Section II-2 principles and processes

Our approach to accomplishing Enterprise science goals is founded on a set of fundamental principles that encompass the role of space science within NASA, program planning and structure, project management axioms, our relationship to our scientific stakeholders, the role of technology, our responsibilities to the public, and guidelines for international cooperation. This section presents these principles and then describes our strategic and tactical planning processes.

S

General Principles

Use scientific merit as the primary criterion for program planning and resource commitment. The Space Science Enterprise is first and foremost a science program, among many activities conducted by NASA. The scope of NASA's mission as provided in the Space Act of 1958 ranges from pure knowledge to advancing the state of practical know-how in many areas for the benefit of U.S. industry. In this context, NASA's space science programs also contribute to other national purposes as secondary objectives. The primary means for establishing merit for Enterprise programs are open solicitation and competitive peer review.

Base the Enterprise Strategic Plan on science goals and objectives,

Peer Review

It is Enterprise policy that funding to support research and mission development be allocated by processes that use peer review to establish scientific merit. NASA uses the following uniform, Agencywide definition for peer review:

> *Peer review is a scientific evaluation by an independent in-house specialist, a specialist outside of NASA, or both, of proposals submitted in response to NASA research announcements, announcements of opportunity, and cooperative agreement notices. Peer review is also used to evaluate unsolicited proposals. Peer reviews evaluate relevance to NASA's objectives, intrinsic merit that includes scientific or technical merit of research methods, the researcher's capabilities and qualifications, and cost.*

All selected science investigations must achieve a top rating for peer reviewed science merit. In making final selections, however, other factors besides science merit also have a role. These factors include alignment with Enterprise goals, national and Agency policy, program balance, available budgets, technological readiness, various types of risk, and contributions to education and public outreach.

For the special class of the New Millennium technology flight validation missions, technology considerations provide the primary selection criteria.

and structure its research and flight programs to implement these goals. These plans are developed every three years. Science objectives are set in partnership with the scientific community, and mission formulation is based on these science objectives within policy and budget constraints established by the Administrator, the President's Office of Management and Budget (OMB), and Congress. In planning, the first rule is to complete missions already started, except in the case of insuperable technical or cost obstacles. The Enterprise defines missions via its strategic planning process (generally larger missions) and incorporates missions formulated by the scientific community (e.g., Explorer and Discovery). While recognizing that not all scientific objectives can be attained by small missions, the Enterprise emphasizes the "faster, better, cheaper" paradigm, where appropriate, to accelerate exploitation of new technological and scientific opportunities.

Aggregate consecutive missions that address related science objectives into "mission lines." It is much easier to explain broad science objectives and a program of related missions to Agency stakeholders and the general public than it is to convey the significance of individual missions, which is often much more technical. Further, a stable funding profile for a series of related missions promotes continuity and flexibility in budget and technology planning. In structuring the flight program into mission lines, the first priority is to preserve and extend existing lines. The second priority is to develop and establish new mission lines corresponding to new high priority science objectives. This is done by identifying and advocating compelling pathfinder missions for the new lines.

Preserve safety as NASA's number one priority; this includes mission success for robotic flight projects. Properly implemented, the "faster, better, cheaper" approach does not jeopardize this priority. Projects will not be approved for implementation until a clear technology path to successful implementation is demonstrated. Each Enterprise flight project will maintain reserves appropriate to its level of technical risk, and testing and reviews will be adequate to provide positive engineering assurance of sound imple-

Mission Formulation

Strategic, or *NASA-formulated*, missions are defined by NASA, with guidance from members of the space science community. Science payloads and investigations are then selected competitively by means of peer review in accordance with the principles set forth in NASA's Science Policy Guide. Examples of this category of missions are major space observatories, Mars Exploration Program missions, and Solar Terrestrial Probes.

Community-formulated missions, in contrast, are designed totally by science community-industry teams and selected by NASA through competitive peer review as complete packages. These missions add flexibility, rapid response to new opportunities, and frequent access to space. This category of missions includes the Explorer and Discovery lines.

