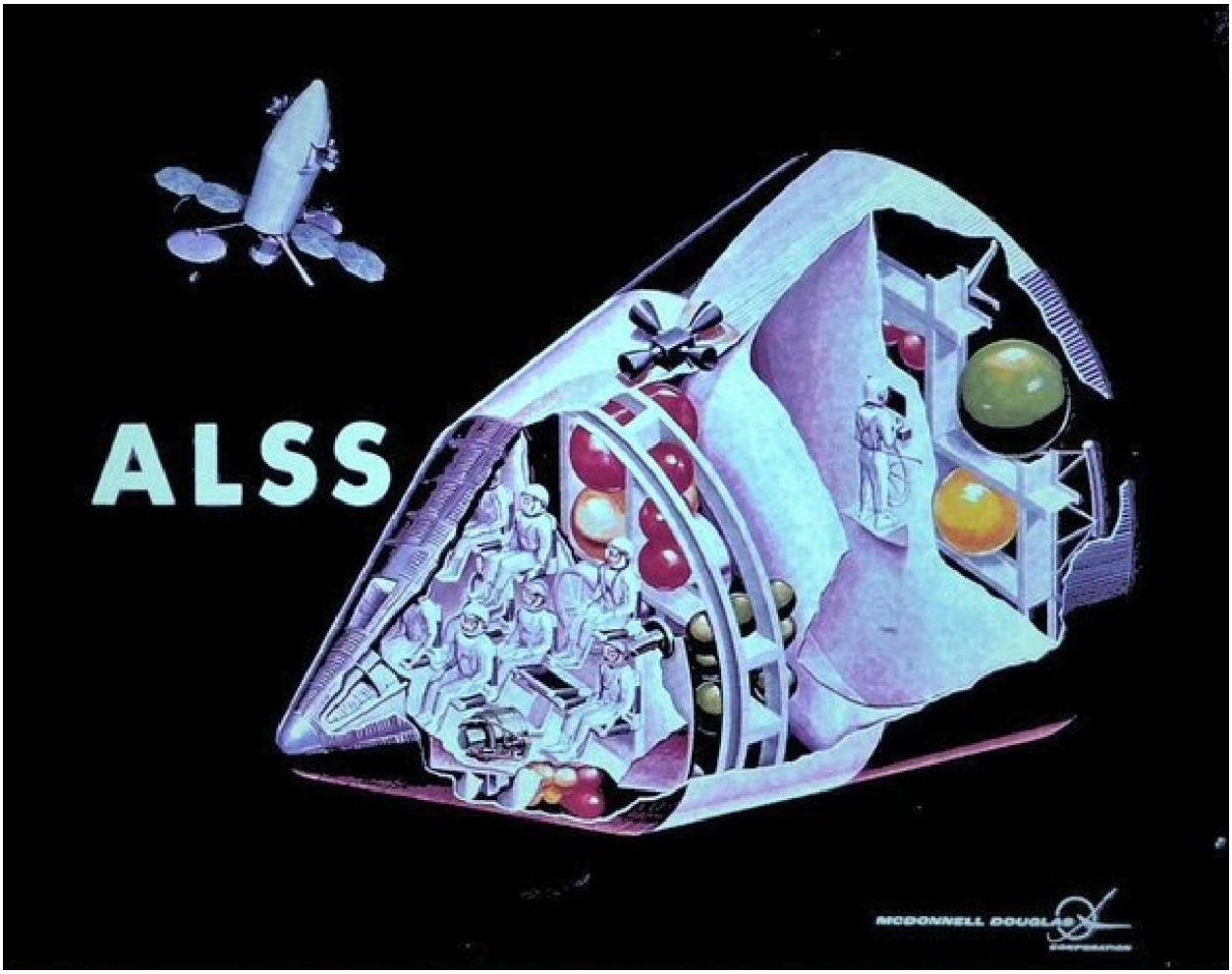


Twins no more.

A Brief look at the history behind the expansion of the McDonnell Aircraft Corporation (MAC) and later McDonnell Douglas (MDC) Gemini Capsule into a multi-crew and cargo transport craft known as either Big Gemini or Big-G.

Preface Glossary:

Some simple terminology needs to be discussed before delving into this subject.

- Gemini A: NASA as flown Gemini Capsule
- Blue Gemini: Never built, never flown Gemini A capsule for the USAF. Offered as an alternative to the X-20 Dynasoar for USAF in Space. Never funded and often confused with the Latter Gemini B because of the re-use of a Gemini A capsule on the mockup test flight of Manned Orbital Laboratory/ KH-10 Dorian, as well as the blue paint on the Retro Module in this instance.
- Gemini B: Complete re-design of the internals for the Gemini A Capsule to meet USAF needs, specifically all new Avionics, escape methods, and the ability to dock with an aft port. This is NOT Blue Gemini
- MAC: Alternatively, McDonnell Aircraft Corporation or McDonnell Astronautic Corporation. In the 1967-1969 timeframe merged with Douglas Aircraft Corporation (DAC) to form McDonnell Douglas Corporation (MDC.) Any of the abbreviations can be used as Big Gemini; the main subject of this paper spans all three company names.
- Avionics: The electronics that allow the operation of an aerospace vehicle (in this case, the Gemini capsule in any form.)
- SM: Service Module: The modular, expendable life support and control module attached to the Gemini capsule in any form. Some service Modules carry fuel and engines; others do not.

