Project Planning at NASA

by John R. Chiorini

A number of NASA project teams have recently experienced a change in the way in which they have created their project plans. This has been brought about by a fundamental shift in the understanding of the purpose of the planning process.

The traditional view of planning is that the essential end product of the process is a schedule of anticipated events together with a statement of the resources necessary to perform all required work. Such a schedule is best produced by identifying all necessary tasks, their logical dependencies, the estimated duration of each task, and the resources required or to be made available for the performance of each task. While such a view carries the implicit assumption of interdependencies, durations and resources, there is nothing in the end-product statement that validates such an assumption.

Plans allow the simulation of a project. Too often, however, the finished logic network and resulting schedule are viewed as suitable for "what if" games, and future event management is restricted to anticipating risks and managing tasks on the critical path. Because the physical plan is the simulation, this view assumes that such a plan, whether created by a planning department, by the project manager working in isolation, or by a project team working as a whole, is an equally useful product, as long as it is "correct." That is, as long as it represents the future state of the project, the process by which it was created is immaterial.

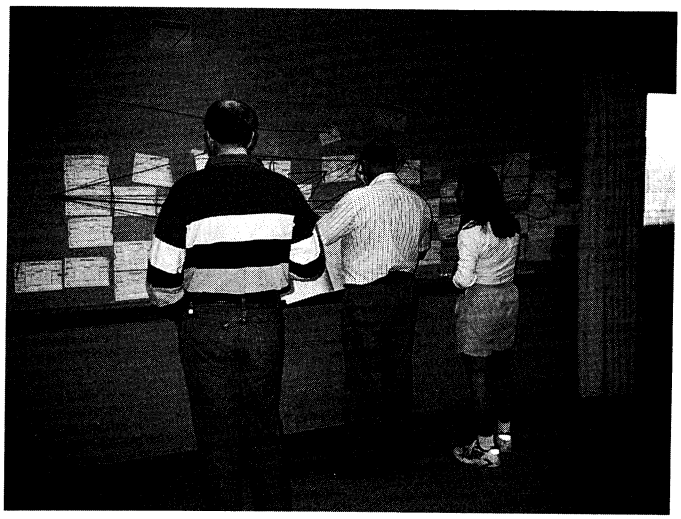

Figure 1. Team Network Development.

The fundamental shift in thinking came with the understanding that the true purpose of the planning process is the translation of requirements into agreements to perform the necessary work. The agreements are made by the members of the team tasked with actual work performance. The schedule, with its underlying logic network and task-level resource plans, is an intermediate product. The agreements are derived from the process of creating that network in a team setting. It is this team process which holds the key to effective planning because validity evolves from the collective decisions made by the project team in the process of creating the project plan. The derived logic network and schedule, which are the end products of this simulation, are more valid than any created in isolation by a planner or project manager hoping to anticipate the future decision of the team.

To date, eight NASA teams have been facilitated in the development of their project plans through a task order contract between NASA Headquarters and the Center for Systems Management (CSM). The teams have included, among others, the Gravitational Biology Facility Project, the Transport Research Flight Facility Project, the Advanced General Aviation Transportation Experiment—AGATE, and both the SAGE Instrument Development and SAGE Software Development Projects. The planning sessions are intensive one-week team events which produce resource-loaded schedules. Facilities used for the planning have included the NASA Wallops Island Management Education Center and off-site facilities provided either through CSM at their plan-

ning center in Cupertino, California, or at other off-site locations provided by NASA.

NASA employees who have attended Project Management training courses conducted by CSM are familiar with the planning process taught by them and the use of facilitated Cards-on-the-Wall sessions to capture the team decisions on the Work Breakdown Structure and project plan prior to entry into the planning software of choice (see Figure 1).

For those not familiar with the process, tasks are first described on large cards (see Figure 2) by team members. Each card contains space to document certain background information on a task, describe the work to be involved in performing the task, identify the input information required to start the task, list output products of the task, describe the estimated duration of the task, and the resources estimated to be needed to accomplish the task work. Team members construct a Work Breakdown Structure using the cards and then link the cards on a large wall with yarn, review the resulting task descriptions and logic with the project manager and the entire team, and only when concurrence is reached, the task cards and logic are captured in project planning software. Because the team gets to participate in the actual planning process, agreements on task interactions, resource commitments, risk mitigation actions, and concessions on durations and hand-off logic are made by the team during the planning process. The initial simulation of the project occurs during the planning, not as some post-plan creation of the logic. That is, the planning process, conducted in a team setting, allows decisions on future events, compromises to be made now that will be implemented some time in the future, workarounds to be planned today to be used, if necessary, at some future event, and agreements to be exercised in the future to hand off products in specific formats to subsequent task teams.

