**NASA's Decadal Planning Team (DPT) and the NASA Exploration Team (NEXT)**

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ABSTRACT

About a decade ago, NASA leadership chartered the small Decadal Planning Team to create an agency-wide architecture for the 21st Century that would integrate both science and human spaceflight. This was followed by the larger NASA Exploration Team, which during the subsequent two years developed an implementation strategy for the priorities identified by the Decadal Planning Team, including priority joint science and human spaceflight goals, technology investment strategies, engineering designs for major elements of the architecture, and a series of options for extending humans and robots to locations beyond the immediate vicinity of the Earth. The work of the teams, and that of the Space Architect's office which followed, laid the foundation for some key elements of the President's "Vision for Space Exploration" in 2004. In particular, these teams recommended an ambitious and sustained technology program that would enable astronauts and humans to travel "anywhere, anytime." Locations in space were treated as "stepping stones," rather than destinations, whose value was assessed according to their importance in enabling subsequent, more ambitious voyages. Operations in free space, including the ISS and follow-on human-occupied 'gateways' in space – perhaps at libration points – were evaluated as attractive locations for supporting lunar surface operations and preparing for long human voyages beyond the Earth-Moon system. With a book project underway that will shed light on such lesser-known aspects of the "Vision for Space Exploration," major files and summary reports of the pair of NASA teams are being made public.

## Summary History of the DPT and NEXT

Almost exactly a decade ago, in June 1999, the NASA Administrator chartered a small internal NASA task force, the Decadal Planning Team (DPT), to create a new integrated vision and strategy for space exploration. Dan Goldin was determined to break from previous processes used for developing agency strategic plans; thus, he combined both senior scientists and experts in human spaceflight, requesting that they not be bound by the vast numbers of previous agency planning efforts. He intended the results to be available in time for the start of 21st Century in the event that the space agency would be given an opportunity by the White House for a major new initiative. For that reason, the DPT was kept confidential, away from external review – and interference – and reported only to the senior NASA leadership (i.e., Goldin, associate administrator for human spaceflight Joseph Rothenberg, associate administrator for space science Edward Weiler, and a handful of others). That confidentiality has kept the significant effects of the DPT poorly known outside the team's membership. Indeed, none of the small number of articles or books written to date about the creation of President Bush's 2004 "Vision for Space Exploration" (VSE) made any significant mention of the DPT.

The DPT originated via coordination between the NASA Administrator and the Office of Management and Budget senior examiner for NASA, Steve Isakowitz, which produced a modest budget line for “next decade planning” in the FY99 NASA budget. Although this budget line continued for some years – and an occasional story about a “secret” senior NASA planning team occasionally appeared in the space press – almost no notice was taken of the existence of the DPT.

One significant difference between DPT and other senior-level NASA planning efforts was the length of time permitted for the group to develop and explore complex options for the future of science and human spaceflight. From the start, DPT and its successors avoided the agency’s popular “90-day study”-style of long-range planning.

The efforts of the Decadal Planning Team evolved after about a year into the Agency-wide team known as the NASA Exploration Team (NEXT). NEXT established a cross-enterprise, cross-Center systems engineering team with emphasis focused on revolutionary, as opposed to evolutionary, approaches. This confidential team was instructed to develop technology roadmaps that would enable science- and discovery-driven human and robotic exploration. Again, the goal of NASA leadership for this follow-on activity was to keep its visibility low and its effect on NASA’s future high.

Previous (and subsequent) human spaceflight planning efforts had concentrated typically on one of two destinations: the Moon or Mars; in other words, they were “destination-driven.” In contrast, DPT and NEXT architectures were all “discovery driven”; that is, these teams advocated the development of a handful of essential technologies that would permit humans and robotic spacecraft to travel to any priority locations that were identified by their discovery, science, or commercial potential. The DPT and NEXT teams adopted the slogan "Go Anywhere, Anytime" that would be made possible by conquering the hurdles of space transportation, crew health and safety, human/robotic partnerships, affordable abundant power, and advanced space systems performance. Specific destinations in the DPT/NEXT architectures were used as “stepping stones” in the teams’ parlance. Each location was assessed for its intrinsic value, but <u>also</u> its value to enable increasingly ambitious human and robot exploration to additional destinations. None of the destinations was intended to be a final goal and all were to be considered part of an expanding human and robotic presence throughout the Solar System.

