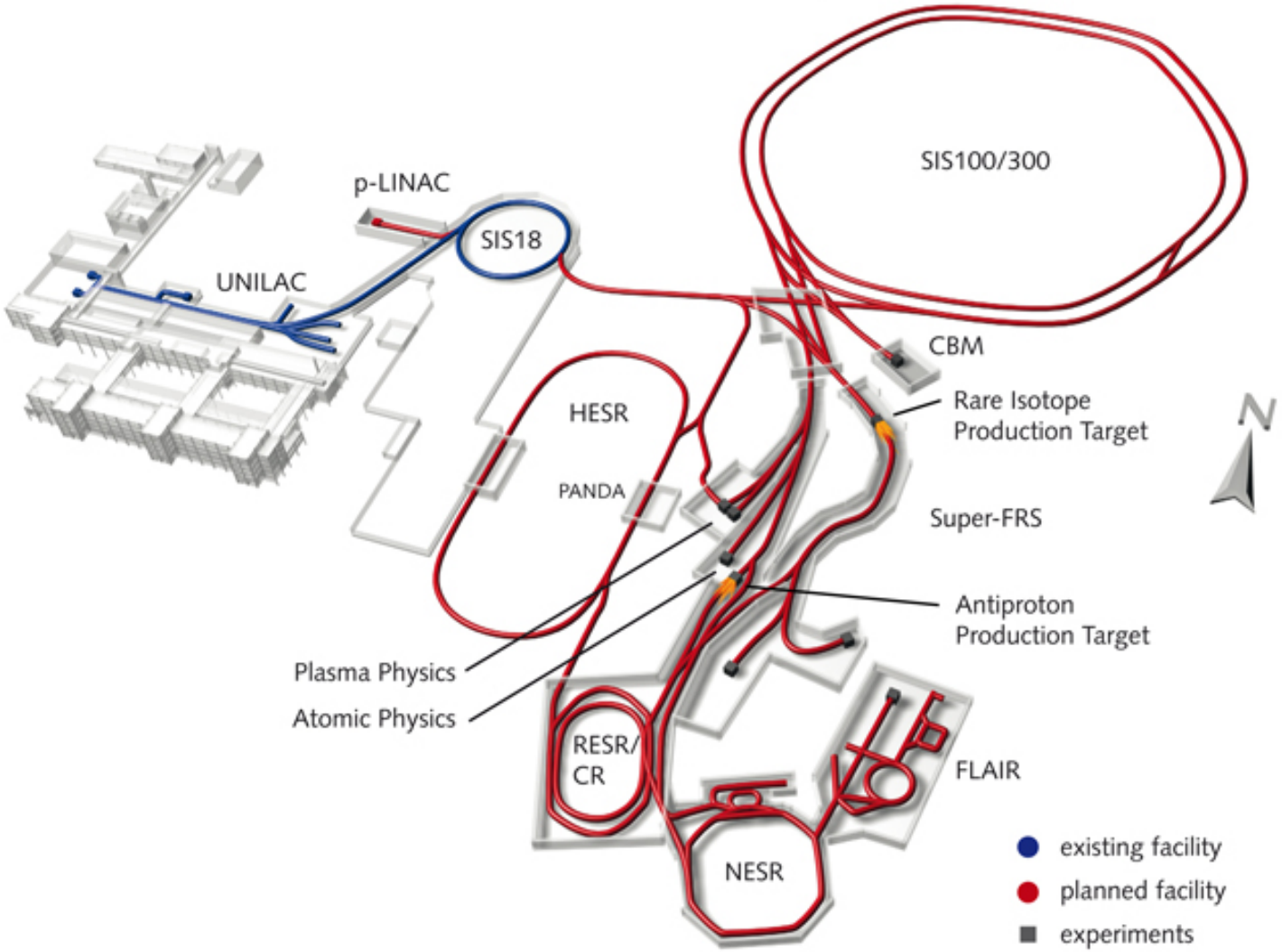
Research Program

"The research program of GSI spans over 17 decimal powers: it ranges from the modification of materials to the destruction of cancer cells, to the investigation of atoms, to the investigation of atomic nuclei as well as the Quark-gluon plasma"

