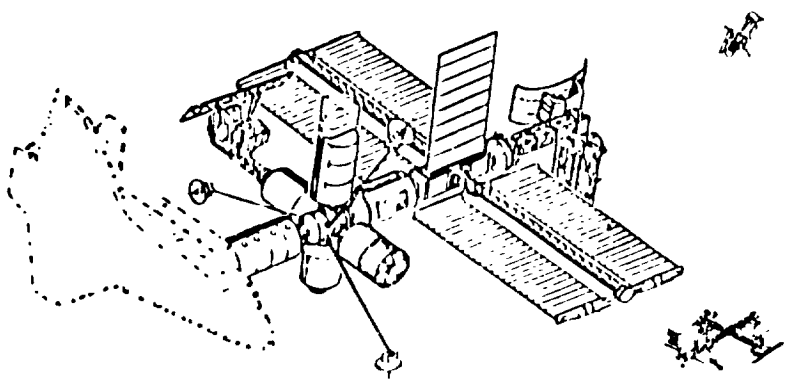


VGM068

CUSTOMER AND MISSION INFLUENCES ON SPACE STATION ARCHITECTURE

Fritz Runge

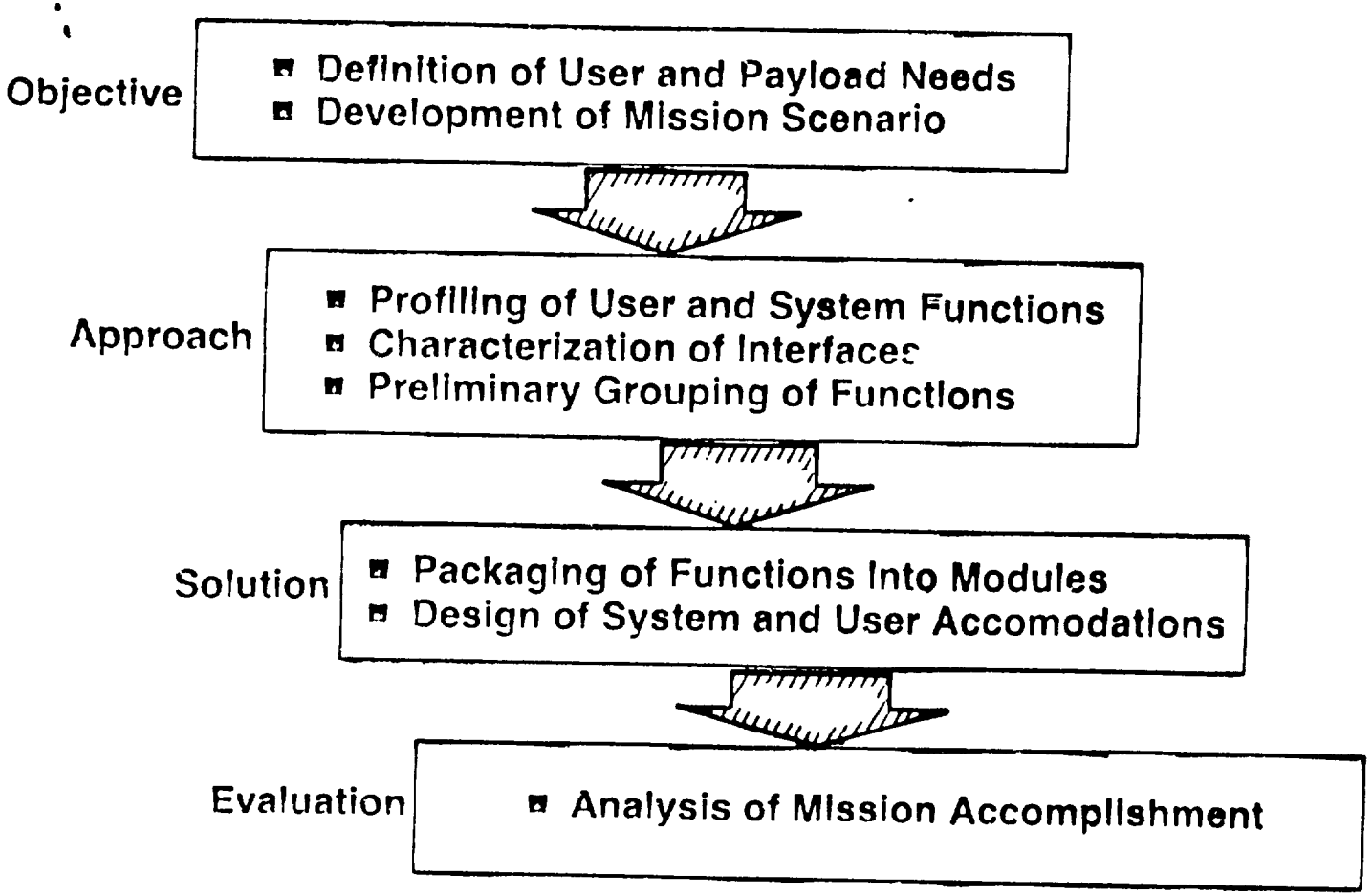
ARCHITECTURAL CONSIDERATIONS IN A SPACE STATION

VFV802

• Uses (Missions)	Science, Applications, Commerce, Defense (Integrated and Isolated)
• Occupants	Scientists, Engineers, and Technicians
• Activities	Interior: Habitation, Control, Research, Production, Maintenance, Logistics with IVA
	Exterior: Berthing, Sensing, Assembly/Checkout, Maintenance, and Logistics with EVA
• Interfaces	Shuttle, Attached Payloads, Free-Flight Payloads, and Long- and Short-Range Excursion Vehicles
• Utilities	Atmosphere, Water, Power, Data, Communications, Thermal
• Locomotion	Orientation, Reboost, Manipulation, Excursion
