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The Impact of NASA and the STG on History

16.1 ORGANIZATIONAL EXCELLENCE

In retrospect, it is difficult to believe the level of excellence that was evident in many federal government organizations in the years 1957–1961. Of course, an organization is made up of people, and there couldn't have been a better group to start the space program. These people were exceptional. Here is an example by organizational area.

16.1.1 President and Congress

President Eisenhower's response to the launch of Sputnik on October 4, 1957 was to control the narrative and to control the civilian space program's future. His direction was specific and, by today's standards, both rapid and effectual. His vision and leadership after the Soviet challenge provided clarity of purpose to those wondering how to respond to Sputnik, which was perceived more as a threat to national security than a scientific satellite. But Eisenhower knew the Soviets well. He had already responded on the military front with ICBM and IRBM developments, and he was now prepared to respond on the civilian front. On November 21, 1957 he organized the President's Scientific Advisory Committee (PSAC), named James R. Killian, Jr. of MIT as the chairman of an 18 member committee, and relocated the committee to the White House. It was Harvard physicist James B. Fisk who led one subcommittee which included NACA Chairman General James H. Doolittle and which, with input from NACA's Director Hugh L. Dryden and Associate Director of NACA's Lewis Flight Propulsion Laboratory Abraham Silverstein, along with others, proposed a comprehensive national program in astronautics, emphasizing peaceful, civilian-run research and development. These recommendations were acted upon by others, but these men were the driving force and carried the load through Congress. See Chapter 3.

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It is hard to believe the speed with which others acted to implement the plan for a civilian space program. The Bureau of the Budget responded to Eisenhower on March 5, 1958, and he approved the plan on March 25, just five months after Sputnik. On April 14 Eisenhower sent a Bill to create the new agency to the 85th Congress. House and Senate special committees held hearings on it in May. The House passed it on June 2 and then the Senate did likewise on June 26. Eisenhower signed the National Aeronautics and Space Act on July 29 and NASA became effective on October 1. Now that's how things were done in Washington in 1958!

Only a few years later, in 1961, John F. Kennedy, a new President with vision and leadership qualities, initiated the Apollo program when this country had yet to put a man in orbit. His Vice President, Lyndon B. Johnson became Chairman of the National Aeronautics Space Council and was instrumental in getting NASA's budget through Congress.

16.1.2 NACA and NASA

With the creation of the National Aeronautics and Space Administration (NASA), the National Advisory Committee on Aeronautics (NACA) ceased to exist. The first NASA Administrator, T. Keith Glennan, made sweeping changes. The existing three NACA laboratories and their test facilities were renamed as NASA research centers and given a new focus. Other space related organizations were incorporated. Parts of the Naval Research Laboratory were brought into the newly created Goddard Space Flight Center. Some of the DOD and ARPA satellite programs and lunar probes were transferred to the Jet Propulsion Laboratory, which was run by the California Institute of Technology. Glennan also transferred the Army Ballistic Missile Agency to the new Marshall Space Flight Center.

The new NASA leadership in 1958 for the space program included:

- NASA Headquarters
  T. Keith Glennan, Administrator
  Hugh L. Dryden, Deputy Administrator
  Abe Silverstein, Director of Space Flight Programs
- Langley Research Center
  Henry J. E. Reid, Director
  Floyd L. Thompson, Deputy Director
  Robert R. Gilruth, Director of the STG and Project Mercury
- Lewis Research Center
  Dr. Edward R. Sharp, Director
- Ames Research Center
  Smith J. DeFrance, Director
- Marshall Space Flight Center
  Dr. Wernher von Braun, Director
- Goddard Space Flight Center (1959)
  Harry J. Goett, Director.

16.2 MERCURY MISSION ACCOMPLISHED

The concept of the manned space mission was being studied by NACA long before NASA was created on October 1, 1958. The STG was formed soon thereafter to undertake Project Mercury. The word "Mercury" was first proposed by Abe Silverstein during the fall of 1958. There were many other suggestions but the Olympian messenger was familiar to Americans and finally, on November 26, 1958, it was approved by Administrator Glennan.

From the inception of Project Mercury to its declared conclusion with the launch on May 15, 1963 of Gordon Cooper's MA-9 was barely 4 years and 8 months!

