# FAIR PROJECT MANAGEMENT

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*Abstract*

The Facility for Antiproton and Ion Research (FAIR), currently under construction in Darmstadt, Germany, is among the most complex international research infrastructure projects currently being realized in Europe. The project combines large-scale civil construction, accelerator systems, scientific installations, and a broad range of international in-kind contributions within one highly interconnected project environment.

The experience gained during the FAIR project has shown that technical expertise alone is not sufficient to manage projects of this scale and complexity. Increasing interdependencies between construction, procurement, installation, commissioning, financing, and international collaboration required the establishment of highly integrated project management structures.

Over the course of the project, the FAIR Project Management Office (PMO) evolved from a mainly reporting-oriented organization into a central coordination and integration structure. Planning, risk and cost management, procurement and in-kind coordination, quality assurance, and configuration management were gradually connected within one integrated management framework.

Particular attention is given to the combination of technical planning, forecasting, and risk assessment methods. Schedule progress, delivery status, technical maturity, resource availability, and risk developments are continuously evaluated together in order to support management decisions and identify critical developments at an early stage.

This paper presents the FAIR project management approach and describes the role of the PMO in coordinating multidisciplinary activities across the FAIR and GSI campus environment.

## INTRODUCTION:

International research infrastructure projects differ in many ways from conventional industrial or construction projects. This is especially true for FAIR [1][2], where highly complex technical systems, international supply chains, numerous in-kind contributions, and parallel construction, installation, and commissioning activities must be coordinated within one common project environment [3].

Even small delays in individual systems can directly affect infrastructure availability, installation sequences, or downstream commissioning activities. At the same time, technical conditions, delivery schedules, and project priorities continuously evolve throughout the project lifecycle.

The FAIR experience clearly shows that local optimization of individual technical areas does not automatically lead to stable overall execution. Without central project coordination, projects typically face inconsistent planning assumptions, incomplete interface definitions, competing priorities, and delayed escalation of critical risks.

Professional project management therefore does not serve only an administrative function. Instead, it acts as the organizational integration structure between engineering, procurement, construction, installation [4], quality assurance, finance, and management decision-making.

As project complexity increased, the FAIR Project Management Office (PMO) gradually evolved into an integrated coordination and steering organization. Planning, risk and cost management, quality management, supplier coordination, in-kind coordination, and configuration management were not treated as isolated disciplines, but were closely linked within one common project management framework.

Integrated schedule and resource planning form the central basis for project steering. In addition, risk analyses, cost monitoring, delivery status, technical maturity, and quality and configuration information are continuously consolidated and evaluated together.

Risk management plays a particularly important role. Due to the large number of system interdependencies, deterministic planning methods alone are not sufficient to identify critical developments and support essential decisions on the project. For this reason, FAIR also uses probabilistic risk and forecasting methods, allowing a more realistic assessment of schedule uncertainties and cost at completion situation.

The FAIR experience also demonstrates that professional risk management does not depend only on methods or software tools. Practical experience of the involved project managers is equally important. Only through long-term project experience is it possible to realistically assess complex interactions, critical interfaces, and to trigger efficiently escalation mechanisms.

In large international projects, risks rarely appear as isolated events. More often, they develop from the combination of many initially small and seemingly unrelated problems. Early identification of such developments therefore requires not only structured methods, but also experienced project management organizations with a broad technical and organizational understanding.

## INTEGRATED PMO- AND MANAGEMENT-FRAMEWORK

As the project grew in scale and complexity, the FAIR PMO developed from a traditional reporting and controlling structure into a central project-wide integration and steering organization.

The main task of the PMO is not limited to creating schedules or reports. Its key role is to combine technical, organizational, financial, and strategic project information within one integrated management structure and to provide a reliable basis for management decisions.

At the center of this approach is integrated project planning. Construction activities, technical infrastructure, accelerator installation, experiment preparation, supply chains, resource availability, and commissioning activities are consolidated within one integrated master schedule and continuously updated. This allows critical dependencies, bottlenecks, and potential schedule delays to be identified at an early stage.

Figure 1 shows the actual organization of FAIR.