1960-1961: Pre-Gemini, the Mercury Mk 2

Initially, Mercury Mk 2 (what later became Project Gemini) was proposed as a simple upgrade to the Mercury capsule to allow two crew to practice before flying on Apollo to Lunar Orbital rendezvous. IE to take the risk out of docking in deep space by trying to do it closer to home where it was “safer.” Initially, McDonnell Aircraft Corp engineers looked at a tandem arrangement for the 2nd crew member in a cylindrical add-on. This proved to be a precarious concept during wind tunnel tests, so a new side-by-side seated capsule would be made by scaling up the Mercury capsule. When Mercury Mk 2 became Gemini, it was an all-new capsule utilizing the same structure, concepts, and construction techniques as the Mercury capsule. The

experiences here would play heavily beyond the core Gemini pod, however. The add-on compartment experience, for Mercury, could literally be considered the start of Big Gemini.

1963: The Beginning of Big-G

To begin with, we must go back to the earliest days of the Gemini program. Boilerplates have just started in the manufacturing process, and the engineers and designers at McDonald Aircraft are looking at the possibilities of expanding the use of Gemini in the "Advanced Gemini" studies. These studies primarily focused on replacing Apollo for the Lunar missions, bringing the marriage of many disparate ideas. A large team of designers and conceptual engineers were quickly assembled to devise many zany, weird, and otherwise, odd-looking ways to get Gemini, a Low Earth Orbit spacecraft by design, to be circumlunar in range and performance. There were five standouts of the many ideas generated by the Advanced Gemini studies for the USAF and NASA.

1. **Cargo Gemini** (unmanned Gemini cargo variant based on the existing pressure vessel.) Would carry small quantities of physical cargo to Space stations, but notably fuel, LOX, and take away waste materials. SM would have actual engines for re-boosting any station it docked nose first with. Service Modules would be derived from either Transtage or Agena. A centaur-derived stage was also conceived but would likely never have been considered after the failure of Centaur A. The nosecone would be re-designed, and the parachute, if desired, would be stored dorsally and not in the nosecone.

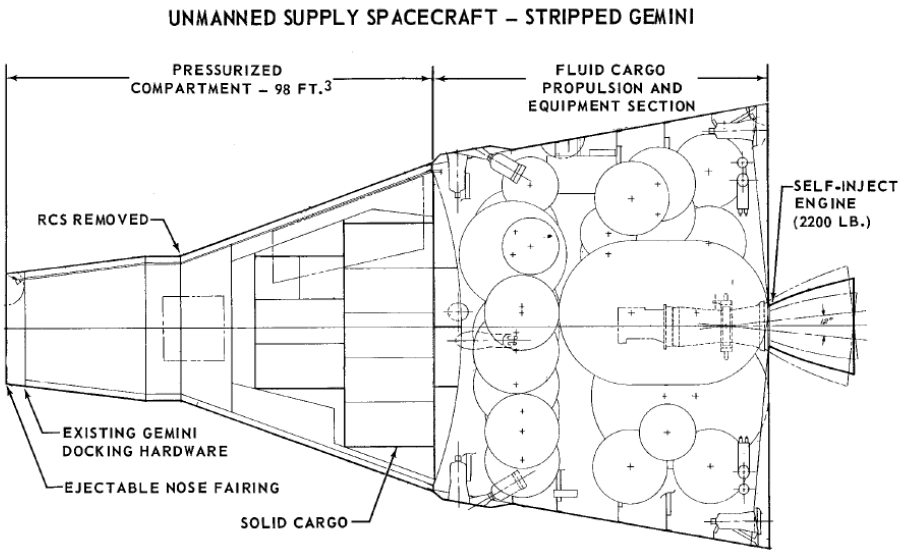


FIGURE 7.1–1

2. **Gemini Ferry**. A completely new Capsule based on the Gemini B capsule with room for 1-3 more crew in a “hitchhiker” aft compartment. A new SM would be needed, given the larger diameter of the Gemini Capsule. Gemini Ferry would either Nose or Tail dock. If nose docking was used, a tunnel or a powered actuator deflection of the craft itself would allow crew transfer without EVA. Gemini Ferry would not have re-boosting capabilities.

