“La Storia dell’Esplorazione Spaziale”

Introduzione al libro “Spacecraft: 100 Iconic Rockets, Shuttles, and Satellites That Put Us in Space

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Corso di Costruzioni e Strutture Aerospaziali – A.A. 2019/20
Prof. F. S. Marulo

Biografie

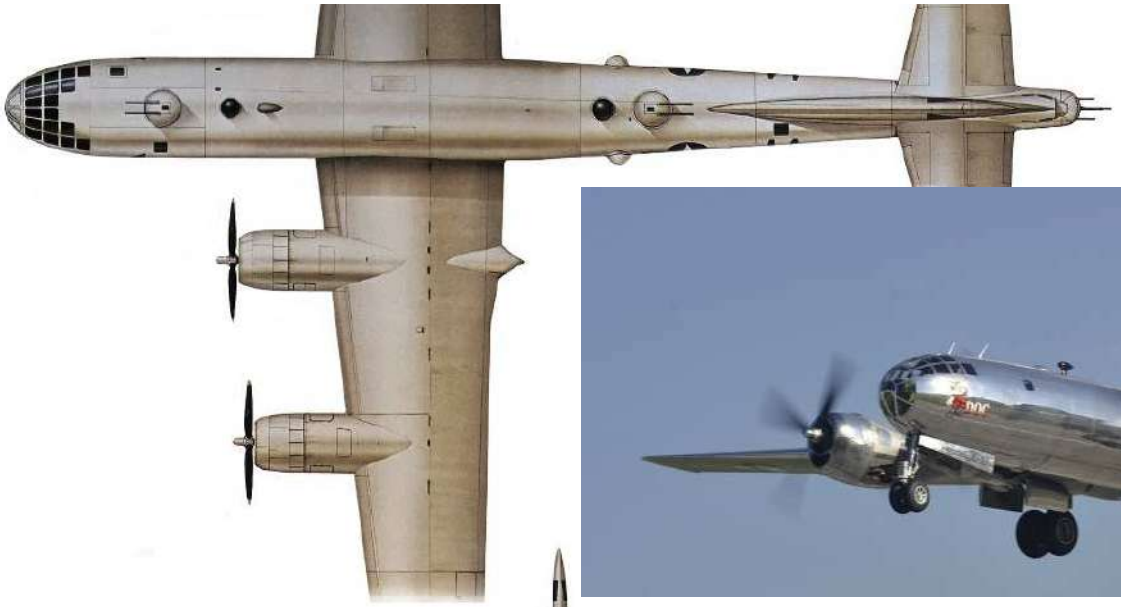
Giuseppe De Chiara è nato a Napoli nel 1968, ha conseguito una laurea in Architettura (con tesi in progettazione spaziale) ed opera nel settore aerospaziale dal 1998, prima presso il MARS Center ed attualmente presso Telespazio (società Leonardo/Thales) come System Engineer. In precedenza ha lavorato nel campo della progettazione di esperimenti in microgravità, supporto all'addestramento scientifico degli astronauti e come Operation Leader per payload a bordo della ISS. Dal 2003 ha avviato una seconda carriera di illustratore aerospaziale.

Michael H. Gorn è nato in California nel 1950, ha conseguito una laurea in Storia Americana e successivamente il Ph.D. ed ha lavorato per 30 anni come storico prima presso la U.S. Air Force a Washington, poi presso il NASA Dryden Flight Research Center (ora Armstrong) in California come Chief Historian. Gorn ha al suo attivo svariati libri di storia aerospaziali e decine di pubblicazioni specialistiche. Attualmente è in pensione e si è dedicato interamente alla scrittura, risiede nella contea di Thousands Oaks in California.

Premessa

- L'incontro di oggi ha lo scopo di presentare il volume Spacecraft edito dalla Voyageur Press (come parte del gruppo Quarto Publishing U.S. di Minneapolis)
- Spacecraft si propone di essere un compendio di storia, tecnologia e configurazione di veicoli spaziali, rappresentando un'inedita novità nel panorama delle pubblicazioni aerospaziali
- Spacecraft riassume in 100 schede sicuramente non tutti ma senz'altro i principali veicoli spaziali abitati e non degli ultimi 50 anni
- Spacecraft è indirizzato ad un vasto pubblico di specialisti, modellisti, appassionati o semplici curiosi.

L’illustrazione aeronautica vs. quella spaziale (1/8)



Disegno di Keith Fretwell

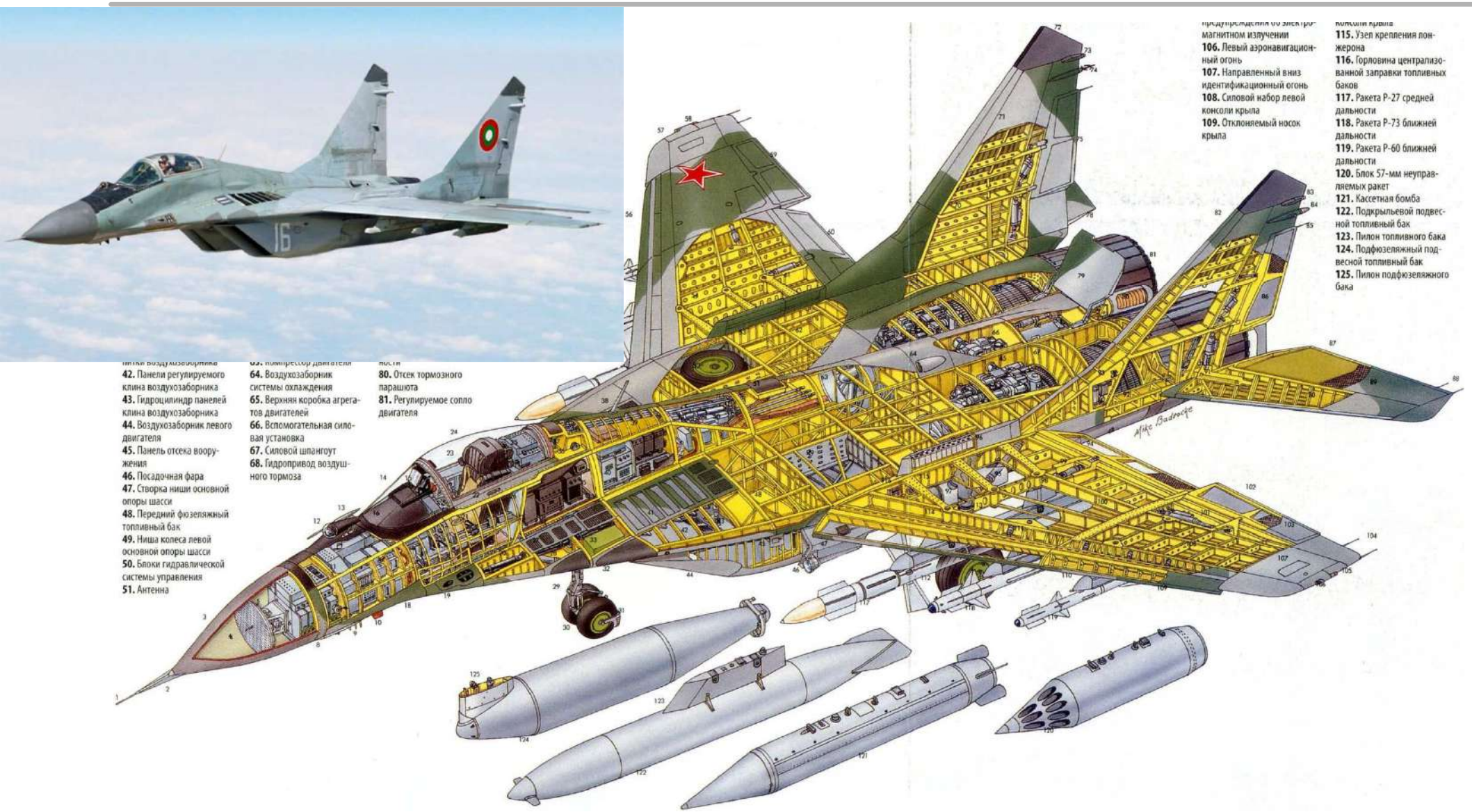
L’illustrazione aeronautica vs. quella spaziale (2/8)

Disegno Kitty Hawk Models

L’illustrazione aeronautica vs. quella spaziale (3/8)