All selected and implemented missions, whether NASA-formulated or community-formulated, address science goals and objectives in the Enterprise Strategic Plan.

mentation. In the event of project cost growth, reserves will be maintained by reallocation of resources within the project's science theme area, by schedule delays, or by descoping. If these measures are not sufficient, or if the necessary descoping diminishes expected scientific returns below the project's science requirements floor, the mission may be canceled. Resource shortfalls will not be relieved by deviating from proven space system engineering and test practices.

Ensure active participation of the research community outside NASA because it is critical to success. The outside community contributes vitally to strategic and programmatic planning, merit assurance via peer review, mission execution through participation in flight programs, and investigations supported by research grants programs. In addition, NASA science and technology programs conducted at the universities play an important role in maintaining the Nation's academic research infrastructure and in developing the next generation of science and engineering professionals, whether they pursue space research careers of their own or apply their technical skills elsewhere in the economy.

Maintain essential technical capabilities at the NASA Centers. NASA has significant scientific and technological capabilities at its Centers. NASA Center scientists provide enabling support to the broader research community by serving as project scientists and operating unique Center facilities, and compete with external researchers for funding to conduct their own original research. Center staff maintain "corporate memory" for Enterprise programs and provide essential engineering support as well.

Apply new technology aggressively, within the constraints of prudent stewardship of public investment. Research in space science pushes the boundaries of our technical capabilities. The relationship between science and technology continues to be bi-directional: scientific goals define directions for future technology investment and development, while emerging technology expands the frontier of possibilities for scientific investigation (sections I-3 and II-4). To maintain the balance between risk and reward, new technologies are demonstrated wherever possible via validation in flight before incorporation into science missions. This policy is implemented through the New Millennium program, in which technology demonstration is the primary objective and science plays a secondary role.

Share the results and excitement of our programs through the formal education system and public engagement. A fundamental consideration in planning and conducting all of our programs is the recognition that the national investment in space science is a public trust and the public has a right to benefit from our work. To discharge this commitment, we use not only print and electronic news media, but also museum and other exhibits and material for formal pre-college education. To ensure infusion of fresh results from our programs into these educational efforts, our policy is that each flight project must have an education and outreach component. The Enterprise has established a nationwide support infrastructure to coordinate the planning, development, and dissemination of educational material (sections I-4 and II-6).

Structure cooperation with international partners to maximize scientific return within the framework of Enterprise Strategic Plan priorities. The Space Act of 1958 provides that NASA shall cooperate in peaceful space activities with other nations. Today, most of the Enterprise's flight programs have international components (section II-7). In establishing these cooperative relationships, as indeed in all other aspects of our program, funding is allocated to U.S. participants in international programs through competitive peer review. Foreign participants in U.S. missions are likewise selected

on the basis of merit. In general, NASA seeks to lead where possible, and participate with our partners through collaborative roles in other deserving areas.

Strategic Planning

From its beginnings, NASA space science has based its planning on a foundation provided by the National Academy of Sciences. The Academy's Space Studies Board (formerly the Space Science Board) and its committees critically assess the status of various space science disciplines, identify the most promising directions for future research, outline the capabilities required, identify technologies needed to attain those capabilities, and examine the role of each mission in the context of the total space science program. Enterprise science goals, objectives, and missions can all be traced to Academy recommendations.

Synchronized with the triennial revision of the Agency Strategic Plan mandated by the Government Performance and Results Act of 1993 (GPRA), the Enterprise revises its own Strategic Plan at the same interval. In addition to general information about program and planning processes, the Enterprise Plan lays out science goals and science objectives and mission plans for the near- and mid-term. The near-term is a five-year period that starts approximately two fiscal years from the date of issue of the Plan, while the mid-term extends about a decade beyond that. The Enterprise Plan describes near-term missions and how they address science goals and objectives in more detail than it does mid-term missions, which are presented briefly and schematically. Each release of the Plan also presents information about the Enterprise's technology needs and activities and a review of education and public outreach goals and programs.