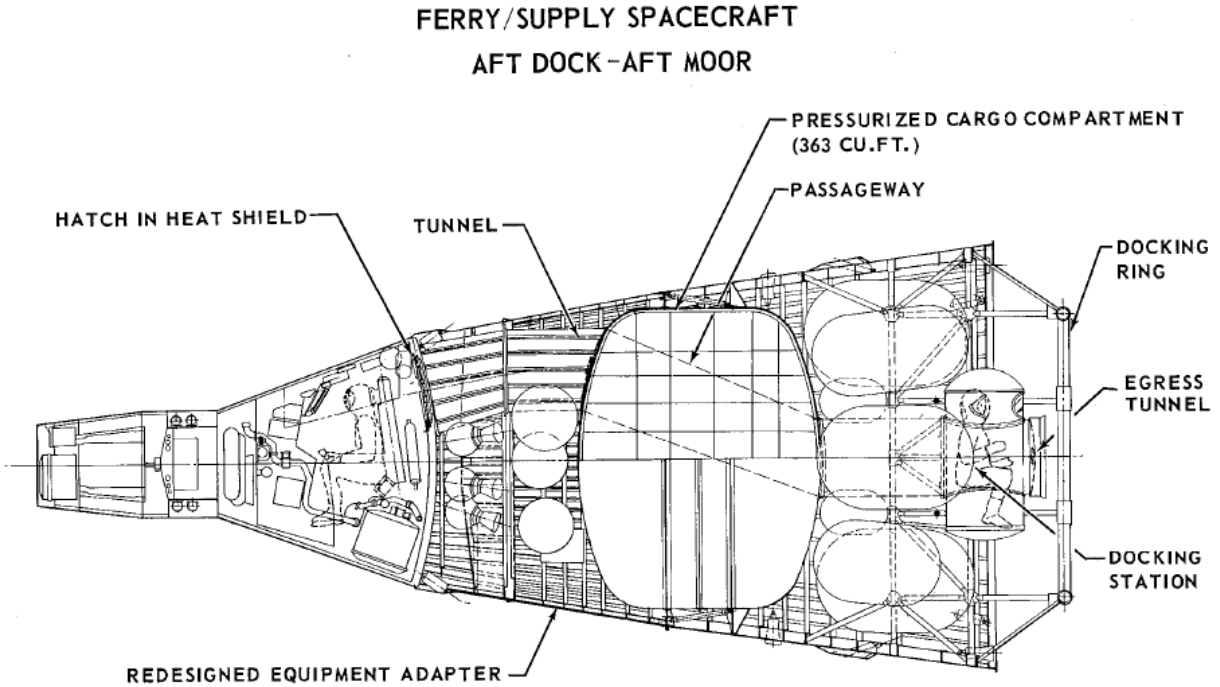
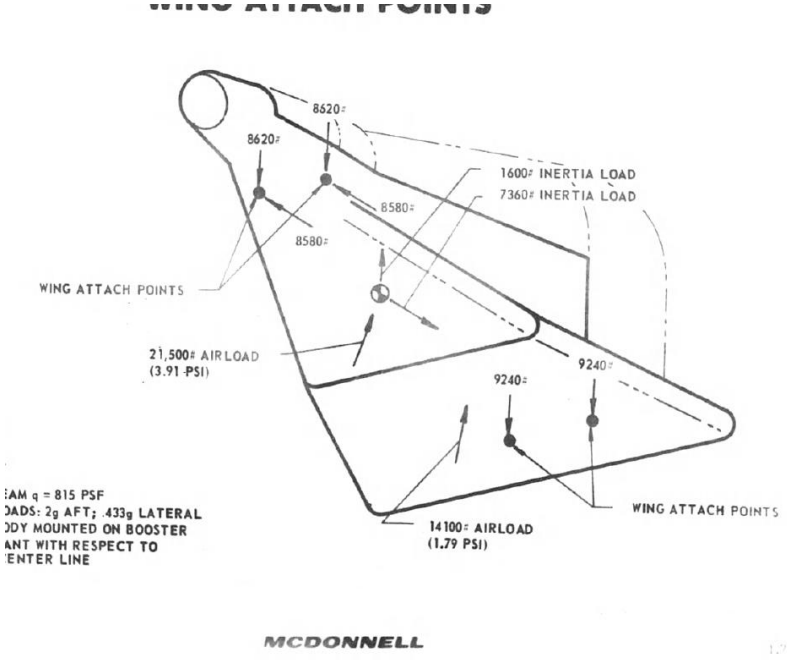
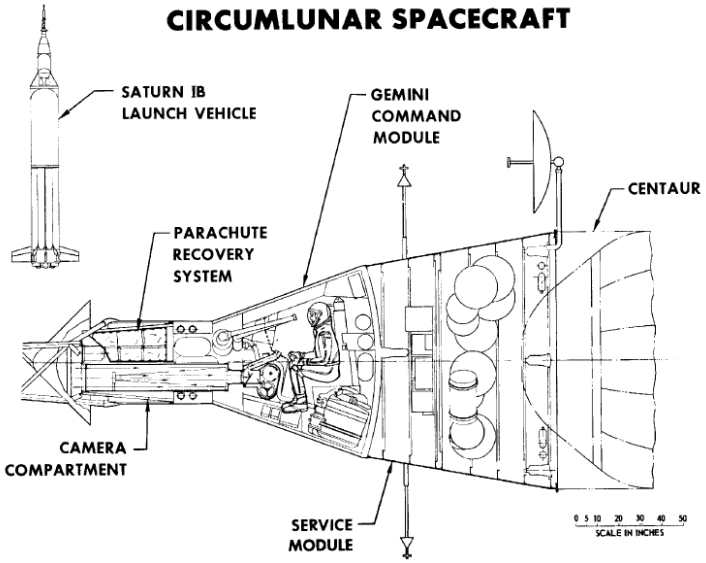