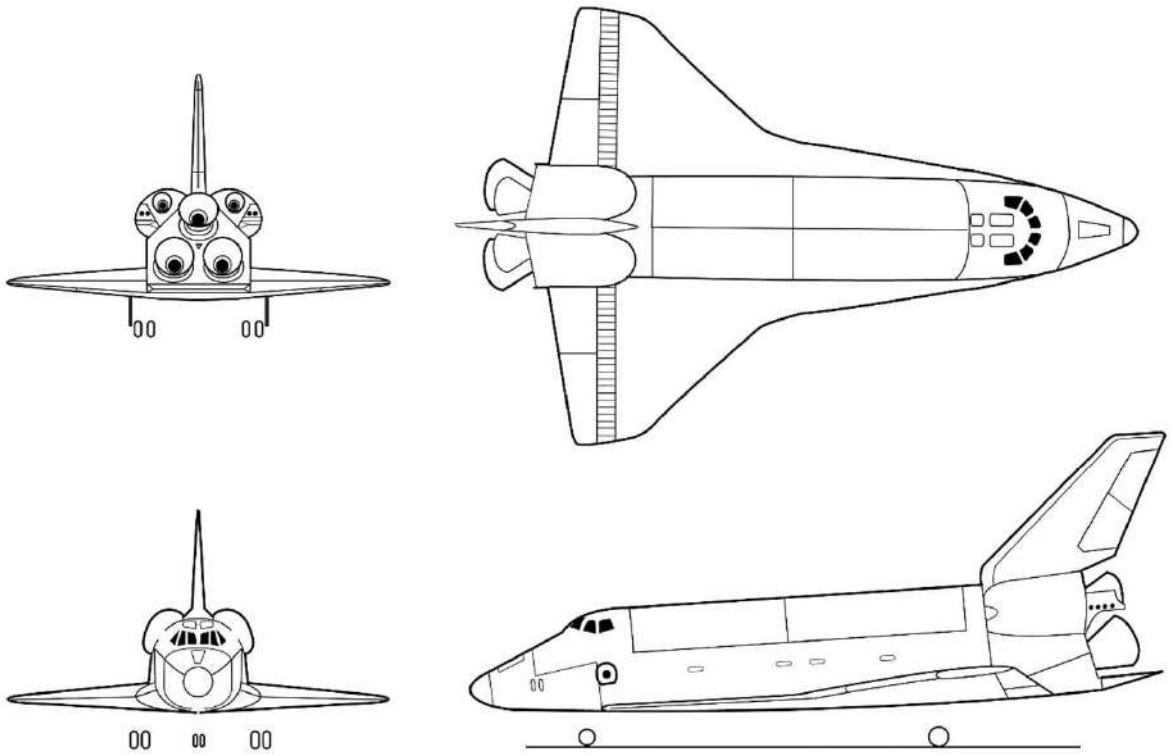
Disegno di Michele Marsan

L’illustrazione aeronautica vs. quella spaziale (4/8)



Disegno di Mike Bradocke

L’illustrazione aeronautica vs. quella spaziale (5/8)



Dryden Flight Research Center March 1998
Space Shuttle 3-view

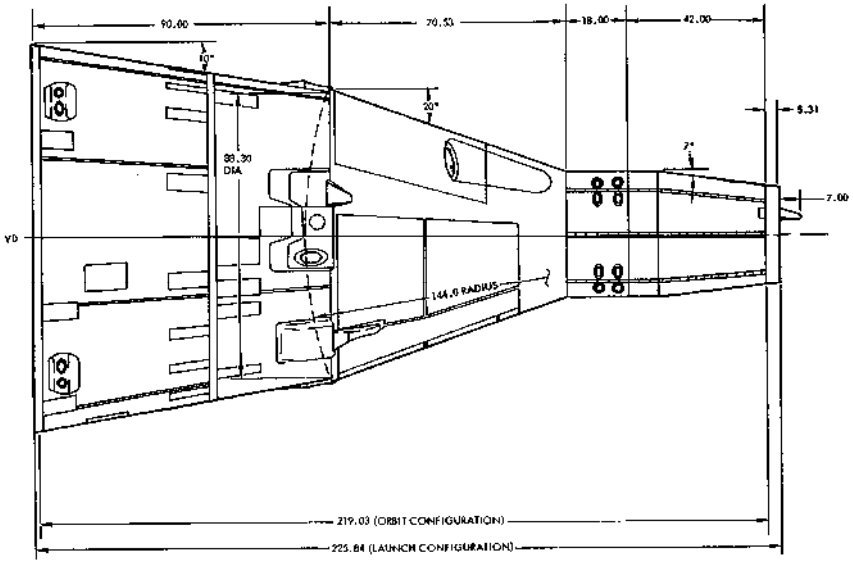
Disegno NASA

NASA Dryden Flight Research Center Photo Collection
http://www.dfrc.nasa.gov/gallery/photo/index.html
NASA Photo: EC02-0131-1 Date: June 19, 2002 Photo by: Tom Tschida
Space Shuttle Endeavour touches down on the runway at Edwards Air Force Base, California to conclude International Space Station construction and supply mission STS-111.

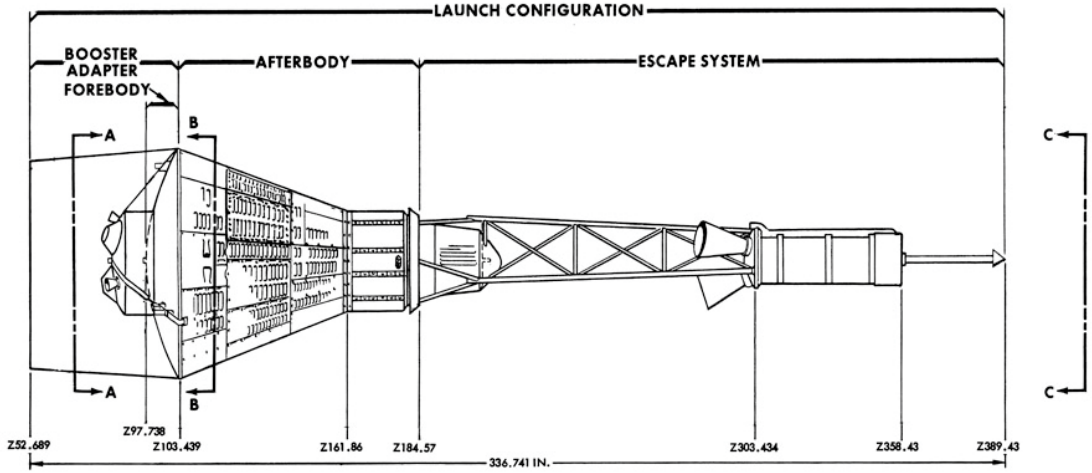
Foto NASA

L’illustrazione aeronautica vs. quella spaziale (6/8)

Foto NASA



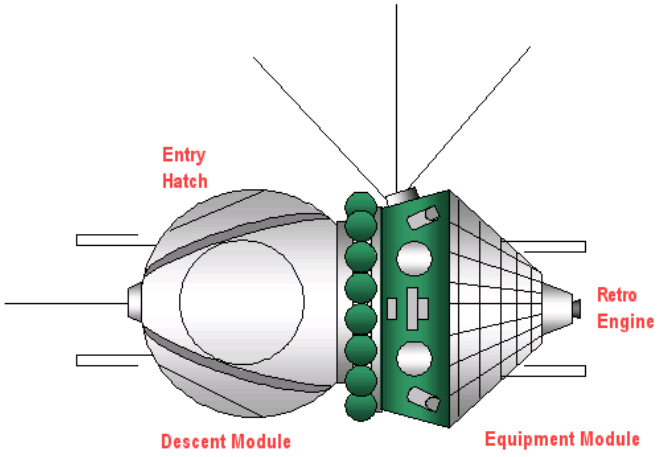
Disegno NASA



Disegno NASA

Foto Udvar-Hazy Aerospace Museum

L’illustrazione aeronautica vs. quella spaziale (7/8)