• Environments	Exterior: Low Earth Orbit and Operations
	Interior: Life Sustaining and Protecting Stage and Payload Storage
• Technology/Cost	Budget-Dependent: Development vs Operations

DEVELOPMENT OF SPACE STATION ARCHITECTURE

VGB597



MANNED PLATFORM ACTIVITY SPECTRUM

VGM113

(Science) (Technology) (Commercial)
(National and International)

Interior

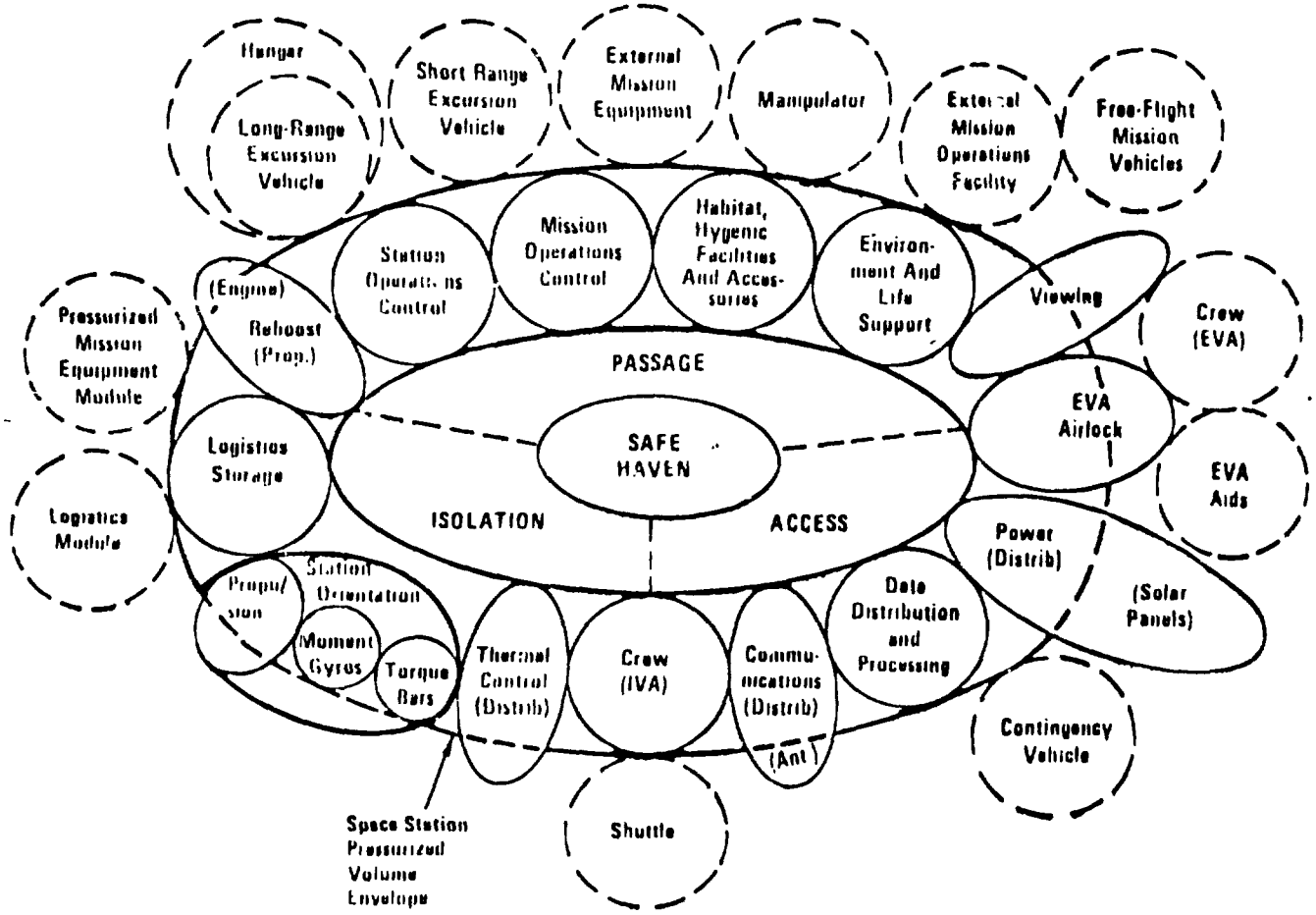
- Payload Operations
  - Life Science
  - Material Processing Applications
  - Technology Demonstrations
- Control Center(s) for:
  - Interior Operations
  - Exterior Operations/Accessories
  - Exterior Payloads
  - Maneuvering Vehicles
- Habitation/Recreation
- Maintenance/Logistics
- Traffic (Daily Routine and Periodic
- Safe Haven
- Exterior Viewing
  - Operations
  - Sight-Seeing