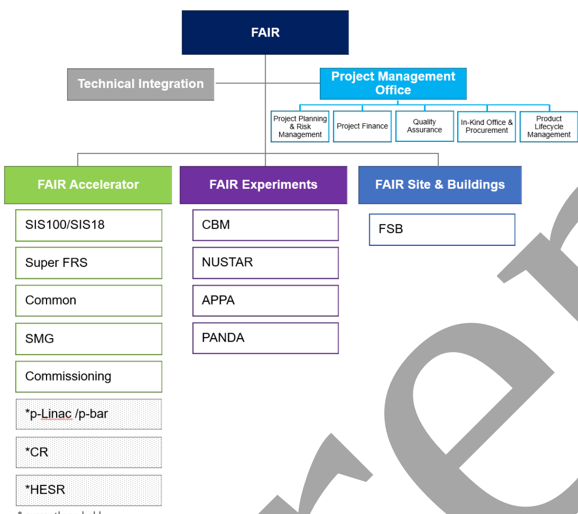


Figure 1: Organization of FAIR with details of PMO.

Today, the PMO organization consists of five specialized functional areas [5]:

- Planning & Risk Management (PPL)
- In-kind Office & Procurement (IOP)
- Project Finance (CBC)
- Quality Assurance (QUA)
- Product Lifecycle Management (PLM)

Planning & Risk Management (PPL) is responsible for integrated schedule and resource planning, critical path analyses, forecasting activities, and qualitative and quantitative risk analyses [6]. The group also supports the technical project organization in prioritizing critical activities and harmonizing planning standards across different project areas.

Since risks in international research infrastructure projects rarely occur independently, but usually arise from complex interactions, risk developments are continuously evaluated together with schedule, resource, and delivery information. Risk reviews and forecasting processes are therefore fully integrated into management and decision-making structures [7].

International supply chains and in-kind contributions represent another major challenge. The In-kind Office & Procurement (IOP) coordinates international partner institutions, industrial procurements, supplier management, and critical expediting activities. Especially in complex supply chains, the close interaction between engineering, procurement, and project management became a key success factor.

At the same time, Project Finance (CBC) connects schedule, risk, and cost information within integrated forecasting and budget processes. Continuous evaluation of project needs against the funding constraints of internationally funded project supports smooth project execution and enables early management decisions when critical developments occur.

Quality Assurance (QUA) supports these processes through project-wide quality standards, design reviews, acceptance tests, and preventive quality assurance measures. The objective is not only to control finished components, but also to identify and prevent quality and integration problems early during development, manufacturing, and installation.

In parallel, Product Lifecycle Management (PLM) ensures consistent management of technical configuration and documentation data. This allows technical changes, component information, and interfaces to remain traceable and consistent throughout the entire project lifecycle.

The strength of the FAIR PMO therefore does not lie in isolated functions, but in the close integration of all management disciplines within one common steering structure. Schedule planning, risk analyses, delivery status, cost developments, funding constraints, quality information, and technical configurations are continuously linked and evaluated together.

## PMO SUPPORT AND GSI CAMPUS-WIDE COORDINATION

Over the years, the FAIR PMO developed beyond classical project control into a central organizational support structure for the FAIR and GSI campus.

Today, its responsibilities include campus-wide integrated schedule and resource planning, coordination of project-related activities, support for technical management decisions, and prioritization and alignment of parallel projects and infrastructure activities.

Thanks to the already established integrated planning and management structures, the PMO was also able to transfer its methods and processes to additional campus-wide projects. This became especially visible after the fire event on 6 February 2026 at the GSI campus, when existing project management structures were immediately used to support several recovery and reconstruction projects.

The already established experience in integrated schedule planning, interface coordination, risk analysis, and resource steering enabled a comparatively fast and structured implementation of reconstruction and replacement procurement activities.

## LESSONS LEARNED AND CONCLUSIONS

The FAIR experience clearly demonstrates that international research infrastructure projects of this scale can hardly be managed in a stable way without professional and integrated project management [8].

Without such structures, projects typically face a gradual accumulation of missing transparency, inconsistent planning assumptions, delayed risk escalation, uncoordinated priorities, and weak interface management. Over time, these issues can lead to significant impacts on schedule, cost, quality, and integration targets.

The successful implementation of complex research infrastructure projects therefore depends not only on technological expertise, but also on the ability to make technical complexity organizationally manageable.

The FAIR experience also shows that methods, processes, and software tools alone are not sufficient. Practical experience within the project management organization remains essential. Only the combination of structured methods, integrated management systems, and experienced project managers makes it possible to realistically evaluate complex interactions and support reliable management decisions under changing project conditions.

In international research infrastructure projects, which are growing in size year after year, project management excellence is essential to ensure proper execution. Society's acceptance of severe failures is shrinking in a world facing numerous severe challenges. Failure is not an option for large-scale scientific projects. Project management excellence and high-performing project management offices must become the norm in this environment.

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