- nuclear and particle physics
- atomic physics
- plasma physics
- biophysics and medical science
- materials research



The FAIR-Project



Implications

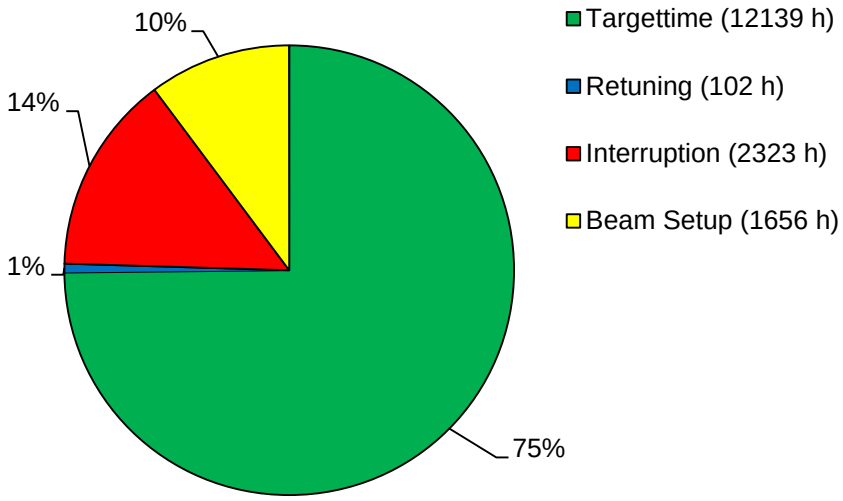
- maintenance of legacy machines, realizing the new project and maybe beam time at the same time, executed by the same persons
- beginning civil construction for FAIR
- machine upgrade for FAIR operations

→

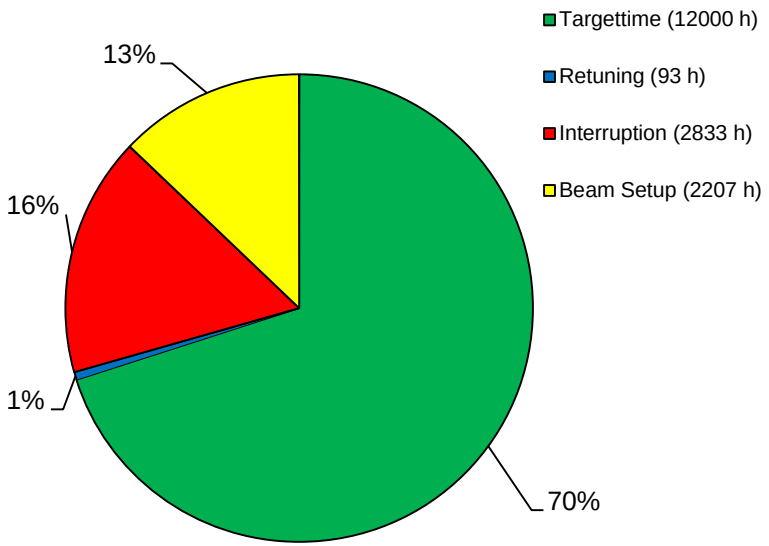
- reduced standard operation → reduced operation team
- more machine experiments and device tests
- insertion of new devices → longer shutdowns

Operation Statistics / Reliability

beam time 2012



beam time 2014



Breakdown Statistics 2014

System	Duration/h	Number of Events	Share (h)
Power Supply	580	412	29,21%
Vacuum	438	119	22,03%
Beam Diagnostics	31	19	1,54%
Operating	38	38	1,93%
Interlock/ Safety System	38	36	1,93%
Ion Sources	143	53	7,20%
Misc.	186	89	9,35%
Infrastructure	40	16	2,01%
RF Systems	328	434	16,54%
Controls	164	70	8,25%
	1986	**1286**	100,00%