FIGURE 6.1-2

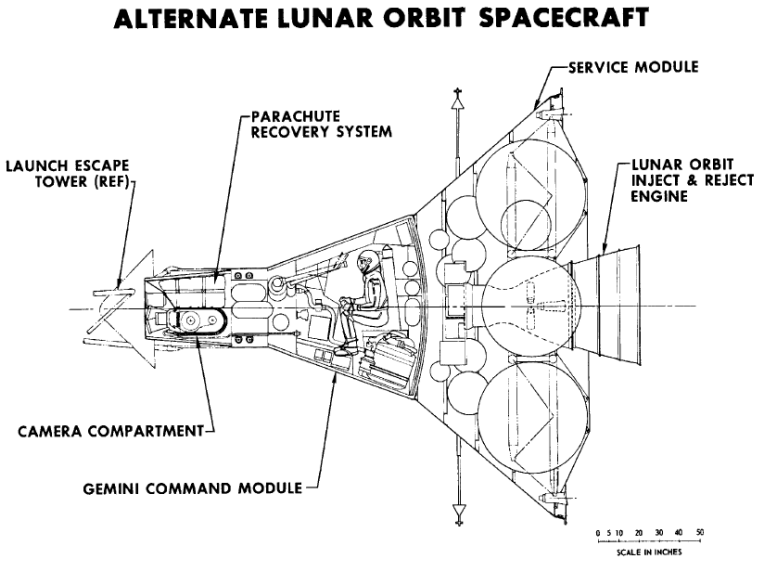
3. **Winged Gemini**. This is a USAF search for a replacement for the X-20 Dynasoar. A Gemini B capsule would gain wings along its “waterline” just below the door hinges on the sides of the capsule. Control surfaces would be added to the aft wing portion and on the Service module. The service module would not be discarded until reaching the lower atmosphere. Recovery would still be by nose-mounted parachute but on land (inflation bags below the capsule.) This would eventually evolve into two versions, one with fixed wings just below the hinge line described above, and one with a “wing-plate” attached to the nose and under the “bottom” side of the capsule. On parachute deployment, the entire wing would separate and have its parachute for recovery in the wing-plate form. This latter form was implemented in the old Kerbal Space Program mod FASA without the wing-plate separation.



4. **Long Duration Gemini**: The Circumlunar Gemini capsule, based on NASA Gemini A or USAF Gemini B. would have had a significantly larger Service module and be launched on a Saturn C-2 rocket. On-orbit, the Long Duration Gemini would detach from the S-IV stage and connect to the on-orbit and assembled C-3 Rocket stages S-IVC train. Then boost for the Moon and back. Latter before this concept was dropped entirely; some people claimed that the Gemini Ferry was to be used for this mission with LOR and the Grumman LM. The last is highly questionable.



5. **Long Duration Gemini for Lunar Reconnaissance**. The only long-duration “Apollo” Replacement that was seriously studied. The Lunar Reconnaissance mission was meant to get a large camera on a flyby of the Moon quickly with enough time to better plan the Apollo Moon Landings. Both North American Aviation and McDonnell Astronautics proposed versions of their capsule to do this mission. In the case of MAC, Alterations to the Long Duration Gemini already studied were limited to Altering the nosecone. The Gemini nosecone alterations would take longer to complete, compared to the NAA proposal, but all up craft having a smaller mass would allow it to launch on a Modified Saturn IB launch vehicle complete with a Centaur C or Agena for Trans-Lunar Injection and midcourse control. As stated in my previous work on Saturn C-2 and C-3, the Centaur C would quickly fail and the Agena, while of much lower thrust, was a much more capable TLI injection vessel due to its Hypergolic fuel that is stable for an extended period in space.



6.

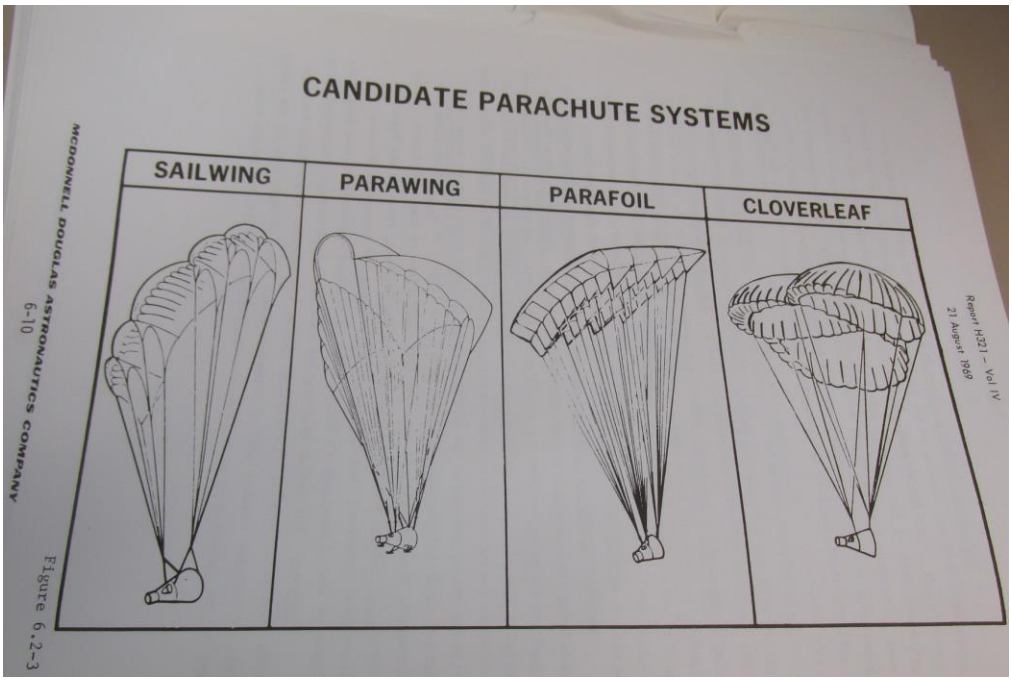
Of the concepts listed above, Winged Gemini was USAF, Cargo Gemini and Ferry Gemini were combined USAF/NASA and both Long Duration Gemini were NASA programs with funds for study paid by the appropriate institutions.

