FAIR RISK MANAGEMENT AS A PROACTIVE STEERING TOOL FOR THE LARGE SCALE MULTI PROJECT

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Abstract

The Facility for Antiproton and Ion Research (FAIR) is a large scale multi project comprising 11 subprojects in the field of accelerators (pLINAC/p-bar separator, SIS100, Commons, Super-FRS, Collector Ring, High Energy Storage Ring), experiments (CBM, APPA, NUSTAR, PANDA) and civil construction. This contribution describes the implementation of a progressive risk management methodology based on a comprehensive assessment on work package level. Complexity factors (number of parts, level of state of the art, level of human interfaces, level of operational complexity) and importance factors (safety, technical performance, cost, schedule, resources) represent respectively the likelihood of risk occurrence and the possible consequences if a risk occurs.

Relative comparison of the normalized factors together with a supplier assessment enables to prioritize the most critical work packages and derive the risk events. The bowtie assessment is then used as a tool to identify risk events with their possible causes and consequences. Risks are evaluated and assigned to a risk or opportunity class. The identified risks are compiled in a risk register.

This contribution demonstrates the full methodology highlighting some typical examples of the FAIR project.

INTRODUCTION

FAIR is a new accelerator facility being built in Darmstadt, Germany and one of the largest projects for research in physics worldwide. The project is built in cooperation of an international community of countries and scientists. Upon completion, the facility will provide outstanding research opportunities and discovery potential. The heart of the facility is a superconducting synchrotron double ring facility with a circumference of about 1,100 meters. This facility called SIS100 was our pilot project for the risk and opportunity management methodology development.

RISK ASSESSMENT

The FAIR project is structurally divided into work packages building the work breakdown structure (WBS). This structure allows a hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables.

Each subproject has a defined number of work packages which contains one or several PSP codes. A PSP code is the smallest project unit used and contains one or more components.

The methodology applied for the risk assessment is a bottom-up approach focusing on the work packages in each subproject [1].

Subproject Risk Assessment

The assessment is completed in two steps. The first step builds up in the second step. In the first step a profile of the machine/experiment or, more generally speaking, the subproject is established. In the second step, the values of this profile are used and the work packages belonging to the subproject are compared relatively according to the same factors. The result of these two steps provides a risk tendency for each work package in a subproject (see Fig. 2).

The goal of the assessment is to establish a prioritization of the work packages in a given subproject and to provide a solid basis for the risk identification.

The risk tendency is defined by assessing the technical complexity and the importance for FAIR of the work package relatively to other work packages from the same subproject.

The complexity is based on 4 factors, respectively, the number of parts and their level of software and hardware integration, the level of human activities, the level of state of the art, and the operational complexity. The higher the value of one of these factors or several of these factors combined together is an indication of the likelihood that something will fail in these work packages.

The importance is based on 5 factors, the safety, the technical performance, the schedule, the costs and the resources. The first 4 factors are parts of our project scope, hence our objectives. The factor resource is important for the project but will also have an influence on the likelihood that something will fail if the factor resource is not adequately used. The importance factors are those factors which could suffer if a risk occurs.

The first step of the assessment provides a profile of the machine (see Fig. 1). In order to do so, the complexity factors are compared against each other and given a value from 1 to 9. The factors are weighed and a geometric mean is calculated. 1 means that the complexity is equal, 3 that it is slightly more complex, 5 that it is moderately much more complex, 7 that it is much more complex, 9 that it is extremely more complex.

The elements from the horizontal row are compared with the elements from the vertical row. It shows which factor has the most impact on the technical complexity of the subproject.

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SIS 100 SP1		Number of parts	Level of human activities	FOAK	Operational complexity	Technical Complexity		
A	Number of parts	1	3	1/5	1	0,8801	0,1912	19,12%
B	Level of human activities	1/3	1	1/3	1/3	0,4387	0,0953	9,53%
C	Level of state of art FOAK	5	3	1	1	1,9680	0,4276	42,76%
D	Operational complexity	1	3	1	1	1,3161	0,2859	28,59%

Figure 1: SIS100 complexity assessment profile.

Likewise, the importance factors are compared using the same scale from 1 to 9 and the same method. 1 means that the impact is equal, 3 that it is slightly higher, 5 that it is moderately much higher, 7 that it is much higher, 9 that it is extremely more higher. It stresses the most important factor of one subproject for the completion of FAIR or which factor has the most impact for FAIR success.

