INTEGRATED PROJECT PLANNING AS A CENTRAL STEERING TOOL FOR THE LARGE SCALE MULTI PROJECT FAIR

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Abstract

The Facility for Antiproton and Ion Research (FAIR) is a large scale multi project [1] comprising 10 subprojects in the field of accelerators (p LINAC, SIS100, Super FRS, p-bar separator, CR, HESR), experiments (APPA, CBM, NUSTAR, PANDA), and civil construction. This contribution describes a fundamental revamp of the FAIR integrated project planning. The main objective is to preserve the advantages of a bottom-up planning topology with the actual and detailed level of information, keeping the ~400 work package leader's central role as plan owners in their field of responsibility. Simultaneously, different project phases (e.g. civil construction, procurement, installation, commissioning) need to be excluded from detailed plans while being re-integrated in the level-1 project master schedule. Additional cost profiles and resource assignment by name allow a progress tracking and flexible project steering.

MASTER SCHEDULE PLAN

The Master Plan, called Level 1 plan, summarizes the scheduling of the entire FAIR project. It gives a comprehensive overview of the project timetable and is a valuable steering tool for the highest management. In the respective project plans, the civil construction project phases, the procurement phases of accelerators and experiment components, the installation phases, and the commissioning phases are gathered in summary tasks, which are mirrored by means of external links in the Master Plan.

In order to minimize the duration of the whole FAIR project, a time window was defined in each building block (time frame for installation) during which the installation of accelerator and experiment components becomes possible before the commissioning of the building. The final installation phase occurs after the official commissioning of the building, namely after the HBO Hesse Building Order) approval. The inspection of the HBO ("Acceptance by HBO") is common to all building blocks and represents the last phase of the civil construction subproject (see Fig. 1). For an overview of the FAIR buildings, see Fig. 2.

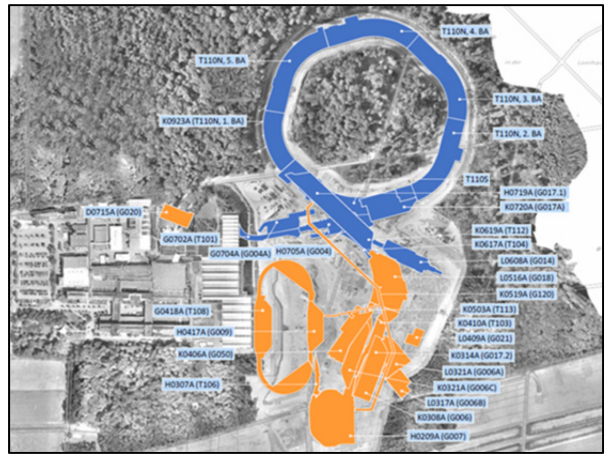
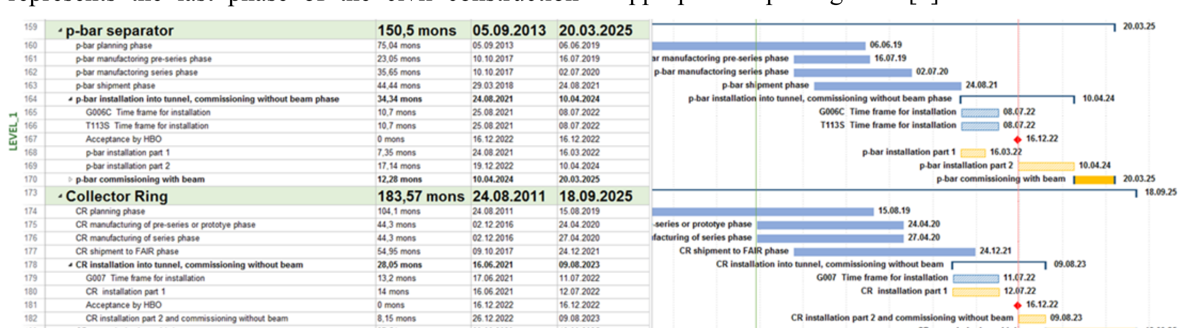


Figure 2: Overview of the FAIR buildings.

The scheduling of each machine subproject (accelerator or experiment) is divided into six phases (see Fig. 1). The first four phases (planning, manufacturing of pre-series, manufacturing of series, and shipment), are mirrored from the subproject's overview plan, and are the exact image of the summary tasks of the procurement phases of all components. The fifth phase (installation into tunnel) encloses the installation phases. If a machine is located inside different buildings with different installation time frames it will have several installation phases. The last installation phase starts after the HBO approval. The installation phases are planned in detail in a dedicated plan. The end of the installation phase is represented by the milestone M11 (machine ready for beam). The final phase (commissioning with beam) of each machine is the mirror of the summary task scheduled in a dedicated plan, in which the commissioning of all machines is scheduled.

The actual status of the Master Plan and the underlying detailed plans was saved as the Baseline. It will be used as reference to measure the project progress by means of appropriate reporting tools [2].