There were only three project objectives:

- To place a manned spacecraft in orbital flight around the Earth.
- To investigate man's performance capabilities and his ability to function in the environment of space.
- To recovery the man and spacecraft safely.

There were only four guidelines to achieve those three straightforward objectives:

- Existing technology and off-the-shelf equipment should be used wherever practical.
- The simplest and most reliable approach to system design would be followed.
- An existing launch vehicle would place the spacecraft into orbit.
- A progressive and logical test program would be employed.

Of course ever more detail followed, but fundamentally the project had three objectives and four guidelines!

In early 1959 a complete flight schedule for the capsule and launch vehicles was drawn up, including development, qualification, ballistic, and orbital flights. There were 25 major flight tests, including eleven additional flights made in response to lessons learned on earlier flights. There were only six manned flights; two suborbital and four orbital. One could consider John Glenn's flight to have achieved the three objectives, but the remaining flights drove home the lesson that man was able to cope with all the previous concerns and was an integral part of the spacecraft system. The additional flights also honed the management, engineering, operations, science, and medical skills of the entire team. NASA was clearly ready to carry out President Kennedy's visionary challenge.

16.3 FUTURE PROGRAMS

The writing of this book was essentially completed in October 2015, exactly 57 years after the start of the American space program in 1958. In that time, there have been several generations of launch vehicles and spacecraft. We've been to the Moon, but it has been over 40 years since humans have been that far into space. And the Moon isn't really all that far away. Humans are driven to explore; it is our nature. The spinoff from that urge to explore has changed the world. Always remember, it was the NASA STG that paved the way for the American space program. So, where are we going now?

NASA's plans are laid out for the future and include the development of the necessary tools and technologies to enable us to return to the vicinity of the Moon and even to Mars. But there are things that must be done first, because we aren't currently capable of achieving these goals with humans. This year was the 50th anniversary of the flyby of the Mariner 4 probe that began our exploration of Mars. Follow-on flyby probes, orbiters, and landers have taught us a lot, but we will need to learn a great deal more in the coming decades before we will be able to attempt to send a crew to Mars.

Today, the International Space Station (ISS) is yielding answers to some of the fundamental science, technology, and life support questions, and NASA has several programs and projects to build up our capabilities for deep space travel, including:

- Commercial Crew Program to develop the space transportation capability for safe, reliable and cost effective access to and from the ISS. This includes the Space Launch System and the Orion spacecraft.
- The Asteroid Initiative that includes both the Asteroid Redirect Mission and the Asteroid Grand Challenge. It includes the development and use of a Solar Electric Propulsion (SEP) system and a vehicle to capture an asteroid and redirect it to a location in the vicinity of the Moon, where it will be accessible to a crew flying an SLS/Orion mission. NASA estimates these missions will occur in the 2020s.
- Although NASA doesn't yet have a fully defined Mars program, it is planning to develop the technologies necessary for such a mission. These will include radiation shielding and mitigation techniques, advanced life support systems, advanced pressure suits, advanced propulsion systems, a Mars landing system, plus crew habitats for the 6–9 month cruise to Mars and a month on the surface of the planet before the long haul back to Earth. NASA is committing only to the 2030s. As yet, no one is brave enough to make a prediction such as "before this decade is out…"

NASA has created a series of videos that describe many of the above mentioned programs, projects, and technologies for the journey to Mars. These can be found at: http://www.nasa.gov/topics/journeytomars/videos/index.html.

The Orion Multi-Purpose Crew Vehicle (MPCV) has been designed and built by Lockheed Martin, but it isn't capable of going any great distances without a service/habitat module. The European Space Agency will provide the Orion service module, developed by Airbus Defense and Space. The first unmanned orbital test flight of an Orion capsule occurred on December 5, 2014, using a Delta IV launch vehicle; you can watch that launch on YouTube. There are plans to launch an unmanned Orion on a Block 1 Space Launch System into a circumlunar trajectory on or about September-November 2018 as Exploration Mission-1. The first manned mission is scheduled for 2021 and it will fly in lunar orbit. The flight to a captured asteroid is planned for 2026. These longer duration missions will require a deep space habitat module and a logistics module to support a crew of four. The modules will be built in three variants, depending on the requirements of the missions. Further information is available at www.nasaspaceflight.com.

