DESIGN PROCESS ENHANCEMENTS FOR PLANETARY MISSIONS

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In order to produce and successfully carry out low-cost missions many changes are required. It is useful to divide these changes into (a) changes to the input parameters describing the mission to be flown, and (b) changes to the process used to convert those inputs into a spacecraft and a mission. Examples of the former include the science goals, instrument complement, risk philosophy and mission duration. Examples of the latter include design tools, configuration management process, teaming arrangement, and management style. This paper will address recent conceptual changes to the latter set.

Project lifetimes can be divided into concept definition, formulation, implementation and operations phases. During concept definition, the design process has been accelerated by properly defining the required design depth, understanding the linkages between tools, and through management of team dynamics. Design methodologies in formulation and implementation phases can be revised along similar lines, using a similar process. Here, system requirements can be held in crosscutting models, which are linked to subsystem design tools through a central database that captures the design and supplies needed configuration management and control. Mission goals, which may be thought of as the rough equivalent of level-one system requirements, are then captured in timelining software that drives the models, testing their capability to execute the goals. In our concept, the team dynamics revolve around use of three institutional teams, each concurrent and highly parallelized.

In the past, performance-driven paradigms have been the management style of choice, emphasizing data return with cost and schedule being secondary issues. Now and in the future, with costs capped and schedules fixed, design practices can be centered around this concurrent team design approach that considers all the core design variables together: what must it do, what must it cost, how much power, how much data, etc. The design models described above can confirm that these core variables, including cost and schedule, are internally consistent. The models begin very simple and high level so that they can be used immediately. They progress to detailed models which are integrated and tested in the same way that the hardware and software will be tested when they are built. The models are linked directly to the foundry tools that produce hardware and software to minimize fabrication errors. Thus the old concept of final assembly and test gives way to a new concept where assembly and test start from the beginning.

Metrics are used to measure and control both processes and to ensure that design parameters converge through the design process within schedule constraints. Where traditional linear "waterfall" design methods require management of an ever-reducing margin as the design proceeds to an anticipated endpoint, this methodology manages margins controlled by acceptable risk levels. Thus, teams can evolve risk tolerance (and cost) as they would any engineering parameter. This new approach allows more design freedom for a longer time, which tends to encourage revolutionary and unexpected improvements in design.

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