Not mentioned above is the Rogallo-winged Gemini. This is simply because it was the “BASIC” Gemini up until proven unable to work as intended/designed. Many other ideas came out of this

conceptual design group, but most were either financial dead ends or technically impossible without massive amounts of new technology.

So, what about the Rogallo wing?

After all, Rogallo wings are used even today with hang-gliders, right? Why didn't it work? Simply put, the design chosen was not structurally sound. The failure was due to the compressibility of gaseous elements. With enough force, the gaseous-filled tubes that made up the spine and leading edge of the Rogallo wing would deform, collapse, lose lift via an aerodynamic stall and cause the capsule to crash. We are lucky the test pilots who flew the Rogallo wing test articles only escaped the various incidents with injuries and not death. So, a neat concept for space stowage but not so practical in the real world. With the death of the Rogallo inflated wing, the idea of a Lifting parachute for space recovery did not die. A non-inflated Rogallo would be a non-starter as the amount of space and mass needed far outweighed the two benefits of cross-range performance and landing on the ground instead of the ocean. Instead, it went a different way. NASA had McDonnell Astronautics study alternatives to the Rogallo wing that would still allow for a controlled landing on the ground instead of the ocean. Options studied were the Sail-wing, the Para-wing, the Parafoil, and standard cloverleaf (3 standard chutes.)



Of the options, cloverleaf introduced the most danger due to the need to keep Big Gemini horizontal and all the rigging to do so.
Parafoil was highly experimental, and unknown if it was reliable yet. Sail-wing had a fantastic Lift to Drag ratio and could glide forever, but it was, to put it bluntly, pretty darn voluminous in the storage container. Para-wing seemed to be the best option; it did not have the fantastic lift to drag of the Sail-wing, nor did it have the extraordinary control the Parafoil would grant. It was a compromise. Para-wing took up a little more space than a Parafoil and gained significant glide distance. You might not land in a 50 ft circle with it like you could a para-foil, but you would land softer and safer and could travel further away if you needed to.
Given planned landing sites were Edwards Air Force base at Rodgers dry lakebed and White Sands Missile range in New Mexico, both essentially sandy deserts with a limited number of intervening terrain features. Giving up some control of the final landing point for a softer landing made sense.
The para-wing was shaped by straps and attachments and a thicker "boot" around the cables routed through the leading edge, a form of control could be maintained at both high and low speeds. Such a chute is more complex and harder to design than the basic Rogallo wing of the Gemini A NASA program. It is in the search for a better landing parachute for Gemini A to land on the ground that we find the further seeds of the Big Gemini. Without all the inflation devices, but including the extra cables and thickened materials utilized, a new Parachute-wing could be developed for the Gemini capsule. Such a wing, in the planned for space on the Gemini A Capsule, would have about 15% more lifting surface than the Rogallo wing, taking up about the same amount of volume and mass. It is here that MAC engineers and designers realized there were new growth opportunities.

1965: The Concept starts to evolve.

By the time 1965 rolls around, McDonnell Aircraft (or now McDonnell Astronautics Corporation and very soon to be McDonnell Douglas) Has been told firmly by NASA "**NO**" to replacing Apollo with Gemini derivatives. MAC decides to look for other ways to stay in the space business.

By this time, it was evident that the Rogallo wing is a no-go, the new Parachute-Wing is on the horizon but too late for the existing Flight schedule of Gemini Capsules for NASA. And MAC has no contracted work for the rest of the Apollo Program. This left MAC with a space conceptual team with no work and four options.

1. Shutter the space conceptual team either by re-assignment or separation (termination.)
2. Focus on gaining NASA study contracts for the re-invigorated NOVA program.
3. Focus on gaining NASA study contracts for "peer review," like Bell, TRW and Rand corporations are already doing.
4. Come up with something new.

If it isn't apparent, MAC chose 4, and Big G begins gestation inside the MAC think tank. Option 2 and 3 were not on the table because McDonnell did not have the manufacturing capability to enter the large rocket production at this time, nor did they desire to do so. While Peer Review work provides needed funds, it does not have the pomp and circumstance that MAC sought. MAC wanted to put their mark on things further than they already had. Nobody remembers it was Bell Aircraft that proved the concepts of the Moon landing, nor Rand corp, who came up with what would become Agena. MAC wanted to be KNOWN, not an afterthought.