Standard Shutdown

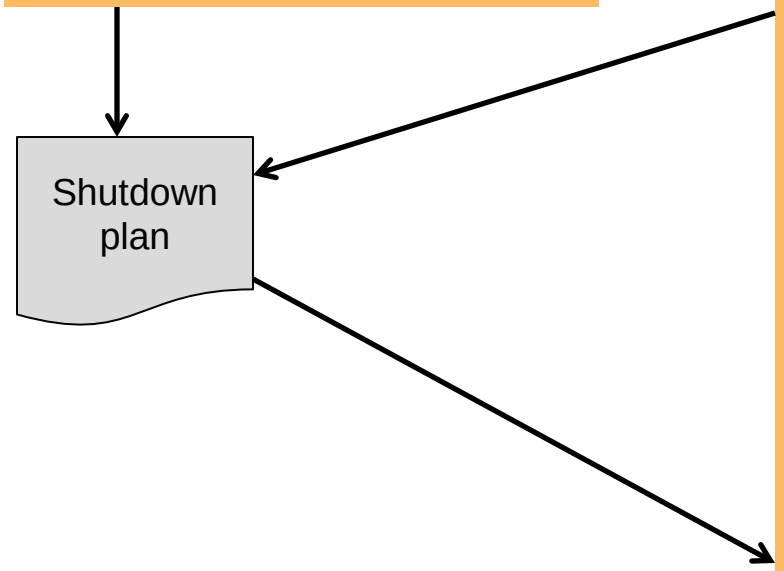
- 4 maintenance periods per anno (duration: min. 2 weeks)
  - maintenance work
  - repairs
  - insertion of new devices
- if possible, all repairs will be shifted into the shutdown periods
- Prioritization and planning by machine coordinators
- Scheduling and tracing by shutdown coordinator (operations department)
- weekly meeting with shutdown coordinator, machine coordinators, the security responsible person for each machine and one contact person of each concerned department

Shutdown Coordination

preparation phase

prioritization, scheduling

- shutdown coordinator
- machine coordinators



weekly Shutdown Meeting

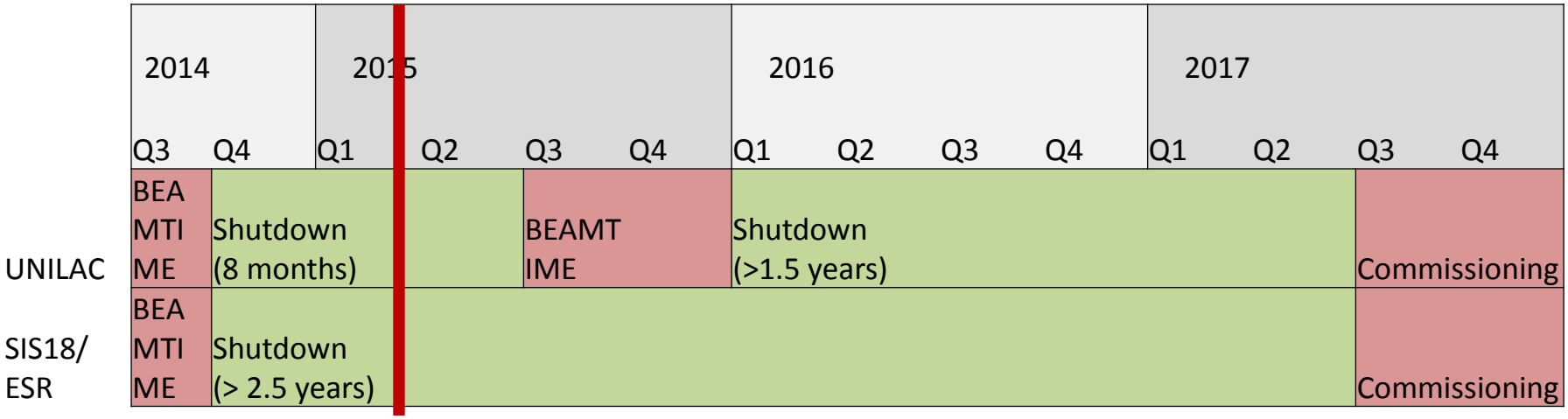
reporting, adjusting

- shutdown coordinator
- machine coordinators
- safety responsible persons
- involved executing departments
- project responsible persons

