Product assurance for instrumental projects in research laboratory

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Abstract

Product Assurance (PA) is an essential activity to support the design and construction of complex instruments developed for major scientific programs. The international size of current consortia in astrophysics, the ambitious and challenging developments, make the product assurance issues very important. The objective of this paper is to focus in particular on the application of Product Assurance Activities to a project such as MOSAIC, within an international consortium. The paper will also give a general overview on main product assurance tasks to be implemented during the development from the design study to the validation of the manufacturing, assembly, integration and test (MAIT) process and the delivery of the instrument..

General definition

- **Quality assurance QA**: is defined[3], as planned and systematic process aimed at determining whether a product or service meets specified requirements.
- **Product Assurance PA:** this terminology is usually used instead of QA to designate a set of activities to be carried out throughout the project life cycle, from the requirements definition to the product acceptance. The main objectives are: to avoid defect, ensure that the final product /instrument will meet the project goal.

MOSAIC Project

MOSAIC [1,2] is a Multi Object Spectrograph (MOS) for the Extremely Large Telescope (ELT) of the European Southern Observatory (ESO). The instrument will both use the collecting power and the resolution of the 39m aperture provided by the ELT. This wide aperture will be combined with Adaptive Optics (AO) correction system to provide unique capabilities.

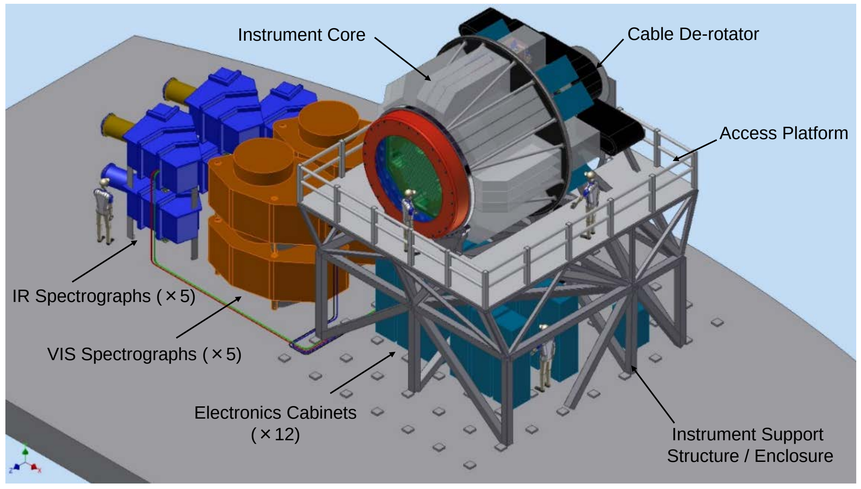

Fig. 1-The overall, full MOSAIC phase A concept

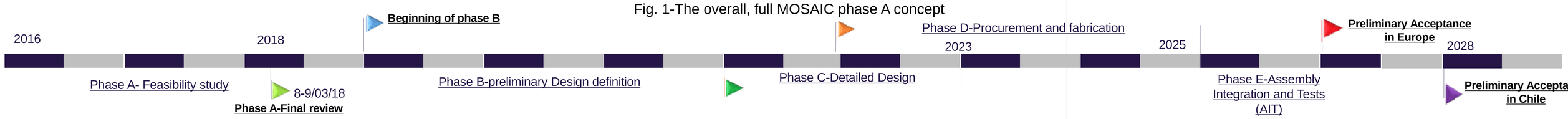

Fig. 2-Estimation of the project Schedule during the phase A

Context for PA implementation

General

- Ambitious and expensive projects
- Very long-lasting project (at least 10 years construction, life-time of 20+ years after commissioning
- Large international consortia to integrate or to organize and steer
- Need high level of optimization and rationalization
- Resources flow bottom up. A classical hierarchical management structure is not possible
- Avoid errors, resulting time and money consuming

MOSAIC Phase A

- 11 countries and 9 institutes involved in technical work packages are part of the project team,
- Budget estimated between 25 and 30 M€
- International consortia to organize and steer (Different level of management (Steering committee, board, Project Office (P.O))
- lasts 10 years

