Commentary on "Applying Lessons Learned in Planning and Scheduling the Hubble Space Telescope to the James Webb Space Telescope" by Hawkins, Jordan, and Giuliano

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Introduction

The paper (Hawkins, Jordan, & Giuliano 2009) illustrates how the integration of different operational factors has increased the HST efficiency; it also discusses how these lessons learned will be applied to the on-going development of the James Webb Space Telescope (JWST). An effective and efficient utilization of the resources is a critical aspect in supporting space missions. For instance, the Hubble Space Telescope (HST) has made significant contributions to our understanding of the nature of the universe. Part of the success of the HST mission has been the creation of systems that allow HST to achieve high science efficiency.

In the development of the future James Webb Space Telescope, the different lessons learned coming from the HST mission have been considered. This paper provides a historical overview of the factors that allowed the HST mission to achieve higher than predicted efficiency, and then shows how this legacy will be used in the case of JWST.

Commentary

Though the paper can be seen as a not very specific Planning and Scheduling paper, it shows well in details the overall context of a mission and the role of P&S technologies in this context. In particular the authors organized the different lessons learned according to the following categories:

- To foster the definition of efficient observing program by using an ad-hoc science selection policy;
- To use advanced planning and scheduling technologies to automate and optimize the different processes;
- To preserve the end user in the loop by using operational procedures and processes which allow to control the P&S process with a mixed-initiative approach;
- To enhance the overall workflow (from the observation definition to the actual scheduling) by using a suite of advanced software tools.

A final but very important comment given by the authors suggests to design our future missions in order to be ready for changes. This might be reflected both in the different systems/tools the mission will use (in which as much flexibility is possible has to be retained) and in the composition of the mission operators (a balanced mixture between software users and software developers is suggested).

Some comments on the paper

- A key factor for producing efficient plans and highlighting possible conflicts is to have fully defined science proposals as soon as possible (during Phase 1 in case of HST). Is it possible to foresee some penalty instruments in order to "force" an early full definition of the different proposals?
- The two missions, HST and JWST, show, in the way they are defined in the paper, several similarities. An interesting point for a general reader would be to clarify which of the mentioned lessons learned can be extended to and/or re-used by missions which belong to other families (e.g., earth-observation missions or planetary missions).
- In the paper is mentioned that the expected efficiency was reached only a few years after the launch of the mission. Why did this happen? It was because of a bad design of the mission? There were elements/aspects not properly considered in the design phase?
- The paper shows that, besides improvements in the P&S tools, many other factors (e.g., science policy, operational procedures, etc.) led to an overall scheduling efficiency. In order to better understand, and re-use, the lessons learned, it would be worth quantifying the effects of each of these factors on the scheduling efficiency.
- The paper mentions that the James Webb Space Telescope will be equipped with an execution agent in charge of examining the pending observations and scheduling them. The presence of this agent might foresee the use of advanced scheduling algorithms. In particular this could be used to manage conflict between observations, for instance, observations which have an overlapping time-window. For instance, with respect to the implemented scheduling strategy, observations might be allocated according to an assigned priority or the agent might use an heuristic to identify which observation to schedule first.

References

Hawkins, R. E.; Jordan, I. J. E.; and Giuliano, M. E. 2009. Applying Lessons Learned in Planning and Scheduling the Hubble Space Telescope to the James Webb Space Telescope. In *IWPSS'09. Proceedings of the 6th International Workshop on Planning and Scheduling for Space, Pasadena, California, USA, July 19–21.*