The strength of the process is best understood in the observation from one participant who noted that only

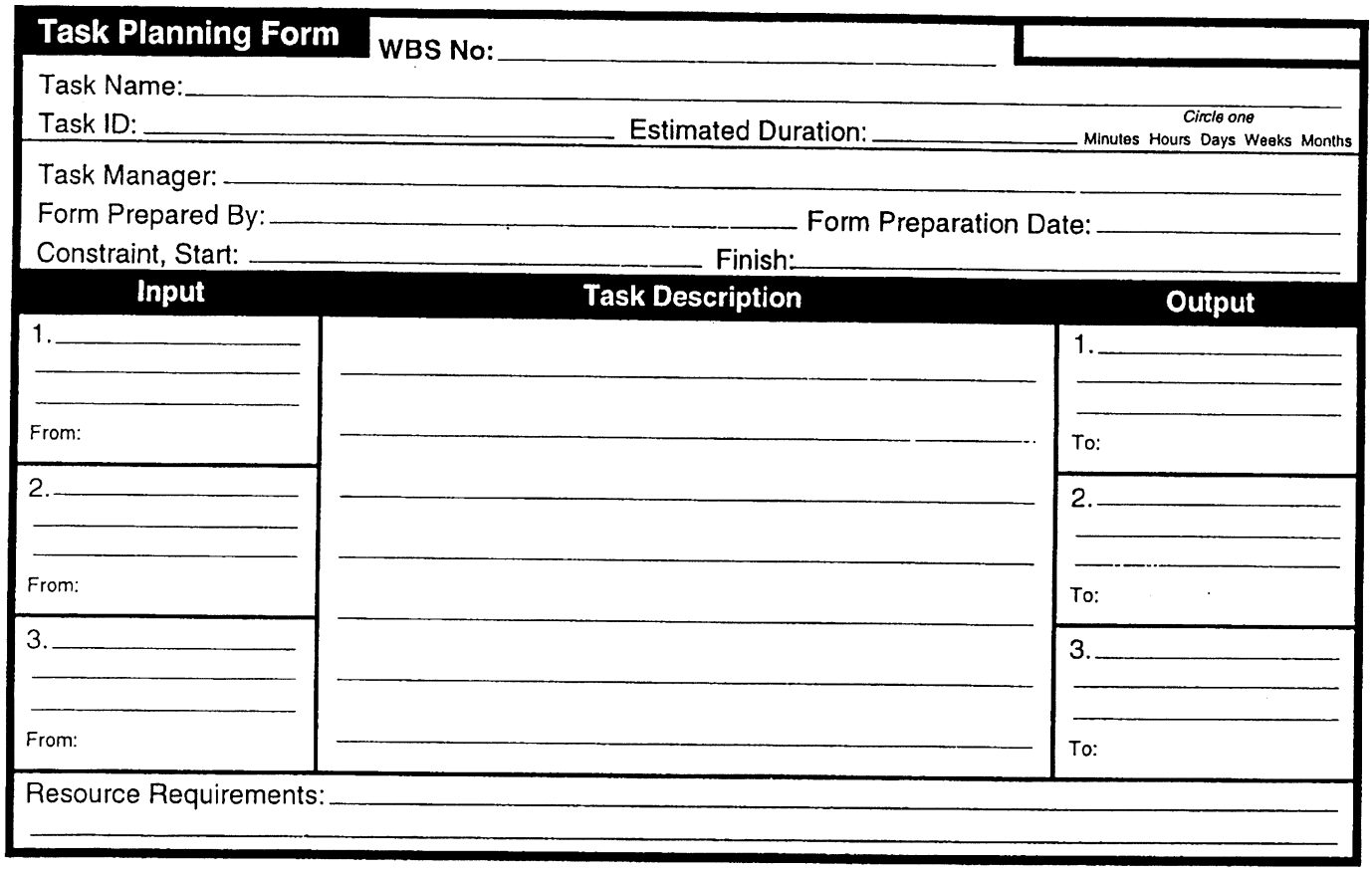

Figure 2. The Task Planning Form.

one or two people can stand around a 19-inch computer monitor and critique planning logic, but the whole team can stand around the 8-foot by 30-foot wall of the planning room and participate in the creation of project logic.

The facilitation model used for planning by CSM involves a multi-step process carried out over a four- to five-day period.

The team gathers, typically the evening before the actual planning begins. For the best planning, the attendees should consist of representatives of all stakeholders: NASA staff, contractors and their subcontractors if the latter groups have already been chosen. Participants should be able to commit their respective organizations in terms of resources to be expended on tasks and risk mitigation actions. It is essential that all involved stakeholder groups be represented during that opening session and throughout the planning session so that critical decisions about tasks, actions, resources, etc., can be made by the group during the planning session and not deferred to players not present during the actual planning. The first session is an opportunity for introductions and for the project manager to brief the group of the current status of the project, get consensus on any deliverables, and review the work breakdown structure and other planning documents that currently exist. The evening overview is essential to ensure a common frame of reference for all participants.