MOSAIC Phase A

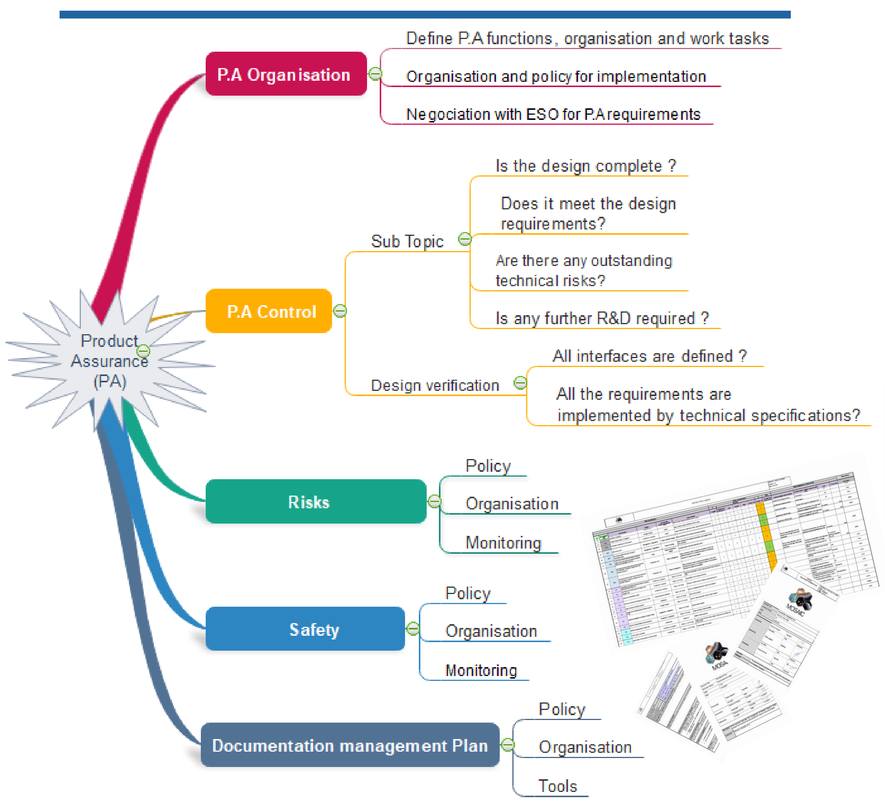

Fig. 3-MOSAIC Product Assurance Tasks during Phase A

General Overview

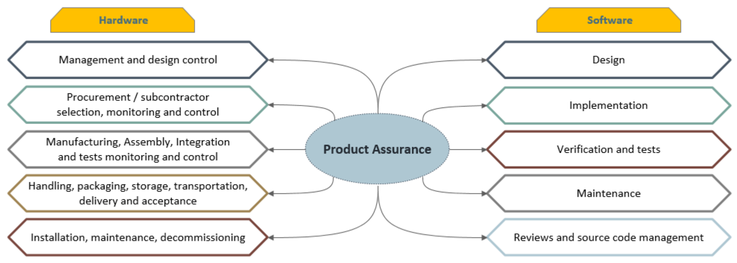

Fig4. Product Assurance during instrumental project lifecycle

Why Product assurance?

The prime objective of Product Assurance (PA) activity is to ensure that all instrument systems accomplish their defined objectives in a safe, available and reliable way.

What PA program involves ?

- Management and control of the PA tasks, with respect to high level requirements and guidelines
- Management of audits, critical items, non conformances and alerts,
- Support and monitoring of the risk management, in coordination with the Project Manager.
- Generation and monitoring of rules related to configuration management and traceability (documentation and parts)
- Lower-tier supplier control for ensuring implementation of PA requirements by the supplier

Benefit versus efforts & costs

Efforts and costs associated with establishing and maintaining a high level of product assurance activities, will be paid during the various phases of the project and at all subsequent stages of the life cycle.

The benefit will accrue to all parties involved in the operation, from design to final dismantling. The necessary efforts must be invested by the participating institutes in the first stages of the project with support from the consortium project office.

CONCLUSION

Assuring quality and reliability performance for high complexity, high reliability equipment/ instrument, is not a trivial task. Although the practice of product assurance is not new and is presently widespread. In fact, we all need to have confidence in the reliability, maintainability of an airplane, an elevator etc before it is used. PA insures that all steps of the process from requirements definition to the delivery has been correctly mastered with appropriate and qualified resources. For MOSAIC and any Instrumental Project in general, a lack of Product Assurance management and / or control can have serious impact on performance, cost or schedule.

During the MOSAIC, phase A, a general approach in adequacy with high-level requirements regarding PA was applied. The work initiated will go on in the next phases and tools like: Automated Systems Analysis using Executable SysML Modelling Patterns (ESEM) to support PA activities will be investigated.

REFERENCES

[1]. F.Hammer. et. al, "The ELT-MOS: towards the construction phase", Proceedings of SPIE (2018), AS18-AS105-52

[2]. F.Hammer. S. Morris, et al. "The E-ELT multi-object spectrograph: latest news from MOSAIC",SPIE Conference Proceeding, 9 August 2016

[3] ISO 9000:2015: Quality management systems -- Fundamentals and vocabulary