159	p-bar separator	150,5 mons	05.09.2013	20.03.2025
160	p-bar planning phase	75,04 mons	05.09.2013	06.06.2019
161	p-bar manufactoring pre-series phase	23,05 mons	10.10.2017	16.07.2019
162	p-bar manufactoring series phase	35,65 mons	10.10.2017	02.07.2020
163	p-bar shipment phase	44,44 mons	29.03.2018	24.08.2021
164	p-bar installation into tunnel, commissioning without beam phase	34,34 mons	24.08.2021	10.04.2024
165	G006C Time frame for installation	10,7 mons	25.08.2021	08.07.2022
166	T113S Time frame for installation	10,7 mons	25.08.2021	08.07.2022
167	Acceptance by HBO	0 mons	16.12.2022	16.12.2022
168	p-bar installation part 1	7,35 mons	24.08.2021	16.03.2022
169	p-bar installation part 2	17,14 mons	19.12.2022	10.04.2024
170	p-bar commissioning with beam	12,28 mons	10.04.2024	20.03.2025
173	Collector Ring	183,57 mons	24.08.2011	18.09.2025
174	CR planning phase	104,1 mons	24.08.2011	15.08.2019
175	CR manufacturing of pre-series or prototye phase	44,3 mons	02.12.2016	24.04.2020
176	CR manufacturing of series phase	44,3 mons	02.12.2016	27.04.2020
177	CR shipment to FAIR phase	54,95 mons	09.10.2017	24.12.2021
178	CR installation into tunnel, commissioning without beam	28,05 mons	16.06.2021	09.08.2023
179	G007 Time frame for installation	13,2 mons	17.06.2021	11.07.2022
180	CR installation part 1	14 mons	16.06.2021	12.07.2022
181	Acceptance by HBO	0 mons	16.12.2022	16.12.2022
182	CR installation part 2 and commissioning without beam	8,15 mons	26.12.2022	09.08.2023
183	CR commissioning with beam	27,51 mons	09.08.2023	18.09.2025

Figure 1: Extract from FAIR project schedule.

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Beamline	#	Nomenclature	PSP-Code	Element Type	WP Number	WP Name
1S21	117	1S21QD12	2.8.2.2.1	E:Quadrupole (hor. focusing) Duplet 2. Lens D:Quadrupol (h	2.8.2.10	SIS100 Quadrupole Module
1S21	118	1S21VQ2	2.8.7.1.2.3.1	elliptic quadrupole chamber (downstream), type D4	2.8.7	SIS100 Vacuum
1S21	119	1S21VC5B	2.8.7.1.2.1.7.1	elliptic BV-CWT (downstream)	2.8.7	SIS100 Vacuum
1S21	120	1S21VHGR	2.8.7.1.4.1	heating jacket for BV-CWT	2.8.7	SIS100 Vacuum
1S21	121	1S21VMGW	2.8.7.1.4.1t	temperature sensor(s)	2.8.7	SIS100 Vacuum
1S22	1	1S22YP	2.8.12.6.3	Bypass Line Connection Box to QP in warm section	2.8.12	SIS100 Local Cryogenics
1S22	2	1S22YP	2.8.12.5.2.1	Long straight module (plain)	2.8.12	SIS100 Local Cryogenics
1S22	3	1S22VV1T	2.8.7.1.3.2	gate valve (upstream) DN160CF	2.8.7	SIS100 Vacuum

Figure 3: Extract from the component list (ATB) of SIS-100 machine.

SCHEDULE STRUCTURE

The integrated project planning is based on the clear definition of deliverables and a corresponding allocation of responsibilities. There is one person responsible for each deliverable, as well as for each machine, and for each experiment. The FAIR project consists of 6 accelerator subprojects, 4 experiment subprojects and 1 civil construction subproject (the FAIR Site and Buildings (FSB) project). These subprojects are structured in 390 work packages. There are 163 accelerator work packages, 218 experiment work packages, and 9 FSB work packages. Work packages are defined by the Work Breakdown Structure (WBS).

The most relevant outcome among the several activities that are behind the establishment of the WBS is the matching of the WBS with the component list "*along the beamline" (ATB)* list for all FAIR future machines (see Fig . 3). In the ATB, every single piece, which has to be mounted in order to construct the machine, is listed sequentially as it will be located "along the beamline". Each item in the ATB list is associated with a work package and, therefore, with a work package leader.

Each work package is planned in one or more Microsoft-Project (MSP) plans, and each work package leader is in charge to write and update his/her project plan (or project plans), where the procurements of the components assigned to his/her work package are scheduled. Costs and human resources are also planned in the plan.

Each work package leader is responsible for his/her schedule and uses it to steer his/her project. However, all individual schedules are part of the integrated master schedule. To ensure compatibility and readability, standardized activities have been developed [3]. Some of these are optional and can be used if applicable. Others are mandatory for each plan and are the basis for progress measurements and links between schedules. Wherever necessary, the work package plans are linked with each other to incorporate mutual influences. Most of these links are *soft links*, allowing the responsible work package leader to assess the changes of incoming links and their effects on his/her schedule before accepting the full impact. If possible, countermeasures will be taken to reduce the effects of delays from one work package to another.