These new launch vehicles will be state-of-the art in terms of technology, but will be built on the experience of past missions. The Block 1 will have about 10% more thrust at liftoff than the Saturn V that sent Apollo to the Moon. It will be able to place 154,000 lbs.

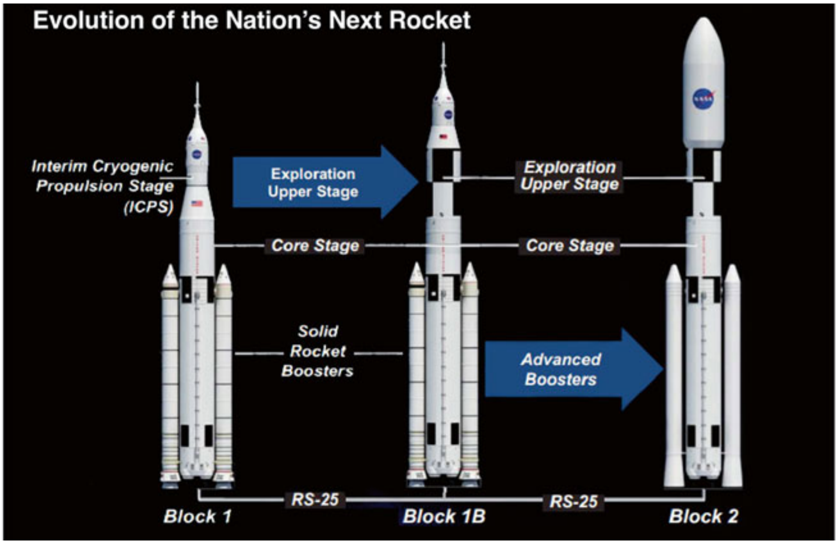

Fig. 16.1 The Space Launch System vehicles. (Photo courtesy of NASA)

Fig. 16.2 The Orion attached to the Service Module and booster upper stage. (Artist concept courtesy of NASA)

into low Earth orbit. The Block 2 will have 20% more thrust and carry a payload of 286,000 lbs. They will both use advanced solid rocket boosters, and advanced RS-25 engines similar to the main engines of the Space Shuttle.

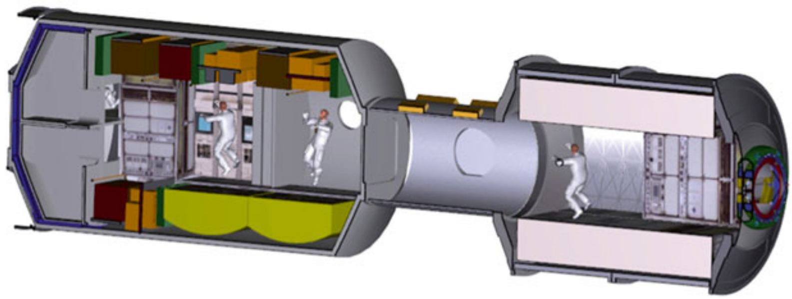

Fig. 16.3 The ISS derived concept for a deep space habitat module. (Artist concept courtesy of NASA)

I predict that if technologies related to long duration habitat modules, extended life support systems, radiation protection and mitigation, and advanced pressure suits all progress at a faster pace than currently envisaged, there will be considerable thought given to a mission to Phobos, the larger of the two Martian moons. It would most likely involve a rendezvous and perhaps a remote soil sampling operation, although a landing on such a small body would be feasible. It would be far more exciting than an asteroid mission, engender more public and Congressional support, provide valuable scientific results, and demonstrate a lot of Mars mission technology. Depending on when that mission decision is undertaken, it may be possible for the mission to occur by 2028. I also predict that the first manned landing on either Phobos or Mars will occur on or about March 30, 2036! That of course is just my dream to have the landing on my 100th birthday. When you consider this Nation's great debt and the fact that 66% of our GDP goes to pay off this debt and the out-of-control entitlement programs, with Defense consuming another 17%, there is precious little left for all the other programs, let alone space exploration. Perhaps 2050 or later is more realistic date for a Mars mission.