Vostok Spacecraft

Disegno di Reubenbarton

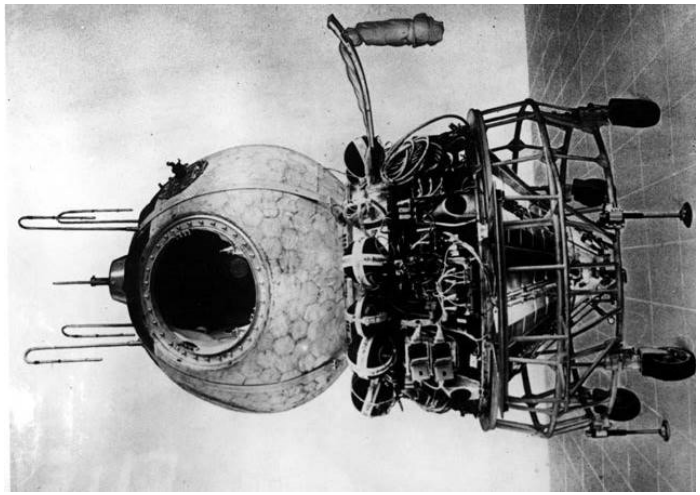
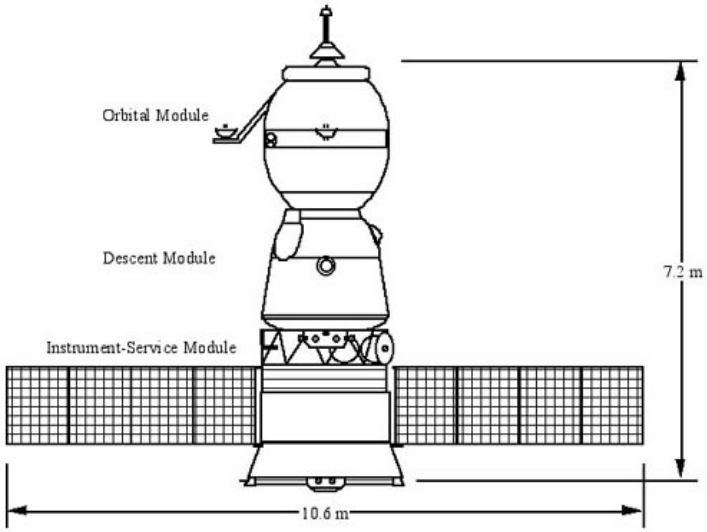


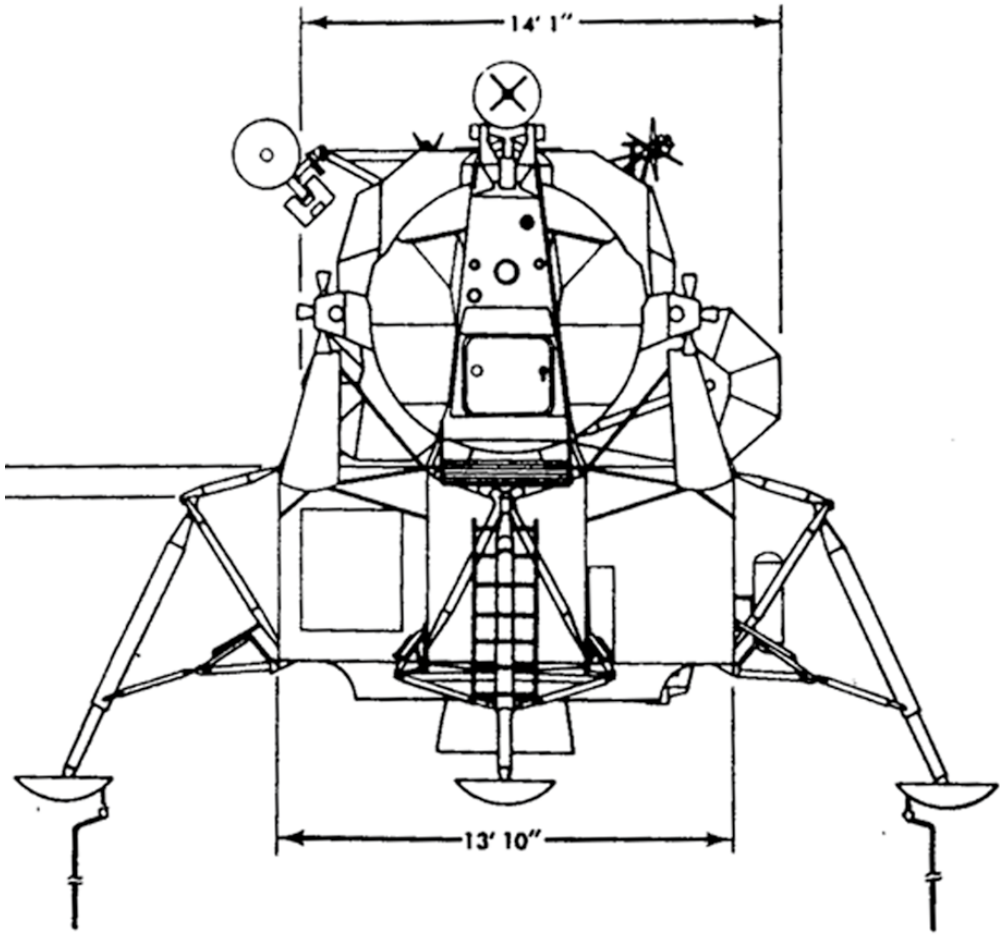
Foto RKA Energia

Foto NASA



Disegno NASA

L’illustrazione aeronautica vs. quella spaziale (8/8)



Disegno NASA

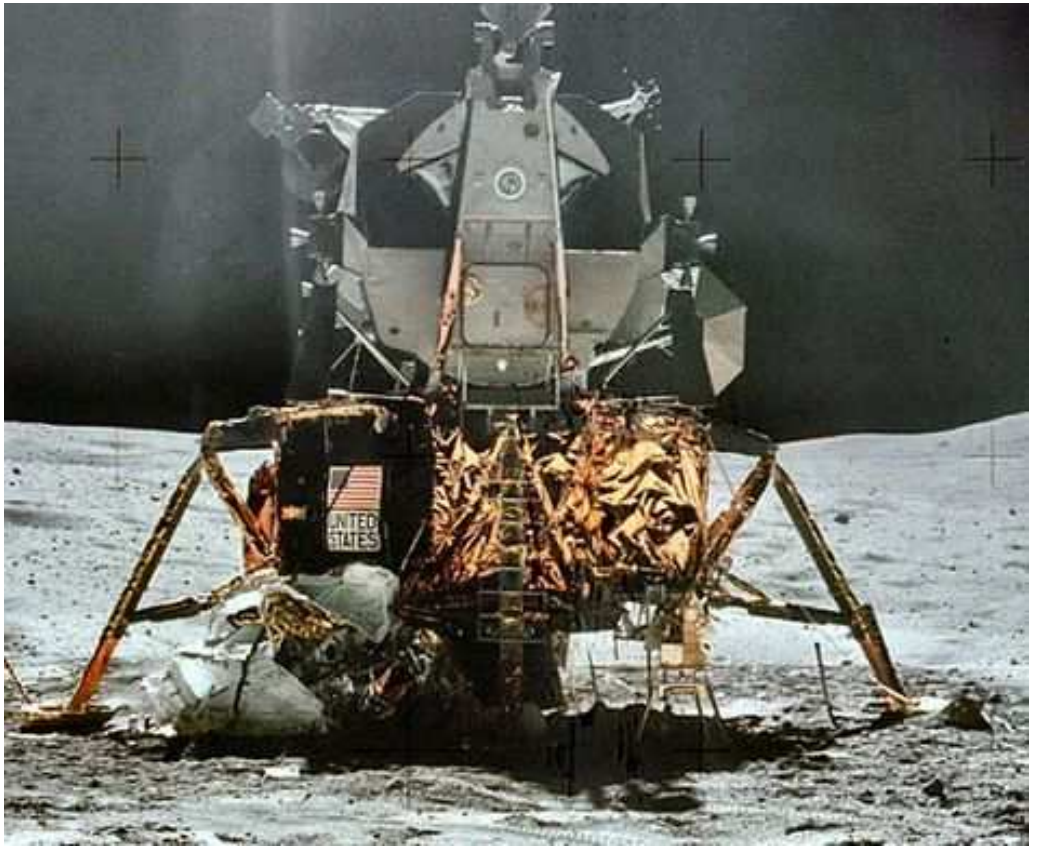


Foto NASA

Foto RKA Energia

Cosa disegnare? E come?

- La scelta non è casuale dal momento che esistono diversi modi di rappresentare un oggetto, specialmente un mezzo di trasporto
- Come visto in precedenza l'iconografia spaziale si è spesso concentrata sulla geometria del mezzo tralasciando il suo «vero» aspetto ossia cosi come appare ad un osservatore neutrale
- Dunque gli elementi esterni, finiture, lavorazioni, sistema di protezione termica (mylar, alluminio ecc.) fanno parte della rappresentazione del mezzo?
- La risposta così come per l'illustrazione aeronautica è senz'altro positiva, è necessario rappresentare **tutto** quel che si vede di un mezzo spaziale e **tutto** concorre ad una corretta rappresentazione
- Da qui la decisione di rappresentare tutti i veicoli spaziali con lo stesso stile (ovvero con le stesse caratteristiche grafiche) ed alla stessa scala, ove possibile

Il problema delle fonti

1. Disegni tecnici originali (quando possibile)
2. Fotografie
3. Fotografie
4. …..e ancora fotografie

Le 5 regole d'oro

1. What you see, is what you get

   Quello che vedi è quello che hai (niente immaginazione!)

