



Science & Technology Facilities Council

Rutherford Appleton Laboratory

On the Need to Use Operations Planning Expertise Early on During the Mission Design Phase

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<http://www.stfc.ac.uk/ralspace/default.aspx>



Purpose

- The purpose of this presentation is to discuss the relevance of using Operations Planning Expertise in general, and Science Operations Planning Expertise in particular, **early on** during the Mission Design Phase (MDP) in order to increase the:
 - Productivity
 - Performance
- ## Of Operations Planning Systems



Productivity / Savings

- Savings can be increased by, typically, reducing the amount of staff effort required to:
 - Design
 - Implement
 - Runthe system



Productivity / Savings

- Staff effort can be reduced during the **Design phase** by:
 - identifying faster the potential problems and the best ways of solving or avoiding them
 - utilising existing design patterns and/or “toolkits”
- Staff effort can be reduced during the **Implementation phase** by:
 - identifying, during the MDP, ways of avoiding the duplication of effort



Productivity / Savings

- Staff effort can be reduced during the **Execution phase** by:
 - identifying, during the MDP, ways of:
 - Reducing the need and the time required to execute maintenance activities by, for instance, decreasing the:
 - Constraint variability
 - Complexity of the constraints and constraint updates
 - Avoiding unnecessary planning steps



Productivity / Savings

Continued...

- Reducing the time required to execute the planning steps by, for instance:
 - Enabling the elaboration of planning rules/constraints that are easier to express and to satisfy, regardless of whether the execution of the planner is manual or automated
 - Optimising the plan update frequency and/or decreasing the complexity associated with the execution of the plan updating
 - Increasing automation; i.e. the OPE should seek to create a functional architecture that will increase the level of automation by clearly separating the process that can be automated from the ones that cannot



Productivity / Costs

- Costs associated with the use of Operations Planning Expertise during the Mission Design Phase will:
 - Depend on its operating mode
 - Likely decrease with time
- These two points are further discussed in the next slides



Productivity / Costs

- OPE Operating Mode: an example (1 of 2)
 - **Activity 1:** Execute a permanent monitoring of the evolution of the mission design for all missions
 - **Purpose:** To assess whether a new mission design would require more sophisticated analysis in order to optimise the performance and productivity of the operations planning system
 - **Costs:** This should require a small amount of resource and only aims at assessing the potential complexity of the operations planning associated with a specific type of design



Productivity / Costs

- OPE Operating Mode: an example (2 of 2)
 - **Activity 2:** Execute a more or less complete analysis of the operations planning issues
 - **Purpose:** To optimise, during the MDP, the performance and productivity of more or less complex Operations Planning Systems
 - Typically, by identifying operations planning problems and their potential solutions
 - **Cost:** This activity, potentially, can require a significant amount of resources



Productivity / Costs

- Time evolution of OPE costs
 - The cost of involving the OPE early on during the MDP should decrease with time, particularly if Type III OPE is used, as the OPE becomes:
 - More efficient because the body of knowledge and expertise continues to grow; i.e.:
 - The concepts, methodology and communication strategy become more and more developed and robust
 - Less needed because the design teams become more familiar with the concepts and methodology; i.e. because they:
 - Understand faster and faster the issues identified by the OPE
 - Anticipate more and more those issues



Performance

- Performance can be increased, typically, by increasing the level of automation for the following three reasons:
 - **First**, automation reduces the execution times of the plan generation and plan update processes
 - Such reduction enables the ability to react faster to unpredicted events thus increasing the chances of:
 - Preventing the spacecraft being damaged
 - Missing the study of transient unpredicted scientific phenomenon



Performance

- **Second**, plans generated by automated system are less likely to contain mistakes that can lead:
 - at best, to loss of data
 - at worse, to serious hardware damagesbecause if a mistake is detected then the system can be adjusted so that it does not happen again
- **Third**, increased automation facilitates the development of automated autonomy to further increase the chances of:
 - Preventing the spacecraft to be damaged
 - Missing the study of transient unpredicted scientific phenomenon



Performance

- Automation can be increased by both:
 - Optimising the design of the functional architecture
 - Performing the optimisation early on during the MDP
 - i.e. at the time when trade off between scientific objectives, cost and technology can be made and can be made at low costs



- Optimising means increasing the chances of:
 - Preventing the spacecraft being damaged
 - Missing the study of transient unpredicted scientific phenomenon

By identifying the sub-systems that can be automated/made autonomous

- By avoiding complicated architectures
 - By using OPE early on during the MDP



Conclusion

- The use of OPE, particularly of Type II and III, early on during the MDP can help to increase the P&P of the mission:
 - Indeed, a concept that allows faster and better architectural design of the operations planning system can:
 - Save money during the design, implementation, testing/maintenance and running phases
 - Increase the scientific returns (e.g. By increasing automation)



Conclusion

- It is difficult to believe that involving OPE early on during the MDP cannot be justified in the medium to long term



Question

- Do you support the idea that Operations Planning Expertise should be involved early on during the Mission Design Phase?
 - **No**: why not?
 - **May be**: what do we need to do to make up our mind, i.e. to decide “yes” or “no”?
 - **Yes**: what do we do next?