Commentary on: "Status Report on the Development of the JWST Long Range Planning System" by M.E. Giuliano, R. Hawkins, and R. Rager

Nicola Policella
ESA-ESOC, European Space Agency
64293 Darmstadt, Germany
nicola.policella@esa.int

Summary

This paper (Giuliano, Hawkins, and Rager 2011) gives an overview of the HST (Hubble Space Telescope) planning system, and the ongoing progress towards the 2014 launch for the James Webb Space Telescope, JWST. In reviewing the HST solutions, the paper gives insight into the problems with the system, and areas that could be improved for the JWTS system. The paper then gives a high level overview of the development of the JWST planning system, how it was integrated into HST during development, and improvements to the SPIKE system

The JWST planning system will re-use and evolve some of the tools already in use for the planning phase of the Hubble Space Telescope (HST). This also permits to exploit the long experience (about 20 years) of operating HST in order to define the planning cycle.

JWST Planning and Scheduling cycle has been designed considering two aspects which were derived from the lessons learned of HST:

- to keep the spacecraft model in one place;
- to have systems which can easily integrate changes.

The overall approach can be seen as a System of Systems, therefore a "shared constraint modeling" is important to have a unique representation of the spacecraft to which all the systems can refer. Also, a "shared database interface" is used as interface among the different P&S subsystems.

About the SPIKE improvements, during the development of JWST systems three aspects have been considered:

- Make SPIKE more transparent: this means to provide more detailed information to the end users, in order to understand the outcome of a planning process (why my action was not performed?)
- Multi-Objective Scheduling: according the the requirement of the JWST long range planning phase, solution shall consider different criteria. Therefore a multi-objective approach has been considered.
- Least Commitment Resource Models: this improvement aims at better distributing resource usage for efficient short term scheduling. This is based on a novel "resource assignment" model that is positioned between the classical least commitment and specific commitment alternatives used previously in HST.

Commentary

The paper discusses a very relevant aspect in the context of space operations: to transfer operational lessons learned, together with validated software tools, from one mission to another. In particular when, why, and how this should be done.

This justifies the objective of designing tools which can evolve with time and cope with both requirement changes and new available technical solutions. This is needed not only to re-use systems for different missions, but also to cope with the natural evolution of a space mission. To obtain this a more generic system is preferable with respect to tailored solutions. There is than a trade-off between flexibility of the system towards efficiency. How the authors faced this aspect? Was the re-use of systems possible given the high similarities between the two missions (HST and JWST)?

The legacy with the past can however also lead to the use of approaches that are outdated. What could be an advanced, cutting edge, solution 20 years ago, can now be overcame by new alternative approaches (even though the old solution is still operationally valid). The question is when to decide to move to a new solution. Or how far we should keep previous old systems. Have the authors identified guidelines which drove their decision? Are there criteria that should be considered before changing to a new system?

About the future JWST operations, it would be interesting to have some further discussion about the following points:

- How the presence of these tools, and in particular, of lessons learned from previous experience influenced the definition of future JWST operations (and more in general the design of the JWST mission) ?
- How the observers (or investigators) were involved in the design/definition of the HST supporting tools ? Were they pushing to re-use the planning tools also for JWST ?

About the technical solution described in the paper, I would like the authors to address the following points:

- Explanation of automated planning decisions. In the recent years there were different proposals/efforts to provide more intelligent feedback to end users of automated systems. Do the authors have consider this point ?
- To reason about multi-criteria scheduling the authors proposed to analyze the resulting Pareto-surfaces (Giuliano

and Johnston 2011). However still a solution from the different one in the Pareto-surface has to be selected. How this can be done ?

References

Giuliano, M. E., and Johnston, M. D. 2011. Developer Tools for Evaluating Multi-Objective Algorithms. In *Proceedings of the 7th International Workshop on Planning and Scheduling for Space, IWPSS-2011*.

Giuliano, M. E.; Hawkins, R.; and Rager, R. 2011. A Status Report on the Development of the JWST Long Range Planning System. In *Proceedings of the 7th International Workshop on Planning and Scheduling for Space, IWPSS-2011*.