1. Represent (only) what do you understand

   Disegna solo ciò che comprendi (non inventare niente!)

2. Do it right the first time

   Fallo bene la prima volta (così non ci torni su dopo!)

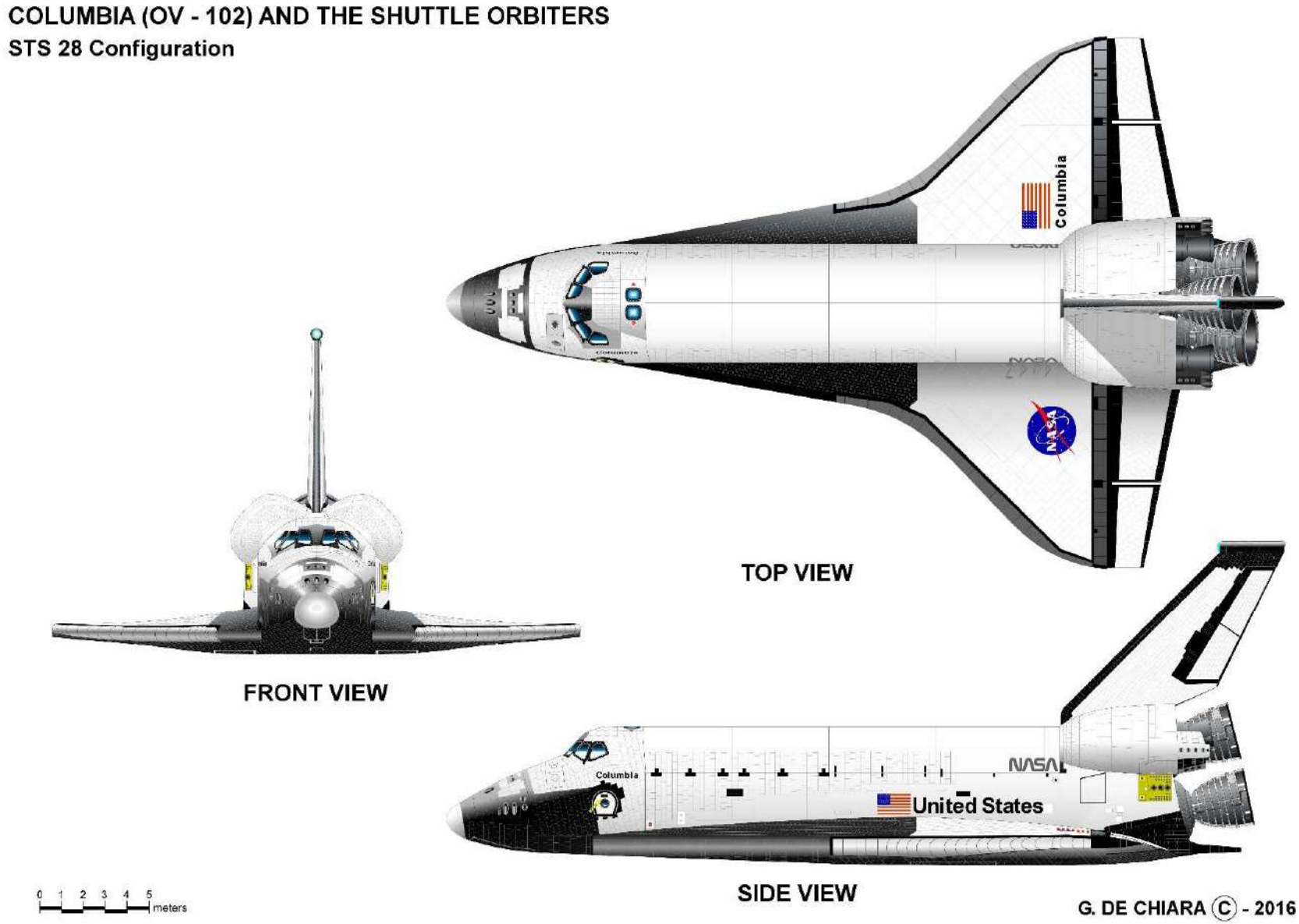
3. Always follows your style

   Crea un tuo stile e mantienilo nel tempo (così tutti riconoscono i tuoi disegni)

4. More efforts today, less tomorrow

   Un po' di lavoro in più oggi significa meno domani

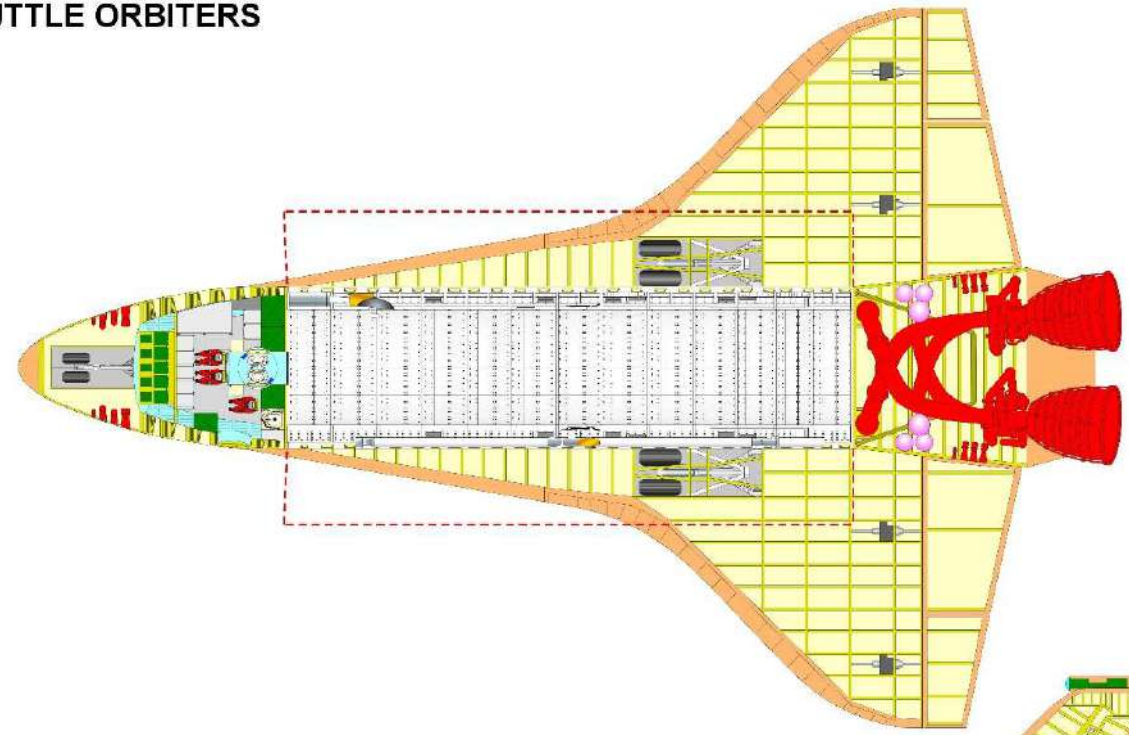
15 anni di illustrazione spaziale (1/5)



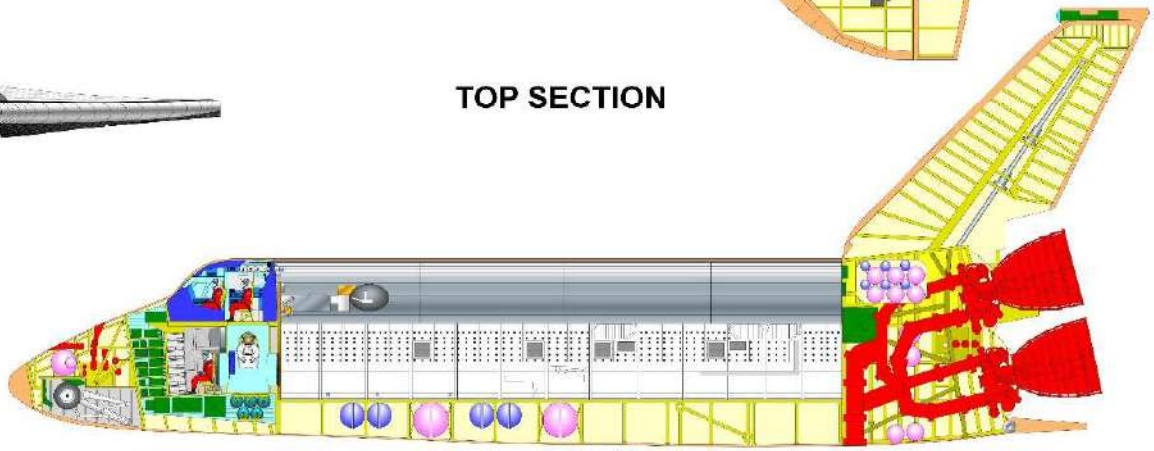
15 anni di illustrazione spaziale (2/5)