The second part of the assessment consists of a relative ranking of the work packages in a subproject.

All work packages are compared against each other using the same factors as in the first step. These factors are split into different criteria in order to support the assessment process and to keep a consistent assessment among the subproject. A scale is given as orientation to the expert in order to facilitate the assessment. The minimum value attributed to a work package is 1. The product of the technical complexity and the importance for FAIR is the risk tendency, as in Figure 3.

This part of the assessment should be revised periodically, at least when the project moves to a new phase. The complexity factors will not change over time as they are the characteristics of the work package or subproject but the factors costs, schedule and resources are likely to vary over time. The project comprises of successive phases, namely the design and planning phase, the procurement and production phase, the installation and the commissioning.

SIS 100	2.8	Technical complexity (X)	Importance for FAIR (Y)	Risk tendency (w=x*y)	Risk tendency (normalised value in %)
2.8.0.1	System Design	0,019	0,035	0,001	1,16%
2.8.0.2	Machine Modeling and Setting Generation	0,035	0,032	0,001	1,98%
2.8.0.3	DMU	0,026	0,029	0,001	1,36%
2.8.1	Beam Dynamics	0,024	0,034	0,001	1,47%
2.8.2.1	Cryo-Magnetic Dipole Module	0,091	0,074	0,007	12,03%
2.8.2.10	Quadrupole module	0,152	0,110	0,017	29,81%
2.8.2.11	Stringtest	0,026	0,083	0,002	3,88%
2.8.2.20	Normal Conducting Magnets	0,041	0,028	0,001	2,09%
2.8.2.21	sc electrical system	0,035	0,048	0,002	3,01%
2.8.3	Power Converters	0,020	0,054	0,001	1,94%
2.8.4.1	RF Acceleration	0,105	0,050	0,005	9,27%
2.8.4.3	Bunch Compression	0,063	0,047	0,003	5,30%
2.8.4.4	Barrier Bucket System	0,048	0,038	0,002	3,25%
2.8.4.5	RF Longitudinal Feedback	0,058	0,028	0,002	2,85%
2.8.4.6	Ko Exciter	0,017	0,014	0,000	0,43%
2.8.5	Injection/Extraction	0,025	0,061	0,002	2,73%
2.8.6	Beam Instrumentation	0,052	0,040	0,002	3,69%
2.8.7	Vacuum	0,043	0,029	0,001	2,20%
2.8.10	Laser Cooling	0,019	0,017	0,000	0,56%
2.8.11	Special Installations	0,014	0,036	0,000	0,88%
2.8.12	Cryogenics	0,061	0,078	0,005	8,46%
2.8.23	Civil Construction Interface	0,027	0,034	0,001	1,65%

Figure 2: SIS100 risk tendency.

Supplier Risk Assessment

The supplier assessment is a part of the procurement and manufacturing phase. All suppliers attached to a work package on the critical path are the most critical for the project success.

Each supplier currently under contract, either In Kind or company contract, is submitted to an assessment done by the work package leader together with the FAIR risk manager. The supplier assessment is based on 2 steps. The first step provides a supplier capability value and the second step a supplier criticality value at work package level.

The supplier capability assessment is driven by four criteria, respectively, the reputation of the supplier, the facilities to manufacture the components and the know-how of the supplier, the project management of the supplier, and the overall funding situation. These four aspects influence the supplier capability to supply the required work package.

Factors in the horizontal row are compared with factors in the vertical row, using a scale from 1 to 9 to compare their impact on the supplier capability to deliver the work package as required. 1 means that the impact is equal, 3 that it is slightly higher, 5 that it is moderately much higher, 7 that it is much higher, 9 that it is extremely higher.

The result of this first step indicates which factor is the most critical at supplier level in order to provide the required components. The value is expressed in percentage and is built up further in the capability assessment.

Once the profile is established, each supplier currently under contract is evaluated with the same criteria mentioned previously for the supplier assessment. The evaluation is done by the assigned work package leader who gives a note from 1 (poor) to 9 (excellent). The result of these notes provides a supplier capability score at work package level.

The supplier criticality is the ratio of the work package risk tendency and the corresponding supplier capability. The higher the supplier criticality is for a given supplier, the higher the priority to monitor and implement rigorously our quality assurance standards. Conversely, if the supplier capability is rated high and the work package risk tendency is low, the monitoring will be lower.