In the meantime, the Russian Soyuz will continue to ferry astronauts to the ISS. It has gone through many generations since its introduction in the 1960s and the current version is state-of-the-art. This is reflected by the fact that the Chinese and the Indian designs borrow much from the latest Soyuz design. The Soviets lost four cosmonauts on two missions in the early days but the current Soyuz is considered to be safe and cost-effective.

The first Chinese manned mission occurred on October 15, 2003 and they have launched five crews to date. They have evolved their Shenzhou (Divine Vessel) version of the Soyuz design as well as their Tiangon (Heavenly Palace) laboratory design and the Tianzhou (Heavenly Vessel) cargo craft. They hope to man their 60 ton space station in the 2020–2022 timeframe. They also have ambitions for lunar flights. They soft-landed a robotic craft on the Moon on December 14, 2013 that deployed a rover. In the longer term, they have plans for a human landing on Mars in the 2040–2050 timeframe.

The Indian space program has been successful with unmanned satellites, including launching 10 simultaneously, and on September 24, 2014 it inserted a probe into orbit around Mars on its first try. It hopes to launch a human into orbit in 2017.

The Japanese manned space program is primarily linked to the ISS. It doesn't currently have plans to develop its own spacecraft, but they have tentative plans to send a robot to the Moon.

16.4 TECHNOLOGY TRANSFER

The National Aeronautics and Space Act of 1958 that created NASA called for the new agency to disseminate its technology for public benefit. While the average person today doesn't give it much thought, the technology "spinoffs" from the space program are now part of everyday life, not only in the U.S. but nearly everywhere, including the Third World. Initially, the public had the wrong impression about what NASA provided society. Myths about NASA's contributions abound, even today. NASA did NOT invent Tang, Velcro, barcodes, smoke detectors, and the MRI. They did much, much more than that.

The Space Act obliged NASA to make the widest practicable and appropriate dissemination of its results to the public. Whilst the agency was too busy during the formative days of Project Mercury to devote much effort to this task, it began to do so immediately afterwards. In 1962 it created the Industrial Applications Program. This evolved into the current Technology Transfer Program, designed to carry out the responsibilities of sharing NASA's research with the public. Over the past 50 years there have been at least 13 major laws and executive orders designed to enhance the legal authority of NASA to facilitate the transfer of its technologies to industry and the public.

As technology spinoffs emerged in the Apollo era NASA started to send reports to Congress to demonstrate the results of its Industrial Applications Program. It followed up with its annual *Spinoff* publication.

Today, Technology Transfer is a major NASA effort at Headquarters and at each of its field centers. It covers the following areas:

- Health and Medicine
- Transportation
- Public Safety
- Consumer Goods
- Energy and Environment
- Information Technology
- Industrial Productivity.

In the Project Mercury era it would have been impossible to predict the future benefits of the space program to society. There were people then, as there are now, who expect a prediction of the benefits from spending national treasure on the "harebrained scheme" of space travel. Even the spinoffs from the current Mars rovers have resulted in software imaging technology that can detect heart disease earlier than was previously feasible. One trip to a hospital emergency room will open your eyes to space age spinoffs. There are books elaborating thousands of spinoffs.

NASA is tapping into the imagination of American youth to see what they envisage for the world by sponsoring essay contests. The Technology Transfer Program is the responsibility of the NASA Office of the Chief Technologist. For more information see http://spinoff.nasa.gov and http://technology.nasa.gov.

16.5 NATIONAL PRIDE

Why do a million people crowd the roads to Cape Canaveral to see a rocket launch? Why do a million people watch astronauts parade down New York's Canyon of Heroes? Although there may be some who do so on the off-chance of seeing a rocket blow up, most are there to join in the celebration of a human being going into space. They celebrate because they are proud of the astronaut, the team, and their country. Why do people remember where they were and who they were with when Armstrong and Aldrin walked on the Moon? For sure American pride is part of the celebration. Americans, Russians, Chinese, and Europeans all have an emotional attachment to their astronauts, cosmonauts, taikonauts and spationauts; it's a matter of national pride.