Exterior

- Attached Payload Operations
  - Science Instruments
  - Applications Instruments
  - Large Space Systems
  - Development of:
    - — Technology (Prototypes, Performance Measurement)
    - — Operations (Assembly, Alignment, EVA)
  - Assembly Accessories
  - Hi-Alt-Vehicle Buildup/Stowage/Launch Spacecraft Servicing
- Attached/Detached Payload Operations (Tended/Tethered/Teleoperatored)
  - Material-Processing
  - Free Flyers
  - Rendezvous Testing, Tow/Dock
  - Services and Low-G Payloads
  - Co-Orbiting Platform
- Sustaining Resource Installations
- Shuttle Interaction Operations

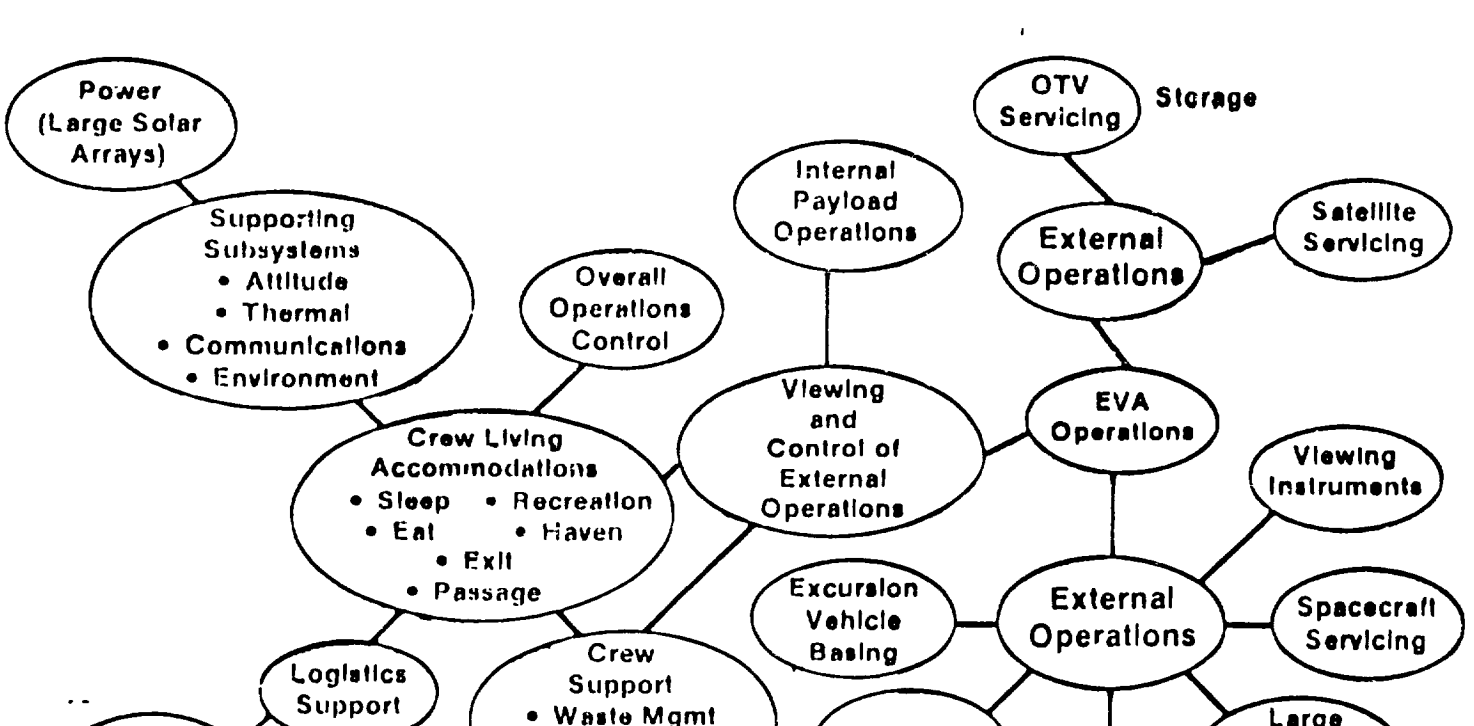
VFV803

BASIC SPACE STATION ELEMENTS



FVX303

INITIAL FUNCTIONAL GROUPING



REQUIREMENTS FULFILLMENT CONGREGATION
(HIGH-MODULARITY CONCEPT)

VFR079

- POWER (11 – 25 kW)
- COMM/DATA