The standard shutdown plan

- Offline-MS Project plan, one for each shutdown period
- on average 200-300 tasks per shutdown (150 per week)
- contains:
  - all tasks
  - logical and chronological dependencies
  - availability of power connections, cooling circuits, LAN, cranes, etc.
- does not contain:
  - planning of personnel resources
- the tasks are grouped per department
- granularity is a trade-off between “don’t forget important steps” and “don’t schedule every screw”

The Major Shutdown



- min.1.5 years of UNILAC shutdown starting in 2016
- min. 2.5 years of SIS18/ESR shutdown since 2014
- 4 months of shutdown parallel to operations

- from 2016 at least 1.5 years without any operation
  - →operators are delegated to other departments
  - →reduced operations department → shutdown department

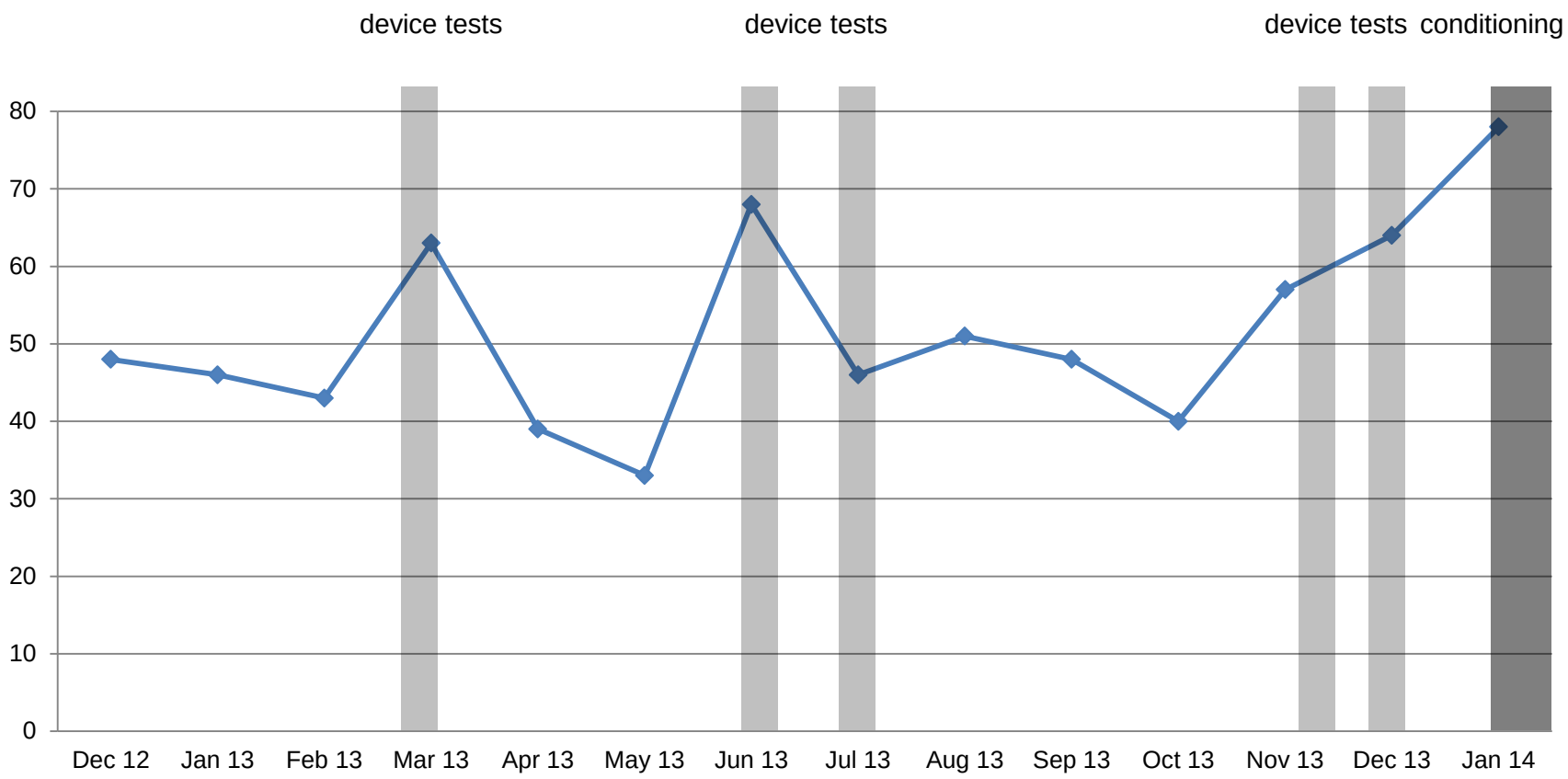
Expectations und Questions

- What differences to standard shutdown can be expected?
  - factor of 50 more tasks (10000) ?
  - unmanageable dependencies?
  - never-ending shutdown meetings?
- What about the personnel planning?
  - Do we need a shutdown coordination office?
- How can we assure the availability of the whole facility at the end of the shutdown period?
- 4 months of shutdown parallel to operations?

Lessons learned from 1 year of shutdown in 2013

- fortunately we had a long (1 year) shutdown in 2013
- 724 tasks / 61 weeks → 18 per week instead of 150 per week
  - more long term tasks
  - lower granularity
  - nearly the same number of smaller tasks per year
- more delays → many postponed tasks
- more time for re-conditioning needed → some departments misuse the beginning of the conditioning phase to finish the last shutdown tasks
- people tend to move things near the deadline

... the last minutes



Grouping the Tasks

- In shorter shutdowns we grouped by machine and below by department
  - so, department members can find their tasks fast and easy
  - leads to a clearly arranged project plan
  - no problem, when a department has only a hand full of projects
- In long shutdown 2013 we came to a limit, because some projects were shared all over the shutdown plan
  - jumping up and down in the plan
  - hard to follow the dependencies
- so we started to group the tasks of some bigger projects
  - clear chronological order per project
  - but departments have to check all projects, whether they are involved → no Problem, because they know their projects