The success of a "ticker-tape" parade in New York is officially measured by the Department of Sanitation that has to clean up the mess. John Glenn's parade generated 3,474 tons of paper, making it the largest parade clean up since V-J Day. No parade since has broken this record; for many reasons. Nobody uses "ticker-tape" anymore and with more televisions in homes, people watch the parade there rather than stay at work in New York; or worse, commute into the city. Also, some the windows of some modern office buildings don't open because they have closed air conditioning systems.

Fig. 16.4 John Glenn's parade down the Canyon of Heroes. (Photo courtesy of Wikipedia)

Project Mercury certainly instilled pride in America. After half a century, flying in space is commonplace. Indeed, the ISS has been permanently occupied since the turn of the century and most members of the public don't know the names of the astronauts. Although people are more blasé now, they're still very proud of the astronauts and of NASA, which is probably the most respected of all the government agencies.

16.6 GENERATIONAL IMPACT

There are many definitions of a "generation" but for this discussion let's assume it is 25 years; the reasonable time for one generation to have offspring. If we start in 1958, the beginning of NASA and Project Mercury, here are just a few of the things which spaceflight has brought to the future in exploration and technology:

- 1958 + 25 = 1983 (1 generation):
  Lunar landing, Viking on Mars, Space Shuttle, PCs
- 1983 + 25 = 2008 (2 generations):
  Internet, Hubble, Windows XP, iPhone, GPS, ISS
- 2008 + 25 = 2033 (3 generations):
  Mars robots, Pluto, robotic surgery, new materials
- 2033 + 25 = 2058 (4 generations):
  World Peace? World Destruction? More of the same? How about a crew on Mars?

The space program instilled wonder and excitement into people all around the world. "If we can do that; we can do anything" became the positive "can do" spirit. "It's not rocket science" became the comment for when we thought we couldn't do something, meaning it couldn't be as difficult as going to the Moon. But alas, there are things that do seem impossible, like balancing the budget, or getting Congress to agree on societal, energy, and economic solutions. However, when it comes to science, we have accomplished much because science is truth; uncorrupted by human frailties, except for those who have warped their data to assure the continued funding for their research. The advancement of science drives the technologies that improve our lives and advanced technologies drive exploration. Science has not only improved our lives, but has also increased our life spans. The fact that we are living longer than previous generations becomes a problem for governments whose planning was based on the promise to pay social security to an increasingly aging population. How do you modify a promise?

NASA routinely informs the public, businesses, and industries of the many "spinoffs" from the space program. These have occurred in almost every field. In many cases you can actually see it if you look. Next time you go to the hospital, look at all the bioinstrumentation, sensors, telemetry, emergency room equipment and monitors. And then add in the space age spinoff of microelectronics in phones and computers. Add to that the advances in medicines, and it is no wonder we are living longer. The impact of these advances also makes us accept them without question. We have come to expect, indeed almost demand technological advances. Just look at the youngsters standing in line to buy the latest phone! In contrast, my generation is inclined to be satisfied with their old phones, in some cases still of the type which plugs into the wall by a cable.

NASA set up an organization called the Space Technology Mission Directorate (STMD) to develop the crosscutting, pioneering, new technologies and capabilities required to achieve its current and future missions. This work takes place in all the NASA centers, academia, industry, and both U.S. and international partnerships. The program seeks to identify and rapidly mature innovative and high impact capabilities and technologies. By stimulating breakthroughs, these programs and activities could transform future missions. Because many of the research results have non-space applications as well, there are many cross applications to technology.

Although many of us would like to see humans exploring the Red Planet, the stay-at-homes on the Blue Planet may be having our own problems by 2050, if not actually earlier. The world population in 1958 was about 2.8 billion people. One estimate by the United Nations for 2050 is 9.3 billion. That's a lot of people to feed, clothe and shelter. But space age technology spinoff is helping farmers to be more productive even today.

In summary, there is no question that Project Mercury had a positive and long lasting impact on American society that has been felt for generations. While the Atlas and the Mercury capsule are primitive by today's standards, one could think of them as the Model T's. And although the STG people who started it all are now old or gone, they have inspired at least two generations of space workers. Hopefully, the spark of imagination for youngsters will keep the space program going; be it manned or unmanned spaceflight. I fear that I will never live to see humans walking on Mars, but you might!