- THERMAL RADIATION
- ATTITUDE CONTROL
- ALTITUDE REBOOST
- EXTERIOR PAYLOAD INSTALLATIONS

→ SUBSYSTEMS MODULE (SPACE PLATFORM)

- CENTRAL BUILDUP PORTS & PASSAGE
- UTILITIES DISTRIBUTION
- LIFE SUSTENANCE (90 DAYS)

→ CENTRAL SUPPORT AND BUILDUP MODULE

- BASIC CREW (2) ACCOMODATIONS
- MINI-CONTROL CENTER
- SAFE HAVEN

→ BASIC CREW MODULE

- LOGISTICS
  - CREW SUPPLIES
  - PAYLOADS
  - PAYLOAD SUPPLIES
  - MANNED PLATFORM AND SPACE PLATFORM SPACES

→ INTERIOR ACCESS LOGISTICS MODULE

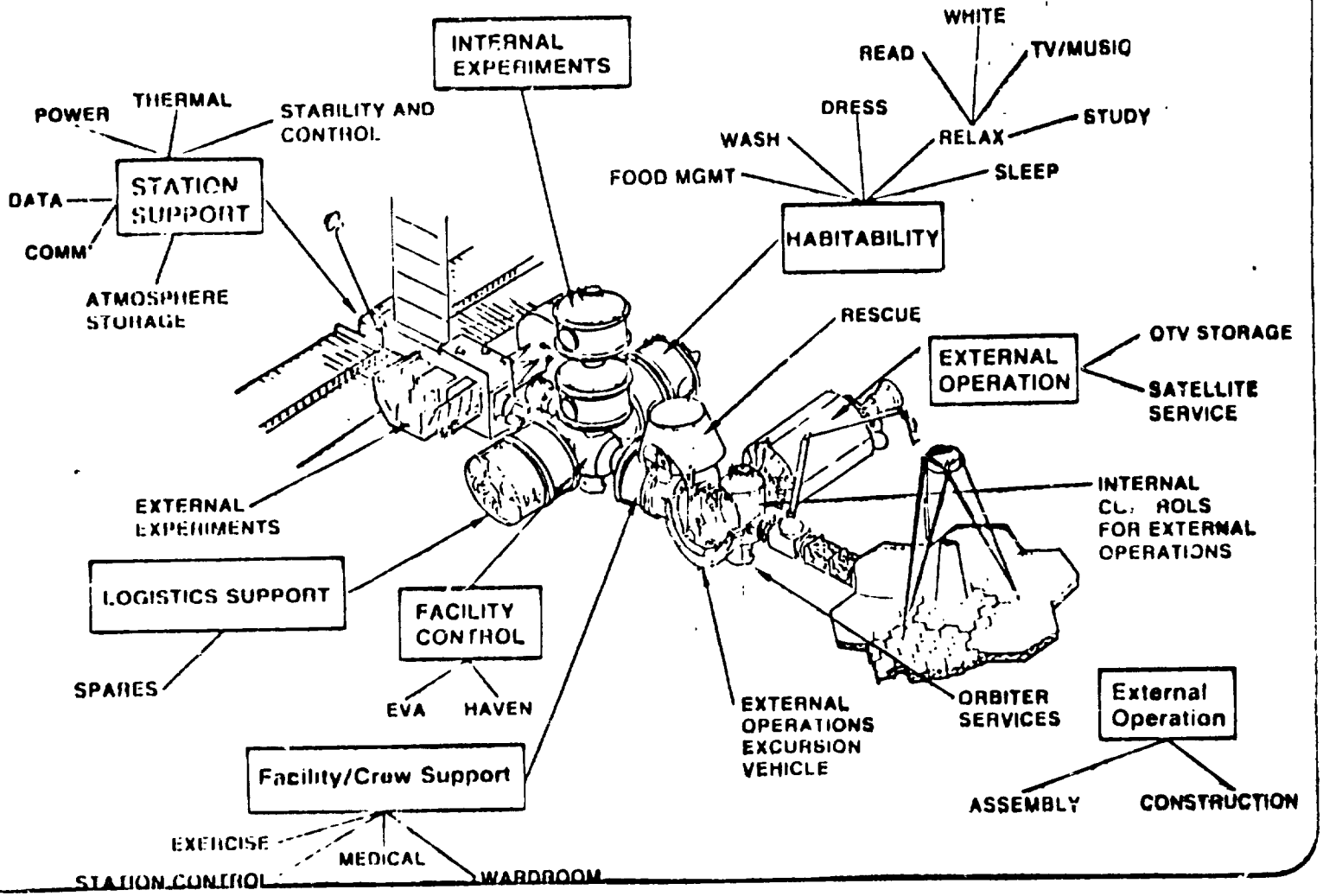
- EXPANDED CREW ACCOMODATIONS AND CONTROL CENTER → HABITAT MODULE
- EXPANDED EXTERIOR PAYLOAD INSTALLATION → EXTERIOR OPERATION MODULE
- EXPANDED INTERIOR PAYLOAD INSTALLATION → DEDICATED PRESSURE PAYLOAD MODULE
- SUBSYSTEM UPGRADES → IVA INSTALLED SUBSYSTEM MODULE
- LOGISTICS ASCENT
  - PLANNED
  - UNPLANNED