1965: Side trip. Gemini B

Before I dive with you further into the history of the Big Gemini, we need to cover some groundwork that lets MAC keep enough of the staff and engineers on hand from the Gemini program. I have mentioned it previously, but I have not covered it. The USAF MOL/Gemini B program. Manned Orbital Laboratory is a great cover name for the spy satellite/station known as KH-10 Dorian. It was a large-diameter mirror photographic satellite station that utilized Gemini B spacecraft to launch, re-supply, and return film exposed and processed in orbit. This station was meant to launch out of SLC-6 at Vandenburg on a Titan IIIM rocket stage or something bigger as the station/satellite kept growing. It is easy to assume that Gemini B was "Blue Gemini," but it is not.

The Gemini B would involve nearly zero change to the Gemini A (NASA) capsule's waterline or exterior profile. Internally Gemini B would change structurally and electronically. The heatshield would have a hatch cut into it to allow crew members to move from the Gemini B capsule through an access tunnel in the service module to access the MOL Station proper. Newer, more

compact avionics and better control would allow for better rendezvous and docking than was practical with Gemini A.

The contract was given to MAC due to the previous extensive military work with the USAF. Also, please remember that while Project Mercury was eventually a NASA program, it was initially a military program primarily of USAF heritage with some US Navy involvement. A few short years later, after a successful, if stolen in the mindset of the USAF Brass, Mercury Program, it is evident that the USAF would come to MAC for their new space capsule.

The main changes to Gemini B involved things like Abort modes. To put it bluntly, the idea of Ejection Seats in a Pure Oxygen environment was REALLY dumb. Ejection seats typically catapult their occupant free of a vehicle via Rocket thrust. Thus, riding an ejection seat is like riding an Open Cockpit Rocket. For those who know about the tragedy of Apollo 1's fire, Pure O2 + rocket flame equals Astronauts becoming Roman candles and not being saved in the case of an abort. For Gemini B, the 6 Retro rockets, if fired at once, would provide enough thrust impulse to separate the capsule from a catastrophically failing rocket in flight. Removal of the ejection seats frees up space to allow for Gemini Ferry and then later Big Gemini.

The capsule lost the ejection seats, and in their place, smaller, lighter, and more comfortable seats were installed. Initially, it was planned that the MOL would still require space suits to be worn, but over time, and thanks to the Apollo 1 fire, this was in question later in the program's design run-up.

Gemini B and Big Gemini would have flown in a mixed gas atmosphere, and the flight suits would have been basic pressure suits and not full-up space suits. This would make more sense from a mass and space perspective and the fact that the capsules were not designed for EVA like Gemini A or Apollo. In the case of both the MOL/Gemini-B and Big Gemini, EVAs were planned through station airlocks, not the capsule themselves. This allowed more crew or cargo per unit volume of space in the capsule.

Gemini B is essential to this story because it is the core of the Big Gemini concept, even more so than the expanded cargo/passenger capacity. The Funding the USAF/NRO/CIA provided to McDonnell for KH-10/MOL was really what got the possibility of a Bigger Gemini capsule underway.

1965: Big Gemini, the basic concept:

The concept of Big Gemini was an outgrowth of the earlier "Gemini Ferry" program study from 1963.

The idea of a "butt-kicker" or "hitchhiker" addendum capsule for extra crew was nothing new to the engineers at MAC.

However, every concept up until now had to have a new custom heat shield developed, or to use the heat shield for the Apollo capsule would have led to a weird tri-conic spacecraft with unknown aerodynamic qualities and issues. In short, the Gemini Ferry failed because it became an all-new spacecraft in every way. Big Gemini was different. Big Gemini utilized the same waterline as the stock Gemini capsule… just longer.

Big Gemini, at the time was conceptualized in re-using the Apollo spacecraft's heat shield. the 150+ inch heatshield diameter allowed for almost an additional 10 feet in length to the primary Gemini capsule. Because of the advances in Digital Electronics in the "transistor revolution," it was possible to design a multi-use avionic system for the Gemini B for the USAF that would handle both the very long KH-10/MOL as well as the wider Big Gemini and service modules. The cost-sharing between the Gemini B and the Big Gemini program is one of the reasons both the KH-10 lingered on after the successes of the latter Corona variants, and Big Gemini remained financially feasible into 1969-1970.

As part of the Big Gemini concept, many things were looked at:

- 5 man "Small-Big Gemini" Utilizing a new small "addendum" part, 3 extra astronauts would fly on a modified Titan IIIM or IIIG. The Capsule and SM diameter would be 120 to 130" in diameter, the same diameter as the Titan core stage or just slightly larger. Currently, there is not a dedicated Service module for this part-set but a "1 crew" addendum to Gemini does exist. This is very similar to the initial Gemini Ferry program from 1963 listed above and should, in fact be treated as essentially the same. I believe that this would only support carrying two crew if aft docking.
- Crew Transporter: With various layouts of the Big Gemini Capsule shown to "safely" carry up to 16 astronauts in the expanded section of the capsule, Big Gemini was first and foremost thought of as a large-scale crew transporter to and from Giant Space stations

Cargo Hauler:

- The large internal volume of the 260” diameter Big Gemini capsule allowed for a significant volume of down mass from space back to Earth. Combine with a potentially substantial pressurized/unpressurized service module, and you quickly have a giant space cargo barge. In space, it would have likely handled as such. The Service Module would be a 396” diameter unit.
- 396” Pressure vessel Big G Min-Mod, was a proposed giant Big G that would have the end diameter the same as the Saturn S-IC’s stage at 396”. Aside from a drawing in the original 1968 report, there is no other mention of it, and I believe that Parachute landing issues would be huge for the technology at the time.
- Orbital Observatory. While not in the final NASA documents, McDonnell was planning on repurposing the “expansion” of Big Gemini into an on-orbit solar observatory for short-duration observations outside of the atmosphere. There were two options for mounting cameras, either in the Big-G pressure vessel or separately in the SM. The latter option would be similar to how cameras were to be mounted on the Apollo Venus Flyby mission. Not a lot is available on this concept, sadly.