COLUMBIA (OV - 102) AND THE SHUTTLE ORBITERS

FRONT SECTION



TOP SECTION



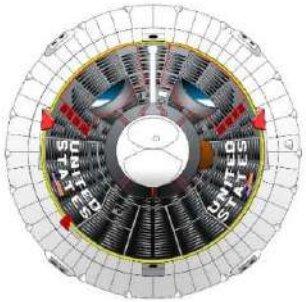
SIDE SECTION

15 anni di illustrazione spaziale (3/5)

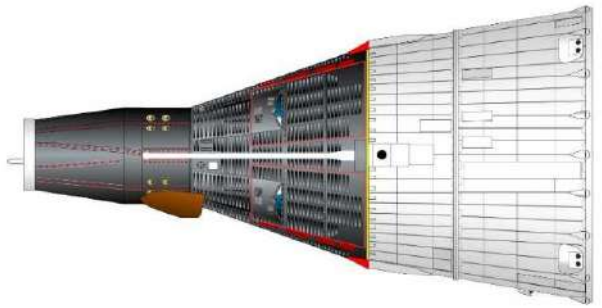
FRONT VIEW

TOP VIEW

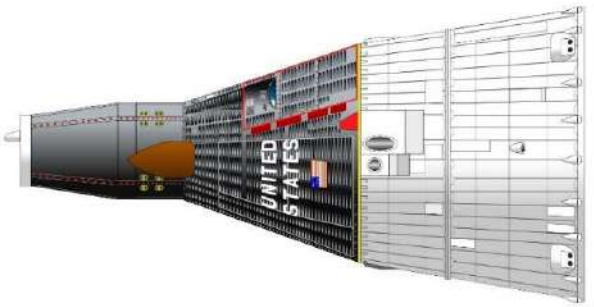
SIDE VIEW



FRONT VIEW



TOP VIEW

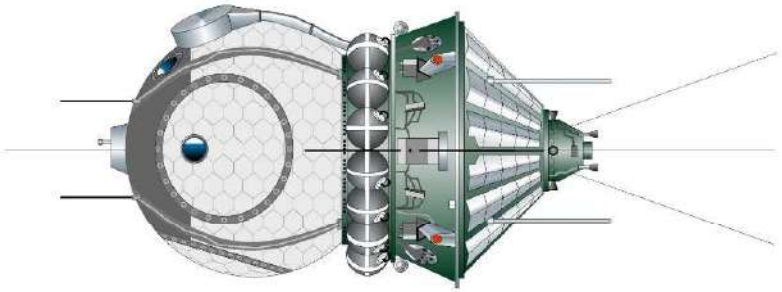


SIDE VIEW

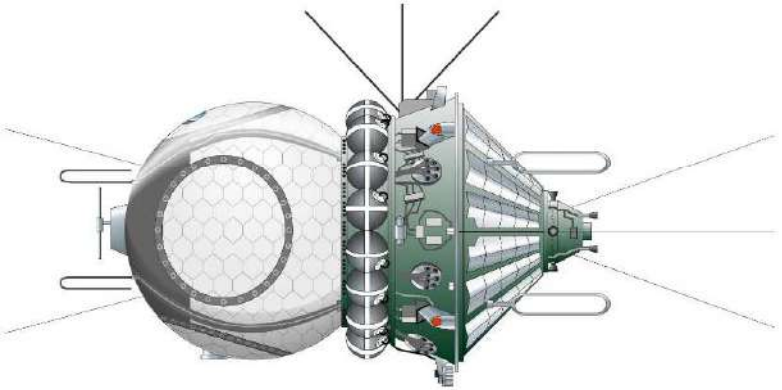
15 anni di illustrazione spaziale (4/5)

VOSTOK 3KA

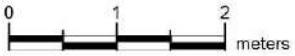
FRONT VIEW



TOP VIEW



SIDE VIEW



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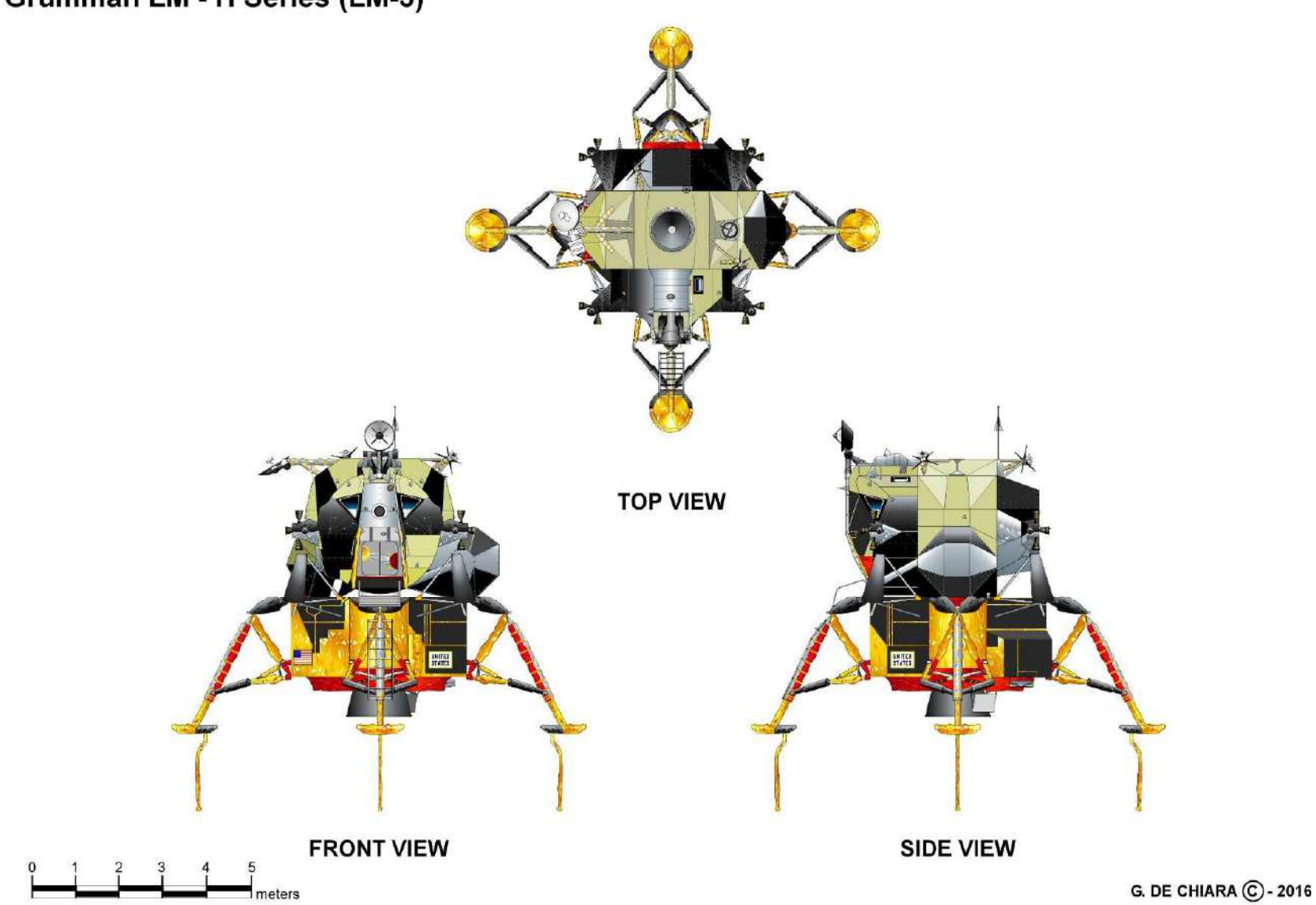
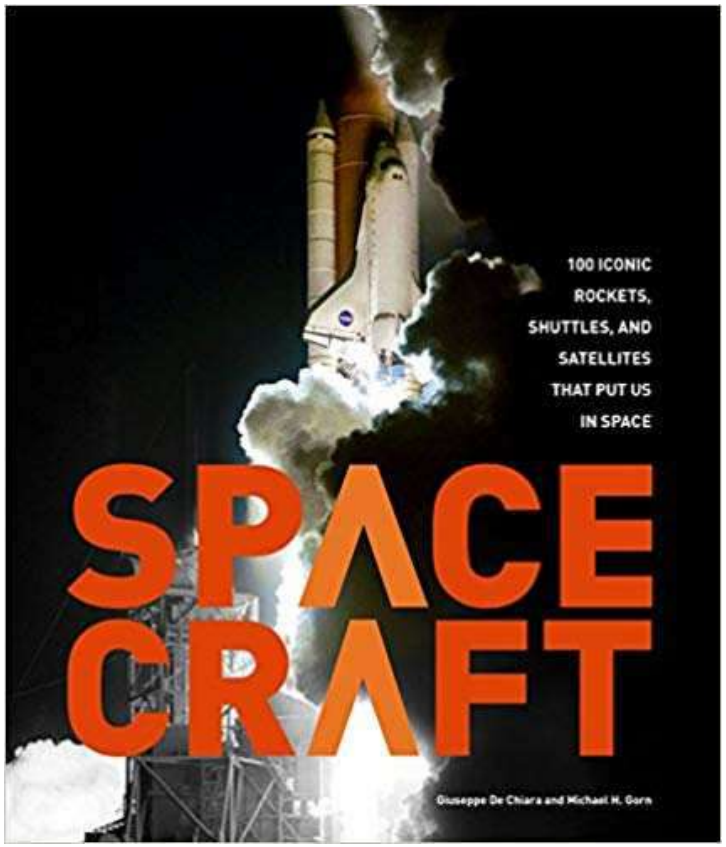
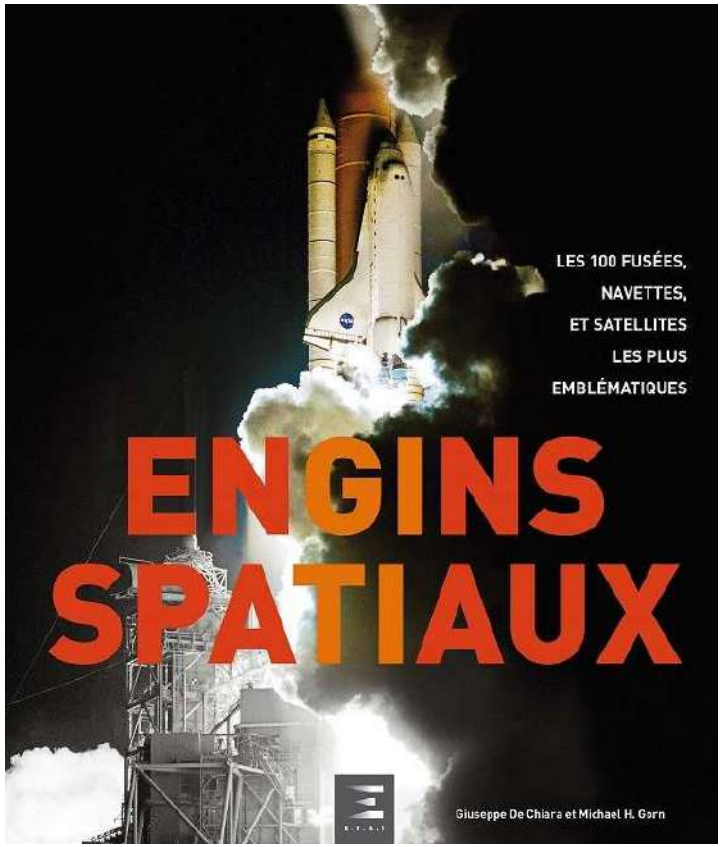
15 anni di illustrazione spaziale (5/5)