→ SHUTTLE (90 DAY CYCLE) EXPENDABLE LAUNCH VEHICLE

- EMERGENCY STATION ABONDONMENT → REENTRY CAPSULE
- EXTENDED REACH LOADING → PLATFORM MOUNTED REMOTE MANIPULATOR

SPACE STATION ELEMENTS

VFX302



CONFIGURATION ASPECTS OF PAYLOAD ACCOMMODATIONS

VGF312

Payload Type	Location Type
■ Internal	Pressurized Module
• Built-In	
• Transient	
■ External	
• Non-Viewing	Any Berth
• Viewing	
— Stellar	Space-Directed
— Solar	Space-Directed
— Earth	Earth-Directed
• Large Assembly	Large Free Volume
• Periodically Serviceable	Close-In Access Aids Possibly Enclosed
• Small Reusable Stages	Semi-Remote Berth
• Large Reusable Stages	Semi-Remote Berths (Near Station Centerline)
• Large Propellant Storage	Semi-Remote Berths (Near Station Centerline)

Constraints

- Approach/Exit Movement Corridors
- Solar Array Shadowing
- Radiator Reflections
- Manipulator Access (Shuttle/Space Station)
- Multiple Orbiter Berthing Ports
- Interim Berthing During Assembly or Exchange

Exterior Payload Operations/Time Impact Configuration Significantly

ARCHITECTURE OPTIONS FOR PAYLOAD ACCOMMODATIONS

VGM110

Laboratory Module(s) (Interior Payloads)

- Lab Functions Only
- Lab and Crew Qtrs Hybrid
- Lab and Sta-Control Hybrid
- Dedicated Types
- General Purpose Types
- Short Module
- Long Module/Unpartitioned
- Long Module/Partitioned
- Some Long, Some Short
- Accessories:
  - Built-In Radiator
  - Scientific Airlock

Service Center (Exterior Payloads)

- Integrate With Multiple Docking Adapter
- Separate Multi-Berth Unit (Trusswork) (Tunnel)
- One Unit/10 Berths (All-In-One)
- Two Units/5 Berths (i.e. Modular)
- Incorporates Big Manipulator
- Incorporates Radiators
- Articulating (For Broad Op's Flexibility)
- Central, Top or End-Mounted
- Rotating Berths For Maximum Viewing Payload, or Assembly Op's Flexibility
- Hangar Provisions (Pressurized/ Unpressurized)

SPECTRUM OF SERVICES SCENARIOS (RELATED TO SPACE STATION)

VGF194

■ User Types and Service Locations:

	On Station	Off Station
• Space Station Attached Payloads	✓	
• Free Flying Spacecraft	✓	Via TMS
• Teleoperator Maneuvering System	✓	Via TMS
• Space Platform	?	Via TMS
• Space Platform Attached Payloads	?	Via TMS
• Reusable Orbit Transfer Vehicles	✓	
• ROTV-Boosted Free-Flying Spacecraft	✓	
• ROTV-Boosted Servicer	✓	