Personnel needs

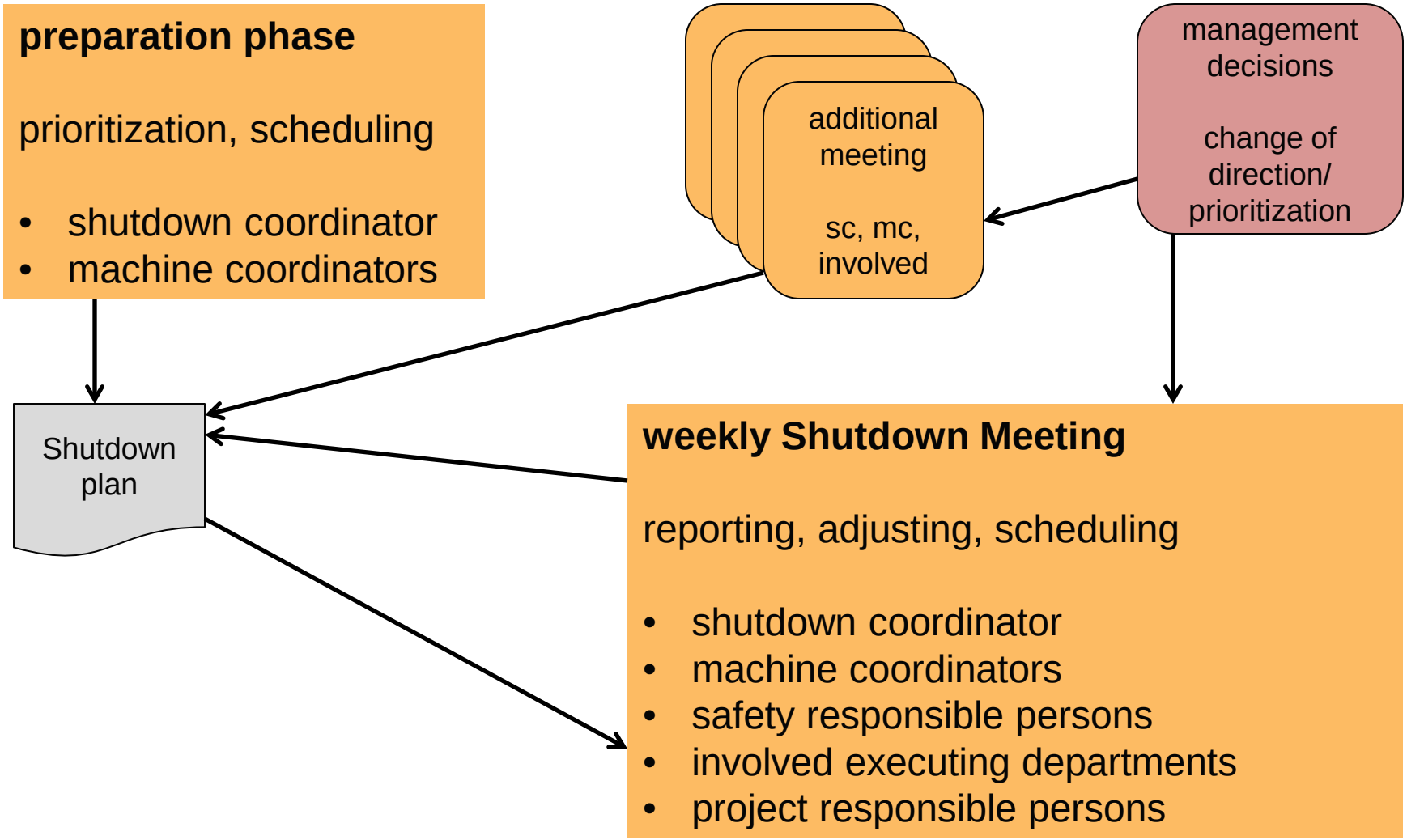
- 1 main shutdown meeting per week is still ok
- 1-2 shutdown coordinators are also enough
- machine coordinators are more involved than in shorter shutdowns
- in some cases additional work package meetings of shutdown coordination, machine coordination and departments are needed