Il libro Spacecraft (1/6)



Voyageur Press
4 Settembre 2018



ETAI
6 Marzo 2019

Il libro Spacecraft (2/6)

- Spacecraft contiene 100 (agli americani piacciono i numeri tondi) schede di veicoli spaziali: Capsule, Spazioplani, Stazioni Spaziali, Razzi, Sonde e veicoli lunari
- Le schede ed i relativi veicoli sono stati scelti in base alla loro importanza storica e tecnica (il che lascia un buon numero di esclusi eccellenti fuori dal libro)
- Le 100 schede sono divise in tre grandi periodi temporali di 20 anni ciascuno, coprendo i 60 e più anni intercorsi dal lancio dello Sputnik fino al volo del Falcon Heavy

1. The First Space Age 1957-1977
2. The Second Space Age 1977-1997
3. Space Exploration At A Crossroads 1997-2017

Il libro Spacecraft (3/6)

INTRODUCTION

Spacecraft tells the story of a momentous period in world history, when we escaped the atmosphere, looked down at the seas and the continents, and for the first time saw the planet in all its complexity, fragility, and beauty. At the same time, we looked skyward into the heavens and saw celestial phenomena as old as creation and as transcendent as the mind can fathom. The daring vehicles that accomplished these missions during the last six decades—from Sputnik 1 to the James Webb telescope—represent the summation of space age exploration up to the early twenty-first century; they reflect the ongoing attempt by humanity to comprehend the workings of the universe and its parts.

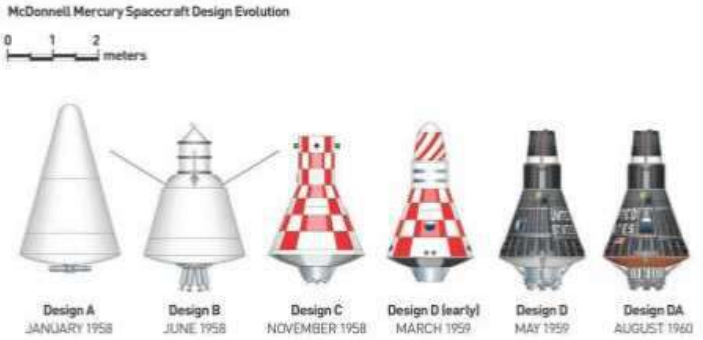
The initial forays into space had Earth-bound parallels. At the dawn of the Space Age in the 1950s, President Dwight D. Eisenhower proposed legislation for a uniform network of high-speed freeways across the United States, ostensibly for national defense. Its usefulness, however, proved far wider. The National Interstate and Defense Highways Act of 1956 represented the biggest public works expenditure in US history (about $41 billion by the end of the Eisenhower administration alone) and expanded the American expressway grid by roughly 41,000 miles. More than that, it stimulated job creation and contributed to the economic boom of the 1950s, accelerated the pace of modern commerce, and narrowed sectional and regional differences, geopolitically unifying the country as never before. In their own way, the spacecraft that serve humanity return many of the same benefits.

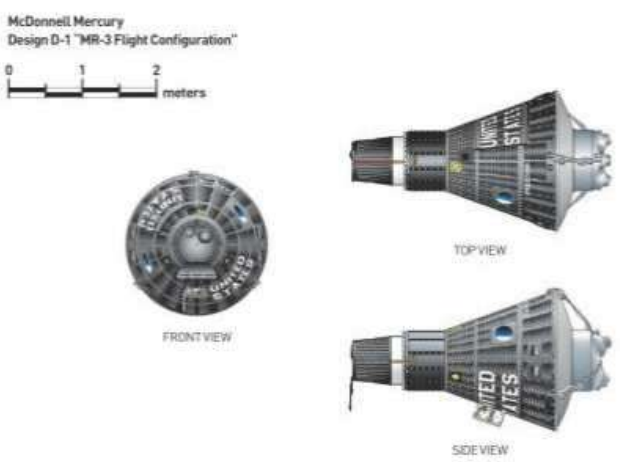
Three years before the passage of this law, on the other side of the world, a New Zealander and a Nepalese Sherpa undertook a completely unrelated challenge. On May 29, 1953, Edmund P. Hillary and Tenzing Norgay became the first people to reach the summit of Mount Everest, the tallest point on Earth at 29,028 feet (8,848 meters). "We didn't know if it was humanly possible to reach the top of Mount Everest," Hillary later said. Of no military, economic, or political consequence, reaching the peak of the world satisfied several deep-seated human drives: the pursuit of origins, the fulfillment of curiosity, the lure of adventure, the revelation of the unknown, and the test of endurance. These same motivations also typify the urge to explore space.

Because this book is confined to spacecraft designed for illumination rather than for tangible results—for endeavors like Mount Everest, rather than the National Highway System—there arises the inevitable debate between human and robotic sojourners. Will we engage with the universe through cosmonauts, astronauts, and taikonauts—through sentient explorers—or will automated orbiters and landers be our surrogates? The spacecraft profiled suggest that both have unique but complementary roles, that robots will continue to be sent to places too inhospitable or too distant for us, and that people will go where risk can be managed and where human intelligence cannot be substituted.