The supplier capability can have the same value for different work packages having different risk tendency values, if for example the supplier delivers different parts in the project. The supplier criticality value will vary depending on the risk tendency value of the work package it corresponds to.

RISK IDENTIFICATION

The phase of the risk identification is the most critical phase as it is the basis for the following steps of the risk management process. Therefore it is crucial to have the key people involved at this stage.

The assessment of all work packages allows a prioritization of the work packages according to their level of complexity and importance for FAIR and their overall risk tendency. The risk derivation focuses primarily on the critical work packages.

Additionally to the prioritization potential of the assessment, it also enables to directly derive risks from the values delivered. It also allows prioritizing the working groups in the subprojects and the participants involved in the risk and opportunity identification process. Hence the workshops are organized with one risk facilitator and the top work package leaders according to the risk tendency of their work package.

The workshops are composed of 3 main phases, a brainstorming phase according to the risk assessment results, leading to a phase of risks and opportunities identification, an evaluation of the risk according to the level of likelihood and impact on the project and the mitigation actions proposed to reduce the risks.

The methodology of the bow-tie recommended by the PMI as standard for Risk Management, has been used to identify the risks (see Fig. 3). In this methodology, the risk is represented with three events having a cause-consequence effect, namely the cause(s), the risk event and the impact(s). First the main event is identified. Second the causes and third, the impacts are identified. The impacts are events which affects our project objectives. These can impact the schedule, the finances, the performance, the quality, the safety, the reputation or it can be a combination of these.

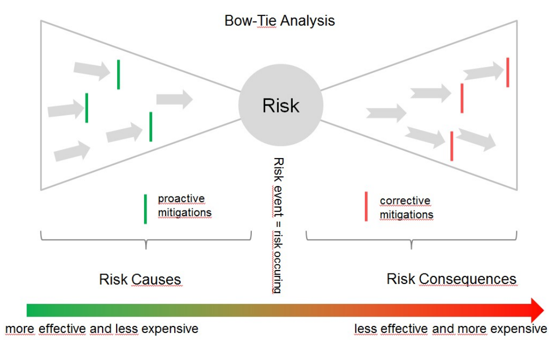

Figure 3: Bow-tie diagram.[2]

RISK EVALUATION

The risk events are evaluated according to their impact(s) on our project objectives. The impact is currently assessed in costs overrun and / or schedule delays against our goals.

Schedule risk is the risk that the project will take longer than the planned schedule. It can lead to costs risks, as longer projects always cost more. In a first step the schedule risks have been identified in workshops on subproject level. The first assessment gives an indication whether one work package is on the critical path or not. The references given for the schedule delay are the milestones M10 and M11, respectively that all components are delivered (M10) and that that the installation is complete (M11). A first rating of the risk is carried out providing a first set of data per subproject. Once all schedule risks are recorded, they are going through a final filter where we look in the project plans (baseline) to review the schedule risk criticality with the last project milestone M12. If this milestone is postponed, then we have a risk which needs to be addressed and mitigated. Risk postponing M11 next to critical and M10 are on our watch list.

Cost risk is the risk that the project will cost more than budgeted. It can lead to performance risk if a cost overrun leads to a reduction in scope or quality.

The performance risk is a risk that the project, once complete, will not fully meet the performance required. Performance risk is not represented in the risk and opportunity matrix but can lead to cost and schedule risks. Moreover, FAIR's characteristic is that it is has a high level of state of the art technology and consequently a fair level of unknown in the achievement of the required performance which will allow all experiments to perform according the Modular Start Version.

OUTLOOK

It is planned to link the risk assessment data to our cost project baseline in order to have the real time data updated monthly in regards to costs (residual needs and committed funds) and critical path. Furthermore, a prioritization on subproject level is planned to prioritize the risks overall in regards to the machines and the experiments. A triangular distribution is planned to improve the likelihood results of the risks.

CONCLUSION

The risk management methodology applied to FAIR establishes a strong basis for the development of the risk management in the project. It enables to identify opportunities and risks impacting the project schedule and costs and as such is an adequate project steering tool.

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REFERENCES

[1] Pöyry Oy, FAIR Risk Concept.
[2] Risknet, https://Risknet.de/en/knowledge/risk-management-process/

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