The majority of MSP plans are procurement plans, where the procurement of components is being scheduled. Twelve installation work packages are scheduled in the respective installation plans. The commissioning work package has only one dedicated plan. The detailed scheduling of the civil construction is also provided in one plan, the so-called Plan of Planning. These four types of plans constitute the so called "Level 3" group of plans.

The integration of the civil construction plan, plan of realization (PdR), and the detailed civil construction plan, plan of planning (PdP), into the integrated master schedule is a major accomplishment for scheduling. Interdependencies in the schedules of the planning and construction for the site the buildings, the accelerator components, and the experiments are now clearly visible. *Installation windows* have been incorporated into the PdR and are mirrored in the individual installation plans (see Fig . 1).

Ten subproject plans and one civil construction plan are being monitored and steered by means of eleven overview plans, which constitute the so called "Level 2" group of plans. There is one plan for civil construction (PdR), one overview plan for each of the 9 machines, and one overview plan for the subproject Commons, which incorporate activities common to the entire project (such as HEBT, cryogenics, control systems,…). The Level 3 plans feed relevant information (summary tasks and ensembles of milestones) by means of external links into the Level 2 plans. The respective subproject leaders are responsible for the Level 2 plans.

Finally, one overview plan, the Master Plan, summarizes the scheduling of the entire FAIR project. It constitutes the so called "Level 1" plan. This scheduling structure allows that the detailed schedule of the Level 3 plan flow into the Level 2 plan, and, finally, into the Master plan to enable the steering of the overall project (see Fig . 4).

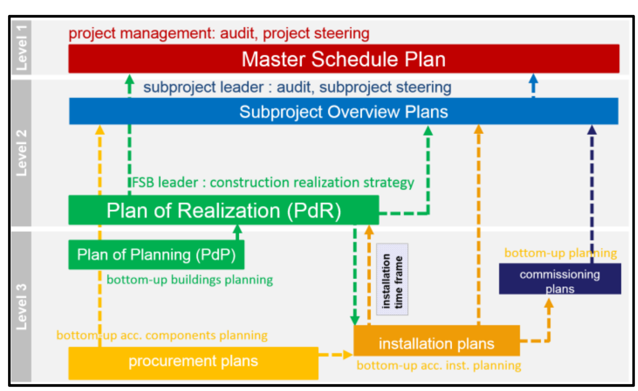

Figure 4: Structure (Portfolio) of the integrated project planning.

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INSTALLATION SCHEDULING PROCESS

The installation phase, located in the critical path of the project, must be transparent and controllable. This phase must allow for an exact indentation of the planning of the inside of a building (tunnel, path) with its construction planning. FAIR PMO and Subproject leaders reached out to other members of the Helmholtz-Association to learn from their experiences in building accelerators. In detailed meetings the planners from FAIR could secure the methodological support from DESY personnel involved in the planning of the XFEL. One of the results was the structured creation of the installation plans in the following steps [2]:

1. Declaration of installation steps and identification of their logical order: workshop day 1 for rough planning.
2. Work package leaders check the completeness, logical order and responsibility: workshop day 2 for bottom-up check.
3. Determine time-length and possible parallel processes: interviews and creation of roadmap.
4. Create MS Project installation plan, integrate building and link to level 3 procurement plan: in MS Project plan.

PROJECT MANAGEMENT WITH THE INTEGRATED MASTER SCHEDULE

The integrated master schedule is used on all three levels to steer the project: the work package leaders measure the progress of their projects, the subproject leaders measure the progress of the subprojects, and the project management closely monitors the master time schedule. Deep dives into the linked schedules of underlying levels complete the picture.

In November 2016, the integrated master schedule was finalized to be used as a baseline to measure future progress. Out of this baseline, dedicated status milestones are fixed on the timeline resulting in a baseline s-curve. Each updated schedule shows these status milestones and the movement over time can be seen in an actual plot of the s-curve.

With this s-curve, it is possible to look ahead of the current project status and observe possible future developments resulting from current delays. This is a powerful type of diagnostics allowing better control over the project. For instance, a future delay can be observed at an early stage and countermeasures can be taken to prevent the delay from occurring. The s-curve is an integral part of the project progress reports and helps to steer the project.

The integrated master schedule will be updated monthly. Additionally, major changes will be incorporated into the schedule as they occur to show implications for the whole project. Updating is the responsibility of each work package leader and subproject leader. With regular updates the current state of all projects can be observed and discussed during monthly steering meetings. Possible delays can be identified well in advance of occurrence and mitigation measures can be implemented systematically and timely.

OUTLOOK

The baseline is fixed and the work package leaders and subproject leaders are committed to their milestones. However, as work progresses, they will continue to look for opportunities to speed up the process via optimization of the sequence of works, and the realization of possible overlaps or iterations. Regular updates of the current progress status will help us to "look ahead" and successfully steer the project.

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REFERENCES

[1] FAIR Green Paper, "The Modularized Start Version", October 2009.
[2] Planning Report FAIR Project, Version 1.0; FAIR Council, December 2016.
[3] https://edms.cern.ch/project/FAIR-000004516