The Mars Science Laboratory's Curiosity rover performs many of the same chores as living spacefarers, without the limiting factors of time, fuel, supplies, and (to name only one safety issue) radiation exposure—the latter a serious health concern according to Curiosity's own findings. On the other hand, the twelve Apollo astronauts who walked on the moon from 1969 to 1972 accomplished tasks impossible for machines. They witnessed and described the palpable texture of the moon's surface, assessed the general features of its geology, and felt the peculiarities of lunar gravity in their every step and motion. They quarried large and highly varied quantities of rock and soil (842 pounds in all). They reported changes in their own physiology and psychology. They golfed! Then they returned to Earth with suggestions for future missions and explained how the experience affected them in artwork, memoirs, and the media.

Spacecraft also illustrates the international context of space travel over the last sixty years. It started as a duel between the United States and USSR, in the height of the Cold War, that not only involved a technological contest, but a struggle for world opinion. The Soviets and Americans trumpeted their space achievements to the world as proof of the superiority of their cultures, their governments, their economic systems, and their political ideologies. But once the Cold War ended, space exploration ceased to be a subplot in a global confrontation and in time assumed a radically different character.





Il libro Spacecraft (4/6)

Skylab entered space on four separate boosters. The Saturn V—configured in two stages on this occasion to allow for the big payload shroud that protected the spacecraft—launched the station itself into orbit on May 14, 1973, with the name of Skylab 1. Subsequently, Saturn 1B rockets lifted three crews of three astronauts each during Skylab 2 on May 25, Skylab 3 on July 28, and Skylab 4 on November 16, 1973.

Skylab operations began with a high likelihood of outright failure. As Skylab 1 rose from the launch pad, a micrometeoroid shield designed to protect the spacecraft broke loose from its mountings, striking and jarring open one of the two main solar arrays. By the time Skylab reached orbit, both parts had blown off. Meanwhile, the other main array became tangled in the ensuing debris and failed to deploy. Without the shield, temperatures inside Skylab rose to 126 degrees Fahrenheit (52 degrees Celsius).

NASA tried to salvage Skylab. Instead of launching Skylab 2 the day after Skylab 1, as planned, NASA delayed the flight for two weeks as its engineers considered repair options and the astronauts practiced in Houston for spacewalk scenarios. In the end, after intensive trial and improvisation, the Skylab 2 astronauts (Charles Conrad, Paul Weitz, and Joseph Kerwin) arrived at Skylab with a solution. They deployed a 22-foot (6.7-meter)–by-24-foot (7.3-meter) parasol that blocked the sunlight and lowered temperatures in the cabin. They also managed to release the jammed solar panel. By the end of their twenty-eight-day mission, they completed about 80 percent of their scheduled solar observations.

Skylab 3 also experienced difficulties. The least threatening involved the three astronauts (Alan Bean, Jack Lousma, and Owen Garriott), all of whom fell prey to nausea for about a week. Despite their illness, they augmented the parasol installed during Skylab 2 with a two-post sunshade, requiring two of the crew to undertake a record EVA lasting more than six and a half hours. More urgently, they reported leaks in two thrusters on the command module, and NASA engineers made plans either for an emergency return to Earth or for a rescue mission. Another EVA failed to find the source of the leaks. Ultimately, ground staff worked out special procedures for a safe flight home, despite the problems. Skylab 3 ended after fifty-nine days.

Skylab 4 went more smoothly, but sickness recurred among the crew. When Gerald Carr, William Pogue, and Edward Gibson recovered, they conducted a six-hour, thirty-four-minute EVA to repair a jammed antenna. Scientifically, Skylab 4 contributed unique observations of the famed comet Kohoutek. The astronauts did EVAs on Christmas Day and on December 29, 1973, to take photographs of the comet as it passed. Skylab's astronauts remained on station for eighty-four days, nearly as long as the first two missions combined.

Skylab gave NASA a foretaste of space station life. In the combined 171 days aloft, the nine astronauts undertook major, frequent, and often dangerous EVAs to repair the station, conducted complex astronomical viewings, and acted as physiological subjects testing the effects of long-term exposure to spaceflight. The crew also experienced the personal peculiarities of long-term habitation, involving such practicalities as sleep, exercise (they used a portable treadmill), food, and waste management.

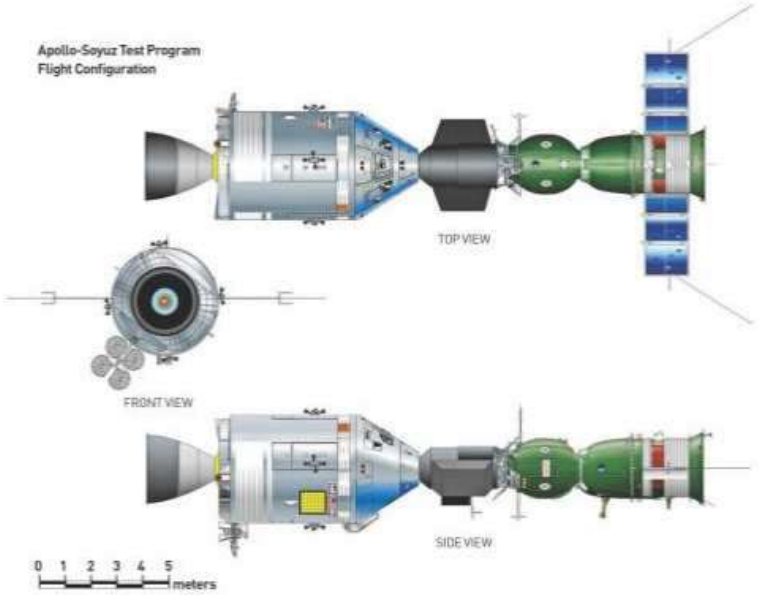
When the time came twenty-five years later to begin assembling the International Space Station—and during the planning and fabrication process leading up to it—the Skylab experiences served as an indispensable manual by which to anticipate the unforeseen.

Apollo-Soyuz Test Project

If President John F. Kennedy used the US space program as a "soft" weapon in the Cold War, during the 1970s his political nemesis Richard Nixon wielded it to deescalate hostilities with the Soviets. The process began early in 1972, when President Nixon made a historic trip to China. Nixon calculated correctly that the Soviets would view a warming US-China relationship with alarm, so the following May he became the first president to visit the USSR. Nixon not only made agreements related to arms control, cooperative scientific research, and expanded trade, but on May 24 he signed a commitment for the peaceful exploration of outer space. This pact later became a joint mission, Apollo-Soyuz test project (ASTP).

In addition to its contribution to international diplomacy, ASTP also served a domestic purpose: the Apollo program had almost run its course by this point. So Apollo-Soyuz injected some anticipation and excitement into a project already losing much of its appeal due to repetition. A good deal of surplus Saturn and Apollo hardware still remained in storage, ready for reuse. For its part, the Soviet space program—buffeted by internal problems as well as the triumph of Apollo—needed the lift that this goodwill flight offered.

Originally, the two sides discussed a simple rendezvous of the Apollo and Soyuz spacecraft at the Salyut 4 space station. But perhaps fearing the appearance of an imbalance between the Soviet and American contributions, they instead agreed to a docking between the Soyuz and Apollo capsules. This plan required each to design its own module, as well as to collaborate on a shared airlock module. The resulting Apollo-Soyuz spacecraft and docking module measured about 71 feet (21.65 meters) long and weighed approximately 51,964 pounds



Il libro Spacecraft (5/6)

Grumman. North American won the $2.6 billion competition, for which it agreed to fabricate two space-worthy orbiters and one full-scale test vehicle. The subcontractors also profited handsomely from the project. Grumman built the orbiter's wings; Rocketdyne its main engines; Thiokol the two solid rocket boosters; and Martin Marietta the massive, liquid propellant external tank. McDonnell Douglas provided overall support. In all, STS startup costs (in 1971 dollars) totaled about $6.75 billion. The NASA Johnson Space Center managed the STS.