As a conclusion to the evening, the facilitator then presents an overview of the planning process and explains the work to be undertaken in the next few days. One of the most important discussion points is the definition of the agreed-to event that will constitute the terminal event of the planning: launch, delivery to KSC, etc. All participants must understand the deliverables due at this event so that the deliverables, can be defined in the actual planning process. Also explained in this introductory session are the ground rules by which configuration management will be maintained. The essential ingredient in that process is the role of the project manager as the final arbiter of the information to be entered into the computer after posting on the walls of the planning center.

The planning work begins with the development of a product-oriented WBS or the critique of the current WBS if a suitable product-oriented WBS already exists. The planning cards are used to describe the lowest level of the WBS—task work, and any higher level integration/testing/procurement work. In this way, those cards can be used directly in the creation of the logic network.

Once a WBS has been created and approved by the project manager, a milestone spine is created and placed on the walls. This spine consists of the major milestones for the project, as agreed to by all participants. A milestone is a decision point where progress on some portion of the project or with the project as a whole can be reviewed and approved. For each milestone, participants must agree on the products to be reviewed, the name or office of the reviewer with authority to approve or limit progression, and the nature of the proof to be demanded at the milestone of the readiness to proceed with the rest of the project. The milestone spine provides a physical frame of reference for all participants, indicating points on the planning wall where strings of project logic need to come together. It constitutes a top-level picture of the completed logic network.

Once the milestone spine is created, sub-teams are designated to work on the portions of the logic between network milestones.

Now the logic network can be created with the planning cards connected by yarn to create the physical network. Each card contains a description of the work to be done for a given task, the input(s) needed to start the task, the output product(s), the resources required to perform the work, and the amount of resources needed and/or the duration that those resources will be required.

Once the collective effort of the team has created the network and the project manager has "walked the walls" to review and approve all cards and logic, the data is captured in whatever software the team will be using to manage the project logic once they return home. A critical path is calculated and the team as a whole analyzes the results to determine if the derived dates for milestones meet target dates imposed by

users, launch dates, etc. The process of analyzing the network and shortening the critical path begins by identifying the earliest milestone date that the team judges to be unacceptable. Decisions are made to change logical relationships, reduce durations by adding resources, etc., until the derived date is as close as possible to the team's target date. The next milestone in chronological turn is then analyzed, and so on until dates are accepted for all milestones. This process of network analysis produces the baselined schedule against which the team agrees to work.

Throughout the planning process, five additional activities of major importance to the usefulness of the final product are occurring. All acronyms used in the planning process are listed as the start of a common project vocabulary. Any project risks identified during the planning are listed for later analysis and development of mitigation plans. Any assumptions made during the planning process are listed, as are action items taken by specific team members. Finally, team building is an ongoing activity.

Participants in this facilitated process have universally praised it for its value in bringing the team together and making clear to all team members the interdependencies that exist. To quote a few:

> "It brought all of us together . . . It made us think about the work involved, the chain of action, the flow, the team work, the communication."
>
> "[It] forced me to think through all of the functions that I will have to perform."
>
> "[I particularly liked] the schedule resolution with all interested parties present."
>
> "[It] gave me a scope of the program that I did not have before."

As noted above, one end-product of the planning session is a resources-loaded project logic network with the critical path clearly identified. Sufficient time is always allowed to balance the critical path such that the team can see the actions necessary to achieve target milestones. Perhaps more importantly, another end-product is a clear understanding on the part of the entire team of their mutual interdependencies. The process of creating the project logic network and reconciling scheduling problems builds teamwork and ownership from participants to the shared challenges of completing the project according to the schedule they have produced as a team.

Successful facilitation will require that the team be prepared to dedicate four to five days to this process, and all critical team members must plan to be present for the full planning event. The project's deliverables and internal products must be well-defined and a terminal event must be defined or definable. An existing product-oriented WBS is desirable since, in the absence of one agreed to in advance by the team, one must be created during the planning session. The project team must include one person knowledgeable in the use of the planning software to be used to capture the logic network so that a team member can take responsibility for exercising the software when the team returns to its home facility. Teams are also responsible for providing their own copy of the software to be used, a suitable computer, and a high-speed printer or plotter. If the team desires to resource-load the network, an agreed-to list of resources by name or labor category must be provided or definable during the planning event. Any limitations on the use of specific resources (i.e., limited numbers of a specific resources, limited availability of a specific resource, etc.) must also be known at the time of planning.

If the team proposes to use a facility other than the CSM planning facility or one provided by NASA Headquarters, the facility must include at least 120 linear feet of hard-surface walls on which cards and yarn may either be taped or tacked. The planning room must be dedicated to the process so that the logic network can remain up on the wall throughout the full planning session.

Planning is most effective when it is done as the initial event on a project. Planning must also be done at the transition from one project phase to another or whenever the current state of the project is such that the existing plan is no longer valid because of project changes or discovery that the original plan was an inadequate reflection of the actual project.