Summary of lessons learned

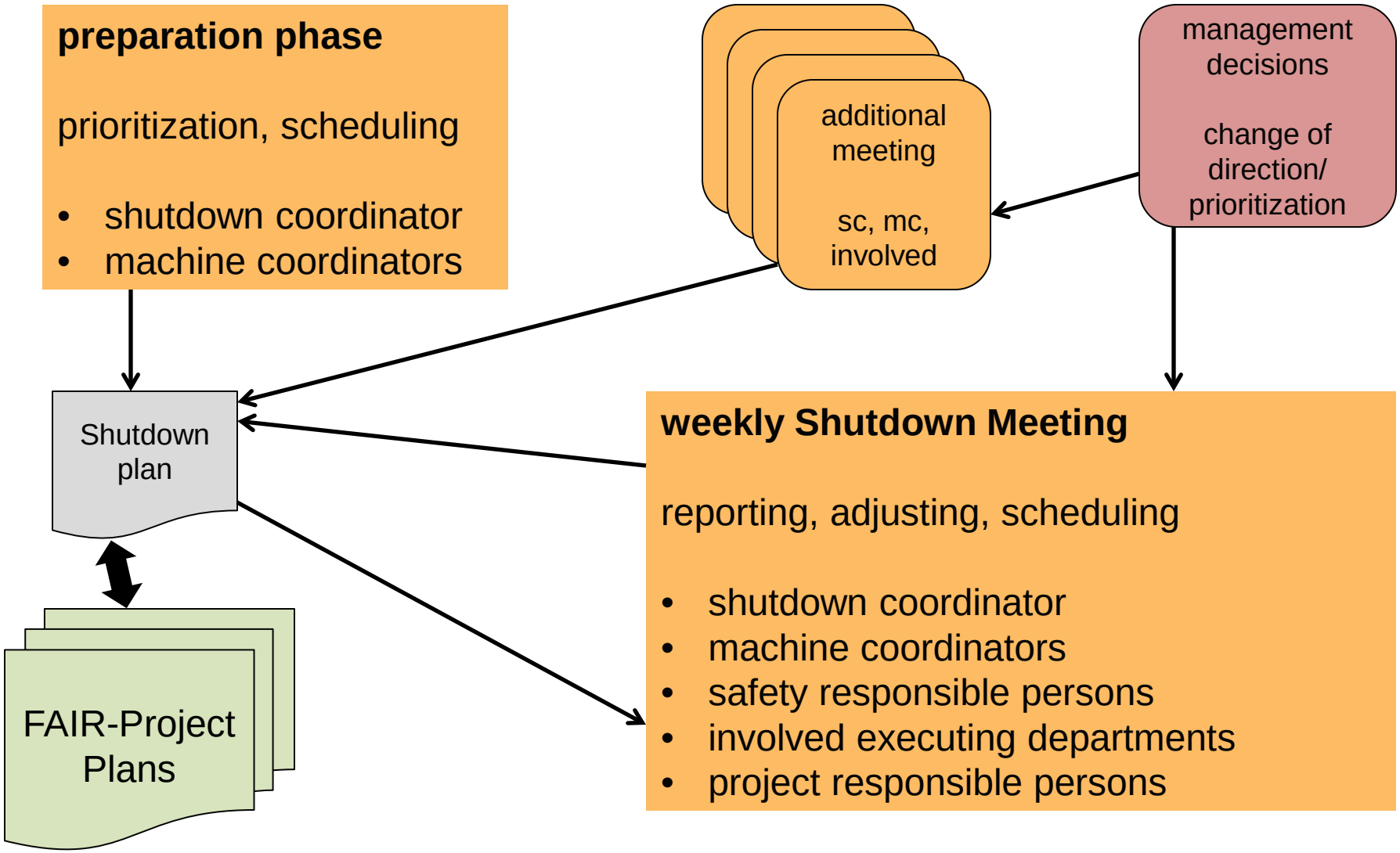
- testing periods are helpful not only to test devices and sustain availability but also to force the departments to meet the deadlines
- detailed planning of media + infrastructure availability is necessary
- flexibility in planning and/or good assumptions of how long a task will be processed
- grouping by project
- additional smaller project meetings on demand

- most of the time a long shutdown is less stressful to coordinate than a short one

Shutdown Coordination in long Shutdown 2013



Status Quo


preparation phase
prioritization, scheduling
• shutdown coordinator
• machine coordinators
additional meeting
sc, mc, involved
management decisions
change of direction/ prioritization
Shutdown plan
FAIR-Project Plans
weekly Shutdown Meeting
reporting, adjusting, scheduling
• shutdown coordinator
• machine coordinators
• safety responsible persons
• involved executing departments
• project responsible persons

Status Quo

- additional planning of the construction work related to the link GSI/ FAIR (beam lines, infrastructure)
- hard constrains because of many fixed dates (coming from FAIR project plans)
- plan became less flexible
- at the moment ca. 600 tasks, but only 2015 is planned in detail
- challenging: UNILAC beam time parallel to shutdown from Jul - Nov 2015
  - but it is a reduced experiment program (UNILAC reaches not full performance)
  - only a few big tasks at SIS during the beam time
- results will maybe reported at ARW 2017

Thank you for paying attention