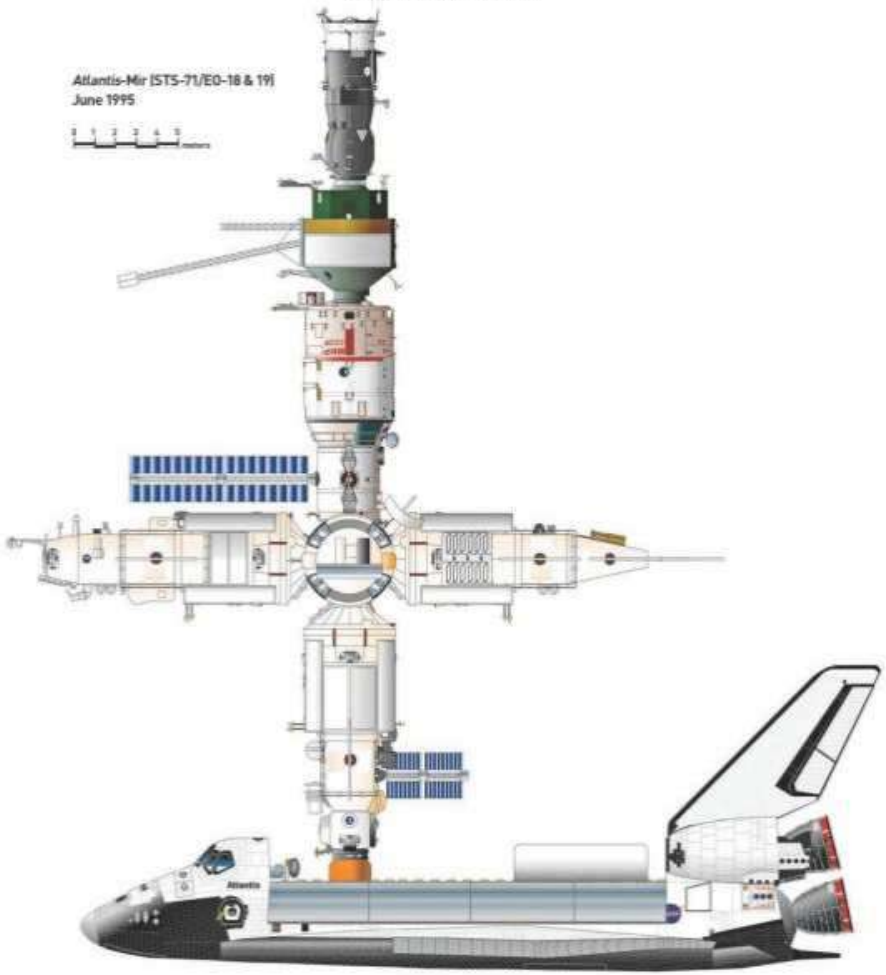
Planning for and fabricating the STS had been one thing. Seeing it fueled and ready on launch pad 39A at the Kennedy Space Center on April 12, 1981—the day of the first space shuttle flight—surprised even those intimately acquainted with its evolution. Gigantic in scale, it looked like a machine from a fable, with the two solid rocket boosters and the taller external tank pointing skyward and a full-scale airliner mounted incongruously on the side of the structure. It inspired even greater appreciation as its engines roared and shook, generating over 6.4 million pounds of thrust as this 4.5 million-pound (2.25 million-kilogram), 154-foot (47-meter) tall, 78-foot (24-meter) wide edifice embarked on its maiden voyage.

The Shuttle Orbiters

The shuttle orbiters represented a technological leap over all spacecraft that preceded them, and their operational record stands alone among the world's space vehicles. Although modified during their period of service from 1981 to 2011, they remained fundamentally the same for thirty years—comparable to a DC-9 airliner at 122 feet (37.2 meters) long, with a 78-foot (23.8-meter) wingspan and a weight of about 250,000 pounds at launch. The orbiters flew 135 missions at an average rate of 4.5 per year. They sent 833 crewmembers into space for an aggregate 1,323 days aloft. They hauled more than 3.5 million pounds into orbit, consisting of 180 satellites and other payloads, they returned fifty-two spacecraft and space station components to Earth, weighing more than 229,000 pounds in all. They docked thirty-seven times at the International Space Station and spent 234 days constructing it. They went on seven missions to capture and repair orbiting spacecraft. They remain modern marvels of technology.

But despite all the positive attributes, two horrific shuttle accidents occurred, taking fourteen lives and destroying 40 percent of the shuttle orbiter fleet. And although billed as the answer to high-cost access to space, the total STS expenditures reached approximately $209 billion, or $1.5 billion per mission.

During its tenure, the space shuttle brought America some of its best moments, as well as some of its worst. In the end, Congress approved the construction of five operational orbiters, adding three to the two originally ordered from North American Rockwell. The orbiter saga began with *Columbia*, like the rest of the shuttle fleet named for ships prominent in maritime exploration—in this case, the venerable US Navy frigate that between 1838 and 1840 became one of the first American vessels to circumnavigate the world. It also commemorated the Apollo 11 command module. *Challenger* recalled the Royal Navy research ship that explored the Pacific and the Atlantic Oceans from 1872 to 1876. NASA chose *Discovery* for the third orbiter in memory of the vessels captained by two English adventurers: Henry Hudson, during his search for the Northwest and Northeast Passages in 1610 and 1611, and Captain James Cook, during his famous journey to the Hawaiian Islands and to Western Canada in the 1770s. The fourth orbiter's namesake, *Atlantis*, had more recent



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SELECTED SOURCES AND FURTHER READING

The following represent a sampling of the sources consulted for this book.

I. The Internet

A cluster of authoritative and trustworthy websites constituted some of the main resources for this book:

1. NASA website:
www.nasa.gov
The US space agency hosts a massive website devoted to its spacecraft, as well as those produced in partnership with NASA. See also the NASA History homepage that includes many open-source electronic books about the history of the space age and valuable documentary materials too. Each of the NASA research centers (Ames, Armstrong, Glenn, Goddard, Johnson, JPL, Kennedy, Langley, Marshall, Stennis, and Wallops) also posts its own informative websites.

2. ESA website:
www.esa.int
The European Space Agency likewise maintains a huge online presence that illuminates its achievements in rocketry and robotic flight.

3. The Russian Space Web:
www.russianspaceweb.com
Created by space historian Anatoly Zak, the Russian Space Web is a private venture that presents reliable and in-depth accounts of Russian space projects, spacecraft, personalities, and missions.

4. Academic institutes:
www.stsci.edu, www.swri.org
The Space Telescope Science Institute, located in Baltimore, Maryland, represents academic institutions pursuing space-based astronomical research. Its website covers the institute's operations work for the Hubble Space Telescope, the upcoming James Webb Space Telescope, and others. Similarly, the Southwest Research Institute in San Antonio, Texas, specializes (among other fields) in space exploration, which is reflected in its web pages.

5. Corporate websites:
www.spacex.com, www.boeing.com, www.blueorigin.com, www.orbitalatk.com, www.ulalaunch.com
The internet sites of SpaceX, Boeing, Blue Origin, Orbital ATK, and the United Launch Alliance profile the spacecraft and rockets originating in the private sector.

6. Encyclopedia Astronautica:
www.astronautix.com
This website presents well-researched articles about spacecraft and rockets from around the world, emphasizing their origins, history, and technology.

7. Web forum:
https://forum.nasaspaceflight.com/
This website represents perhaps the world's foremost clearinghouse for information regarding manned and unmanned spaceflight.

II. Books

The spacecraft narratives and illustrations drew on the following books.

Commercial Publishers
Caprara, Giovanni. *Il libro dei voli spaziali.* Vallardi, 1984.

Gatland, Kenneth. *The Illustrated Encyclopedia of Space Technologies.* Salamander, 1981.

———. *Manned Spacecraft.* Blanford, 1967.

———. *Robot Explorers.* Blanford, 1972.

Gatland, Kenneth, and Philip Bono. *Frontiers of Space.* Blanford, 1969.

Gorn, Michael. *NASA: The Complete Illustrated History.* Merrell, 2008.

ON COLUMNS OF FLAME, WE TOOK TO THE STARS.

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Conclusioni

- La realizzazione di Spacecraft è stata un progetto impegnativo durato 2 anni e mezzo, dal momento in cui è stata formalizzata la proposta fino alla pubblicazione
- Per realizzarlo sono occorse oltre 300.000 parole e quasi 300 disegni (anche se non tutti sono stati pubblicati per ragioni di spazio)
- Tanto impegno è stato premiato sia dalla critica (Forbes, Seattle Post Inquirer, ecc.) che dal pubblico: il volume ha esaurito la prima tiratura in appena 3 mesi dalla sua uscita, ed a 6 mesi dalla uscita ha visto la prima edizione straniera (francese), la prossima tiratura sarà disponibile a partire dal 1 maggio
- La Quarto ha deciso di rendere Spacecraft il proprio portabandiera in occasione del 50° anniversario della missione Apollo 11 sulla Luna, il prossimo luglio
- Auspicabilmente si prevede una seconda edizione, rivista ed ampliata, intorno al 2020/21

GRAZIE PER L'ATTENZIONE