The Enterprise works with the space science community to develop each Enterprise Strategic Plan. This work is done through NASA-formed advisory committees (the Space Science Advisory Committee and its subcommittees) with assistance from ad hoc planning groups, input from the general science community, and technical support from NASA's Centers. Development of the 2000 Plan illustrates the process.

Work on the 2000 plan began in late 1998, when the Enterprise's Science Board of Directors initiated the development of science and technology roadmaps for each Enterprise science theme (Astronomical Search for Origins, Structure and Evolution of the Universe, Solar System Exploration, and Sun-Earth Connection). These roadmaps—which were developed by roadmapping teams that included scientists, engineers, technologists, educators, and communicators of science—address science goals, strategies for achieving these goals, missions to implement these strategies, technologies to enable these missions, and opportunities for communicating with the public. Each roadmapping team was either built from or overseen by its theme subcommittee of the Space Science Advisory Committee. The teams each held a series of meetings to obtain science priority views from community scientists, hear advocacy presentations for specific missions, examine technology readiness for alternative mission options, and discuss relative science priorities, balance, and optimum activity sequencing in light of this information. One technique used to foster convergence was taking straw polls among team members during successive meetings.

At the end of the roadmapping period, each of the four theme roadmapping activities submitted a summary document outlining science and mission recommendations to the Space Science Advisory Committee and to Enterprise Headquarters management. Enterprise management then combined the mission recommendations of the roadmapping teams into an integrated mission plan, guided by the current OMB five-year budget profile, realistic estimates of most likely future resource availability

beyond that, and additional Agency-level and Administration guidance. Likewise, science goals in the roadmaps were used to examine and restate those presented in the 1997 Enterprise Plan.

An integrated roadmap was presented and discussed at a planning workshop that expanded the membership of the Space Science Advisory Committee with other community members and representatives from the technology and education and public outreach communities. Attendees at the workshop also analyzed and revised the proposed updated science objectives, and derived a new set of shorter-term research activity areas. The resulting consensus mission plan and goals, objectives, and research activities serve as the nucleus for the current Strategic Plan.

A draft of this Plan was provided to the Space Studies Board and its committees for review and feedback, and guidance received was used in finalizing the Plan. The findings and recommendations of the Academy's recently completed ten-year astronomy and astrophysics survey were consulted to assure consistency with the draft Plan. Finally, the Space Science Advisory Committee had an opportunity to review the revised Plan and suggest any final changes before the Plan went to press.

Tactical Planning and Budgeting

Congress appropriates funding to NASA for its programs on a yearly basis. While each Administration-submitted budget provides a five-year profile for the Agency's programs, only the first is implemented each year by Congress. Somewhat more than a year before the beginning of a fiscal year, the Enterprise assembles a detailed budget proposal for submission to the Agency Administrator. Preparation of this budget, while based on the Enterprise Strategic Plan, is also guided by the previous year's budget estimate for the new year, policies and guidance provided by the Administrator and the OMB, and the current budget and technical status of missions in development or operating. Ongoing program balance and technology readiness are also considered. A GPRA performance plan for the same fiscal year is assembled in parallel with the new Enterprise budget request. Twelve months before the beginning of the new fiscal year, both the Agency budget and its GPRA performance plan are submitted to the OMB, and after a period of negotiations and adjustments, the President submits NASA's budget request with those of other Federal agencies to Congress for action.

Government Performance and Results Act of 1993 (GPRA)

This legislation requires each Federal agency to periodically develop and deliver to Congress three documents:

- A strategic plan that presents goals and objectives over a five year period; this plan must be revised at least every three years;
- A yearly performance plan that projects which measurable outcomes that support goals and objectives of the strategic plan will occur during the upcoming fiscal year; the performance plan is to be closely coordinated with the requested budget; and
- A yearly performance report, to be delivered six months after the end of the fiscal year in question, that summarizes the agency's achievements against projections in that fiscal year's performance plan.