During the DPT and NEXT studies, several architectures were analyzed, including missions to the lunar surface, near-Earth objects (NEOs), Sun-Earth and Earth-Sun libration points, Mars (via both short and long stays), and the ISS. For each architecture, each destination was assessed for its value to the other possible locations for human spaceflight: the “stepping stone” philosophy that DPT introduced into NASA’s planning processes. These multiple, alternative architectures in turn led to identifying the key technologies that would be necessary to achieve the largest number of goals. Thus, priority technologies advocated by DPT and NEXT were not determined by a single destination, as had been the case with previous NASA strategic plans, but rather optimized by enabling <u>multiple</u> destinations. For example, human life-support system

technologies were identified that would permit operation in both zero-g (e.g., NEOs) as well as reduced-g venues (e.g., Moon, Mars), rather than exclusively in one or the other. Space propulsion technologies were recommended that would permit reduced travel times to the most challenging destinations (i.e., Mars, NEOs), but would be developed and demonstrated in missions within the neighborhood of the Earth (i.e., Moon, libration points).

Given the long durations required for the most challenging human missions, the DPT/NEXT recommended more intensive and relevant use of the ISS than was popular at that time, both inside and outside NASA. The ISS was a key "stepping stone" into deep space for humans in the DPT/NEXT, which a decade ago recommended investing early in those capabilities that would permit human travel "anywhere, anytime." Furthermore, the DPT/NEXT assessed options for subsequent human-occupied stations – "Gateways," in the parlance of these teams – that would follow and build upon experience gained with ISS. Such Gateways would serve both as operational sites, for example for upgrading and maintaining large in-space science facilities, at the same time as they were sites for developing subsequent generations of technologies for more ambitious human exploration: again, another "stepping stone."

After three years, the DPT and NEXT activities led directly into the studies and priorities developed by the newly created Space Architect office at NASA Headquarters and then to the President's "Vision for Space Exploration." Three new agency technology initiatives were begun in response to DPT/NEXT recommendations: the nuclear systems initiative (later renamed, the Prometheus Program), an in-space propulsion development program (e.g., electric propulsion of various types), and augmentations to biomedical investments. [All three were terminated a few years later, as NASA's strategic priorities changed under new NASA leadership.] Many key programmatic recommendations from DPT/NEXT/Space Architect were part of NASA's contributions to the late-2003 process that produced the VSE: using destinations as "stepping stones" rather than final goals, prioritization of key technologies necessary to achieve human travel to multiple venues, combining scientific and human spaceflight goals, and the "One NASA" philosophy of former Administrator Sean O'Keefe. Moreover, several of the original members of DPT/NEXT activities remained for a time at NASA Headquarters and were in a position to share the results of internal deliberations that were not until now made public. Furthermore, many of the recommendations and some of the personnel from DPT/NEXT were acquired by the NASA Space Architect before that position was terminated in 2005. Finally, the DPT/NEXT/Space Architect studies, priorities, and recommendations were made available to the NASA Exploration Systems Architecture Study (ESAS) in 2005, although that latter group adopted an alternative process and philosophy about the role of human spaceflight and science.

Formal History of the "Vision for Space Exploration"

Now, close to the tenth anniversary of the initiation of one of NASA's most influential planning activities, co-authors Steve Garber and Glen Asner are preparing a history of DPT and the policy formulation of the VSE. Among much else, this history will put to

rest a number of commonly held myths about the VSE, including the oft-cited views that the VSE was nearly *ad hoc*, created with relatively little background work (especially from NASA), had no input from the science community, considered relatively few alternative architectures, and had little impact beyond the small circle of individuals involved.

As part of this formal history, significant reports, assessments, and studies from the DPT are for the first time being made publicly available. The reports and assessments compiled here have been reviewed for release by the NASA Goddard Space Flight Center Office of General Counsel and Export Control Office. They are being used as primary source material for the VSE history and, as such, should be considered part of the record made available to the general public.

## Organization of the Files

The files made available here are primarily annual reports, final summaries of assessment studies, and engineering designs for major elements of the architectures that DPT/NEXT developed. The names of many of the files have been changed to be self-explanatory. However, no changes have been made to the content of the files.