1967: McDonnell Astronautics Corporation becomes McDonnell Douglas Corporation.

McDonnell purchased Douglas for the promise of better management at the Long Beach Division (Douglas Commercial Aircraft Division.) All abbreviations for the company are MDC from here forward. While not directly pertinent to the discussion on Big Gemini, it should be noted that some of the cash flow came from new military Contracts that were let with MDC that would not have been let to Douglas had it remained solo. But that is a story for a different article.

1968: NASA awards McDonnell Douglas a contract to develop the Big Gemini concept further and see if it was worth investigating further:

When NASA received reports from MCD in 1968, the engineers and budget people at McDonnell Douglas were already aware that a massive downturn in Space spending was coming soon.

Quickly the Orbital Observatory was shelved, and the engineering team looked at ways of cutting costs on Big Gemini itself. Then the “decision” was reached. Not only would McDonnell offer Big Gemini to NASA, but it would also offer TWO almost unrelated Big Geminis. First the

Min-Mod Big Gemini. With Min-Mod, you have a Gemini B capsule with its heatshield removed, and a bolt-on additional pressure vessel welded to the back of the slightly opened Gemini B bottom/aft pressure wall. This is represented very well in Bluedog Design Bureau's Big Gemini parts (Leo in-game.) Then there was the Optimized or "Advanced" Big Gemini, a completely new craft based on the overall shape of the existing Min-Mod Gemini. In art it is often mistaken for the "Big Apollo" as it is missing the standard Gemini nose. Instead it is a straight conic nose with a 5 Direction RCS array inside.

The Advanced Big Gemini had significant advantages over the "Lego-ed" together Gemini B derived "Min-Mod" Big Gemini.

1. Advanced Big Gemini was significantly lighter and stronger than the Min-Mod Big Gemini.
2. Advanced Big Gemini would be easier to refurbish for re-use and require less maintenance between launch and orbit cycles.

"Advanced" Big Gemini's biggest detractor was the excess costs for developing an all-new pressure vessel. But most of those costs would have also been involved with the Min-Mod. So not as significant as many would believe.

1969: Second Big-G Study contract

NASA awards a more significant contract to McDonnell Douglas to further refine the Big Gemini proposal with an eye. Initially of using three different rockets via differently configured Service Modules and a unified Big Gemini chassis.

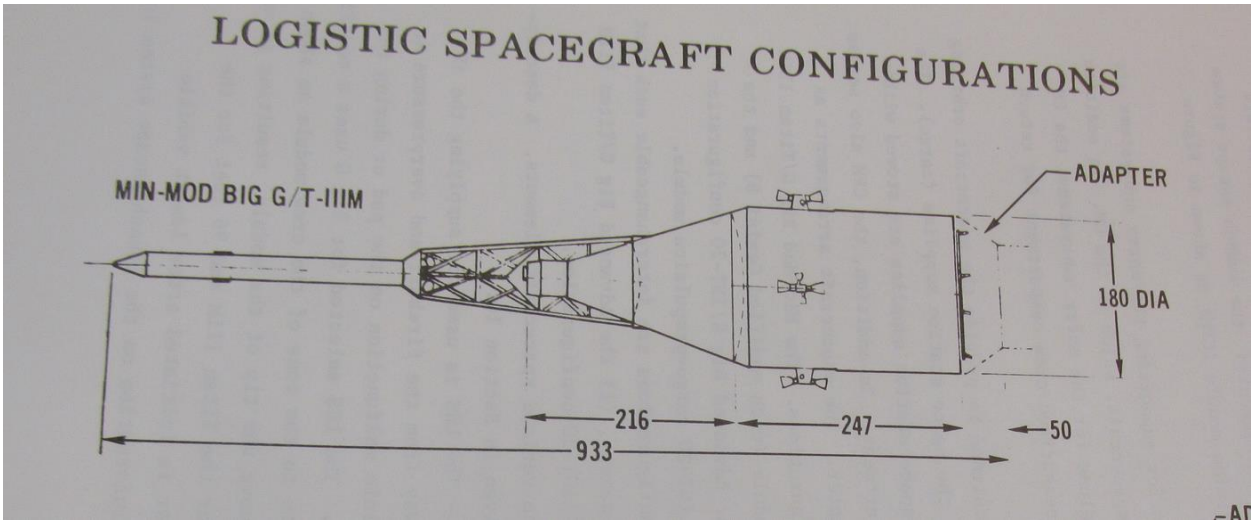
Out went the small 5 Man Big Gemini, whose development we have already traced back to the original Gemini Ferry.

Out went several conceptual Service modules, including the 130" ferry SM, the 275-300" Cylinder SM, the Conic 150"-260" SM and of course, the 396" Cylindrical SM. In the 1969 report, there were only Three Service modules left.