VGF231

SPACE STATION SERVICE CENTER

Objective

- Provide a Broad Range of Enabling and Sustaining Services to Resident and Transient Payloads

Service Functions (in Graduated Capability/Time)

- Berthing
- Activation
- Deployment
- Diagnosis
- Alignment
- Replenishment
- Enclosure
- Replacement
- Modification
- Assembly
- Stowage
- Checkout and Launch
- Manipulation
- Maintenance
- Surface Treatment

Types of Payloads (Nasa, DoD, Commercial, Foreign)

- Self-Propelled Spacecraft
- Propulsion-Staged Spacecraft
- Teleoperator Maneuverer
- Orbit Transfer Vehicle(s)
- Reusable Orbit Transfer Vehicle
- Palletized Payloads) (Resident/Non-Resident)
  - Science
  - Earth Applications
  - Technology
- Space Platforms (?)

SPACE STATION SERVICE CENTER (CONT.)

VGF232

Major Configuration Elements

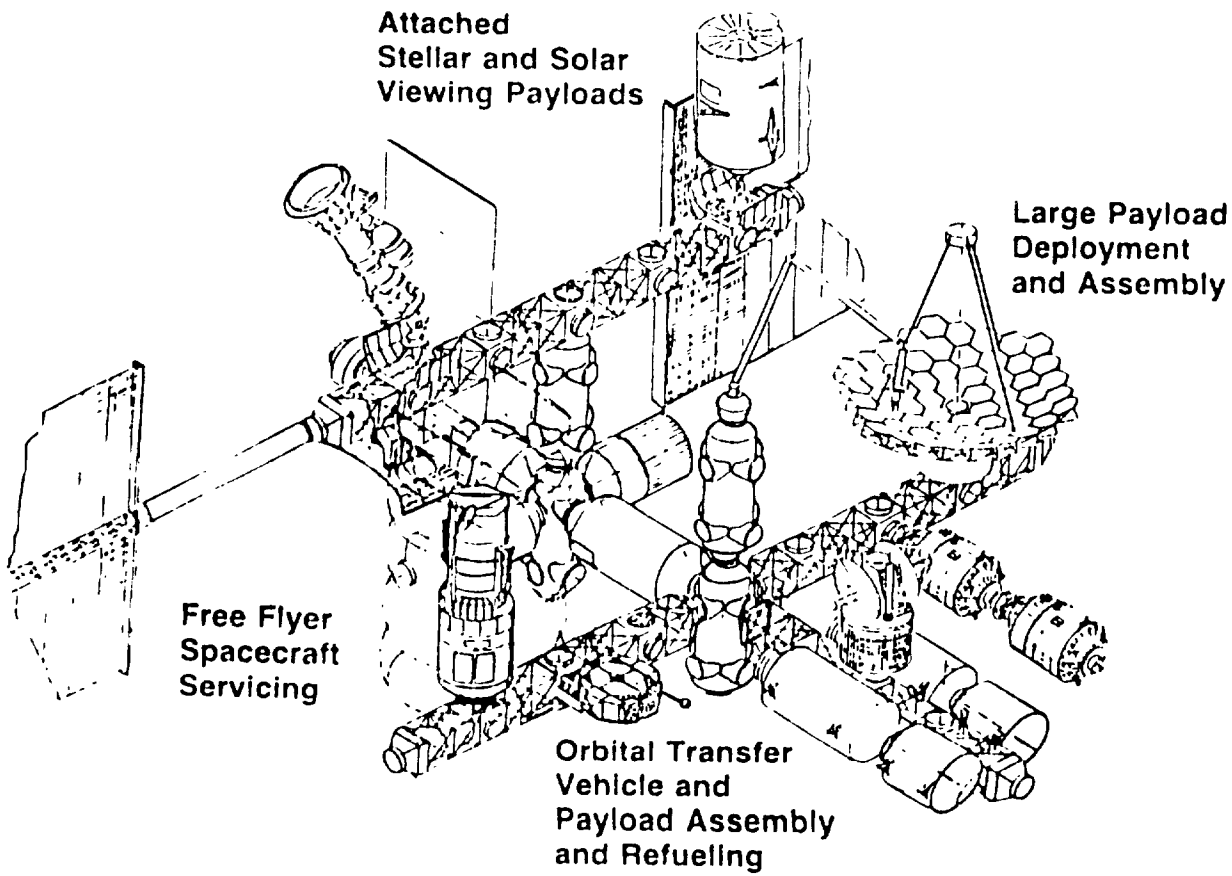
- Servicing Control Centers (General and Dedicated)
- Articulated, Truss Beams(s) with Berthing Ports
- Power, Data and Communications Distribution
- Liquid, Gas Storage and Distribution Systems
- Manipulator(s): Major and Localized — Minor Types
- Enclosure(s): Permanent and Portable
- EVA Access/Assistance Equipment
- Interior Stowage (Replacement/Modification items)
- Exterior Stowage (Interim and Long Term Berthing)
- Tool and Supplies Stowage
- Diagnostic and Checkout Equipment
- Work Bench Areas
- Directed Lighting