### *File: Annual Reports and Summaries*

Three annual reports are included: CY00, FY01, and FY02. The files are structured differently and cover overlapping material as they were produced under different senior management with different reporting requirements. As the engineering and trade studies increased in sophistication as time passed, so did the number of substantive topics (i.e., chapters in the final report in FY02 and an overview of priority recommendations and key 'talking points').

One additional report is included: the report of the National Research Council, "Stepping Stones to the Future of Space Exploration." This was produced in 2004, shortly after the "Vision for Space Exploration" was presented by the White House and continues key recommendations of DPT/NEXT. (The chair of the NRC panel was an original member of DPT.)

### *File: Architecture/Design Reference Missions*

DPT and NEXT developed alternative architectures, in general based on the teams' philosophies of treating destinations as "stepping stones" to other locations and developing technology capabilities that would permit human spaceflight to "anywhere, anytime."

The Mars mission analysis summary describes two options: a "short-stay" and a "long-stay" concept, and the technologies necessary to achieve them. DPT and NEXT were NASA's first extended planning team to examine using Sun-Earth and Earth-Moon

libration points as staging areas – again, "stepping stones" – to achieve multiple goals while simultaneously preparing for more extended human exploration beyond the Earth's neighborhood. Because lunar surface human exploration had been studied extensively (and accomplished a few decades earlier), DPT/NEXT examined how libration points could be used to support lunar exploration. The teams explored the concept of a "gateway," a human-occupied E-M L1 station from which sorties to the lunar surface would be staged, as well as demonstrations of key capabilities necessary for the human voyages to Mars.

*File: Human Exploration*

One of the handful of highest investment priorities that DPT/NEXT identified was systems and subsystems necessary for extended astronaut operations in space. This file identifies major challenges and an investment path to retire risk in human spaceflight.

*File: Images/Animations of Concepts*

Major concepts identified by DPT/NEXT were supported for increasingly sophisticated engineering designs, costing, and technology priorities. The teams agreed early in the process that major elements of the architectures should be illustrated. This file includes several of the illustrations, animations, and graphics that were produced in coordination with DPT/NEXT. Most of this material is the product for NASA of John Frassanito & Associates (http://www.frassanito.com).

*File: Management/Rules*

DPT/NEXT received extensive guidance and additional direction over the three years of their existence. The most complete available set of ground rules still available were those created for DPT near the end of FY99.

*File: Science and Exploration*

An essential goal of DPT/NEXT was to explore in depth how NASA science and human spaceflight goals may be simultaneous and complementary priorities for the agency. That is, how major scientific goals might be used to determine how to use most appropriately astronauts (and robots). Similarly, how astronauts might most effectively be used to achieve major science goals. Neither human spaceflight nor scientific discovery was considered by the two teams to have great priority for NASA over the other. This file compiles a trio of science priorities that the teams developed that were considered to be sufficient motivation to involve astronauts to achieve many of them. Most of these science priorities were developed from existing NASA documents and recommendations from the National Academy of Sciences/National Research Council reports to NASA.

*File: Technology Priorities, Recommendations*

Over the three years of DPT/NEXT activities, by far the highest priority recommendation of the teams to NASA leadership and the White House Office of Management and Budget (OMB) was to invest in a modest number of key technologies that would enable astronauts to travel "anywhere, anytime" using destination "stepping stones." This file includes major reports on recommended future capabilities that DPT/NEXT concluded were necessary for humans to be able to travel beyond the neighborhood of the Earth.

These recommendations produced three funded technology initiatives for NASA: (1) nuclear systems (later renamed, Prometheus), (2) in-space propulsion technologies, and (3) an augmentation to biomedical investments for crew health and safety.

## CREDITS AND ADDITIONAL INFORMATION

The formal history of the "Vision for Space Exploration" is being written under the auspices of the NASA Headquarters History Division by Stephen Garber and Glen Asner

The material in these files are the product of NASA's Decadal Planning Team (DPT) and NASA Exploration Team (NEXT) and have been reviewed for public release by the NASA Goddard Space Flight Center Office of Chief Counsel and Export Control Office.

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Reference to the files in this collection should be "TITLE OF FILE, Product of the NASA Decade Planning Team/NASA Exploration Team, DATE OF FILE."