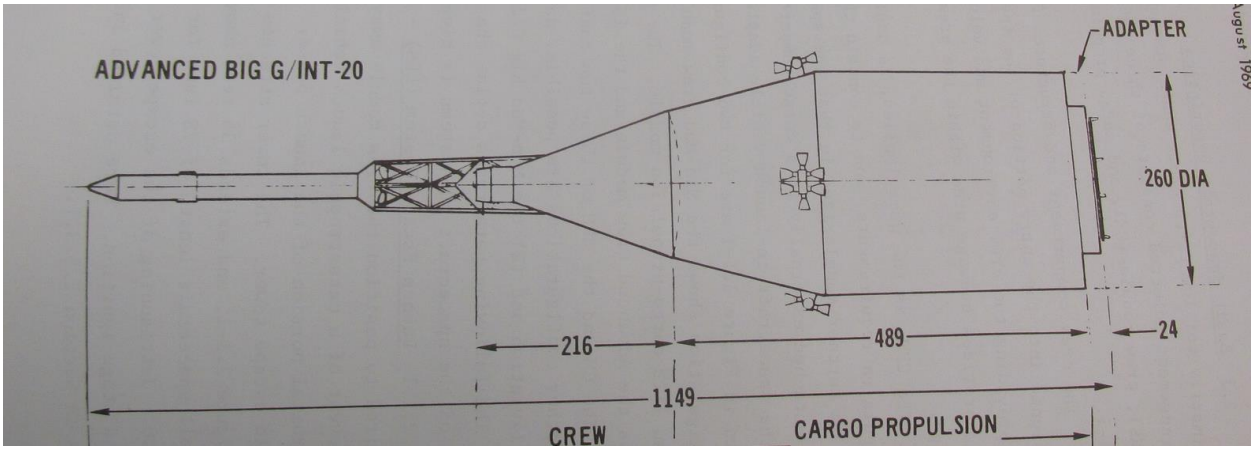
The "Saturn IB CPM Configuration" which was a small Bi-conic SM with a small pressurized cargo area and a total length of about 160" The SM consisted of 2 parts, the forward cone where the RCS and Retro bottles reside and the Aft Pressure vessel where the rear docking port and aft piloting stations would be. There was no escape hatch in this aft pressure vessel.

The "Intermediate 20 CPM Configuration" was a conic Propulsion module going from 165" to 260" with a separate 260" Cylinder that could vary in length but would typically be 290-300"

Long. No Matter the length of the Cylindrical cargo space, the pressure vessel in it would have a separate 65” diameter hatch for emergency egress in the case an Astronaut can not crawl through the 21” diameter tunnel connecting the rear pressure vessel to the Big G Pressure module.
The ”Titan 3M CPM Configuration” which like the Intermediate 20 CPM configuration above had a 65” Escape hatch in the pressure vessel. The combined propulsive and pressure vessel segments were approximately 255” long, separated at the 110” line (to reveal retro motors) and had a maximum diameter of 180”



The Saturn IB CPM Configuration was dropped from the final report because the Titan IIIM version could carry more with a lower launch cost. I further believe the lack of an escape hatch in the Saturn IB CPM variant had much to do with it being dropped. The Intermediate 20 CPM was the most modular and could be lengthened as needed. The Titan IIIM CPM was mass limited due to the limits reached on the Titan IIIM launch vehicle.



1969: NASA Fiscal 1970 Hearings:

Big Gemini is talked about between NASA administrators and Congress in March of 1969, The result of the hearings is Big Gemini being sacrificed on the alter of government to make way for the Space Shuttle. Big Gemini was used by NASA administrators as an "alternative" to Space Shuttle. Many people who are "in the know" believe that if the X-20 program had actually continued and reached flight status, the problems that Space Shuttle would face over its 30ish-year career would have become apparent, and either Big Gemini or "something else" would have been created in its place.

1970: The End

For anyone who at this point thinks the Big Gemini was a valued program, if it isn't obvious, it was at best a "paper" study to come up with an alternative to Space Shuttle that would keep Saturn Rockets flying. Beyond that, the Big Gemini was a great way to keep NASA money flowing to the newly minted McDonnell Douglas corporation. At the point KH-10 Dorian was canceled, Big Gemini became a wasteful drain on NASA's funds. A pork barrel item in Congressional budgets. This may be an overly harsh look at the events, but given the same companies issues in modern history having the same "look and feel," I feel justified in my view.

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Many Photos were taken from the NasaSpaceFlight Forum mentioned above, most collected by Blackstar direct from original documents not scanned in any public forum. Also, many drawings were created and distributed on the web through both NasaSpaceFlight.com and Secretprojects.co.uk User archipeppe (Giuseppe de Chiara) drew most of the computer graphic images for Big Gemini. They are not the most accurate specifically to Service modules, but that is likely due to the lack of available copies of the reports that cover those items more than anything else. It should be noted here that much of the model work in BDB for Big Gemini is currently based on generic non-engineering level artwork by McDonnell Douglas Corporation. Non-Engineering documents tend to be light on details, and thus BDB has similar but different inaccuracies to the artwork by archipeppe. While not the first place many of the dimensioned drawings show up, this is one of the first public uses of them. The photos in question were taken/acquired by Dewayne Day and published on NASASpaceFlight forums a few years ago.