Configuration Constraints

- Extensive Crew Visibility of Operations
- Safe Rendezvous and Exit Flight Corridors
- Efficient Shuttle RMS Loading Access or Handover
- Extensive Payload (Berth) Separation for Viewing or Movement Freedom
- Minimal Solar Array Shadowing and Radiator Reflection

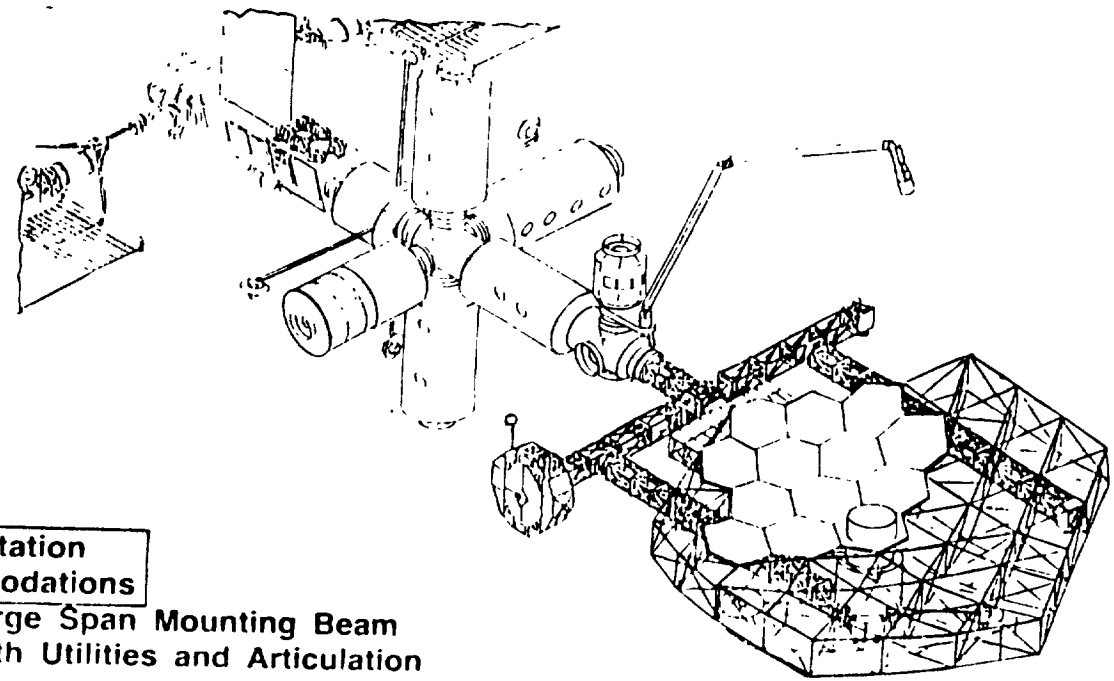
VGF602

ATTACHED PAYLOAD AND MULTI-SERVICE CENTER



LARGE DIAMETER REFLECTOR ASSEMBLY

VGM112



Space Station Accommodations

- Large Span Mounting Beam With Utilities and Articulation
- Long Reach Manipulator
- Interim Stowage Locations For Construction Elements
- Operational Viewing
- Internal Control Center
- EVA Crew Capabilities
- Possible Enclosure/Contamination Shield Provisions

SPACE STATION MISSIONS
EARLY SET (1991-93)

VGK162

Missions Externally Attached to SS Base (Or Co-Orbiting Platform)

SAA	0001	Cosmic Ray Nuclei
SAA	0002	Space Plasma Physics
SAA	0003	Solar Optical Telescope
SAA	0004	Shuttle IR Telescope Facility
SAA	0006	Starlab
SAA	0201	LIDAR Facility
SAA	0306	CELS Pallet
COM	1202	EOS Production Units
COM	1203	ECG Production Units
COM	1105	Communications Test Lab
TDM	2010	Materials Performance
TDM	2060	Deployment/Assembly/Construction
TDM	2070	Structural Dynamics
TDM	2080	Design Verification
TDM	2210	Large Space Antenna Technology
TDM	2260	Earth Observation Instrument
TDM	2310	Fluid Management Technology
TDM	2410	Attitude Control Technology
TDM	2420	Figure Control Technology
TDM	2460	Telepresence and EVA Technology
TDM	2470	Interactive Human Factors
TDM	2510	Environmental Effects Technology
TDM	2560	Satellite Servicing Technology
TDM	2570	OTV Servicing Technology

Missions Accommodated Inside SS Laboratory Modules

SAA	0307	Life Science Laboratory
COM	1201	MPS Lab #1
TDM	2020	Materials Processing
TDM	2520	Habitation Technology
TDM	2530	Medical Technology
TDM	2580	On-Board Operations Technology

Free-Flyer Missions Serviced At/By SS Base

SAA	0012	Space Telescope
SAA	0013	Gamma Ray Observatory
SAA	0014	X-Ray Timing
SAA	0016	Solar Max Mission
SAA	0017	AXAF
SAA	0019	Far UV Spectroscopy

Planetary Missions Supported at SS Base

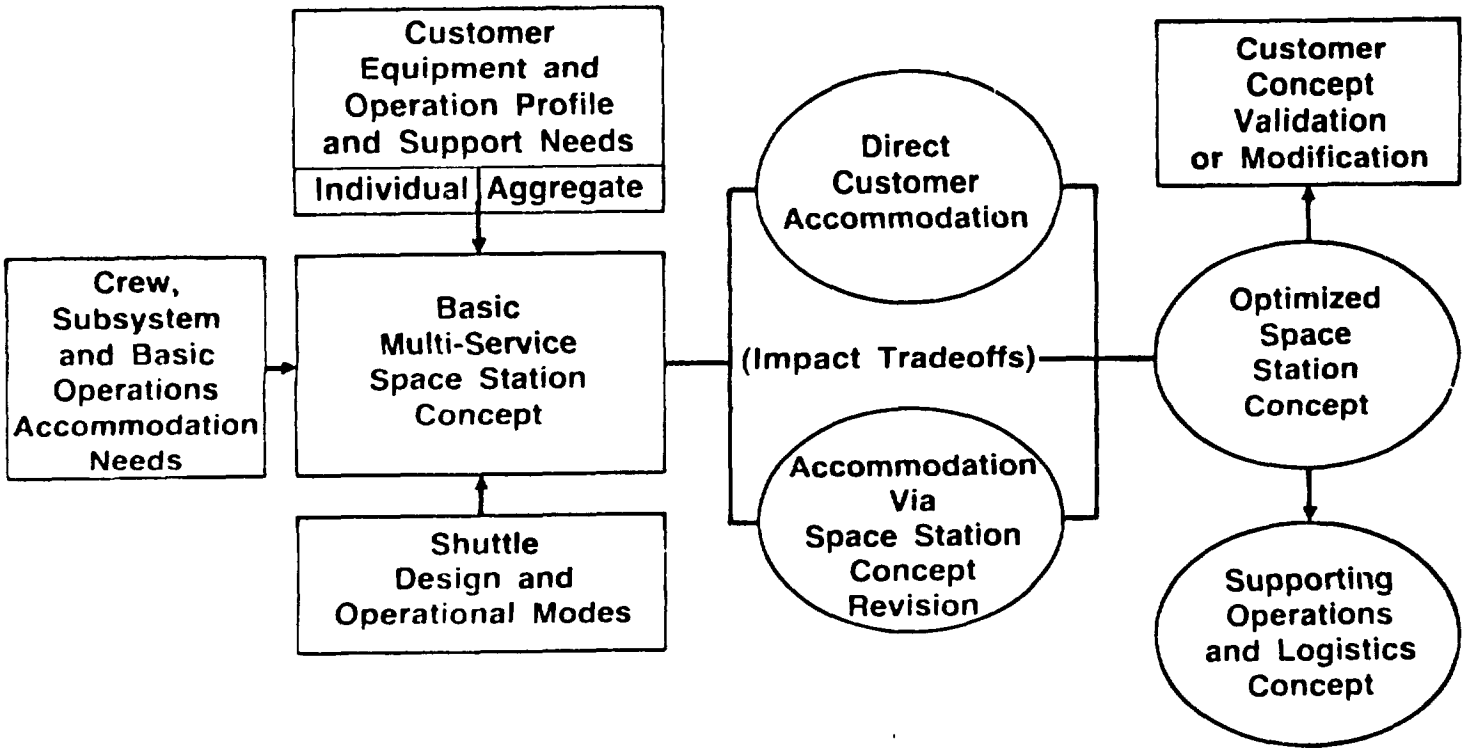
SAA	0102	Lunar Geochemical Orbiter
SAA	0105	Titan Probe

Missions Supported By Polar Platform

SAA	0202	Earth Sciences Research
COM	1019	Stereo Multi-Linear Array

CUSTOMER ACCOMMODATION CONSIDERATIONS IN ARCHITECTURE

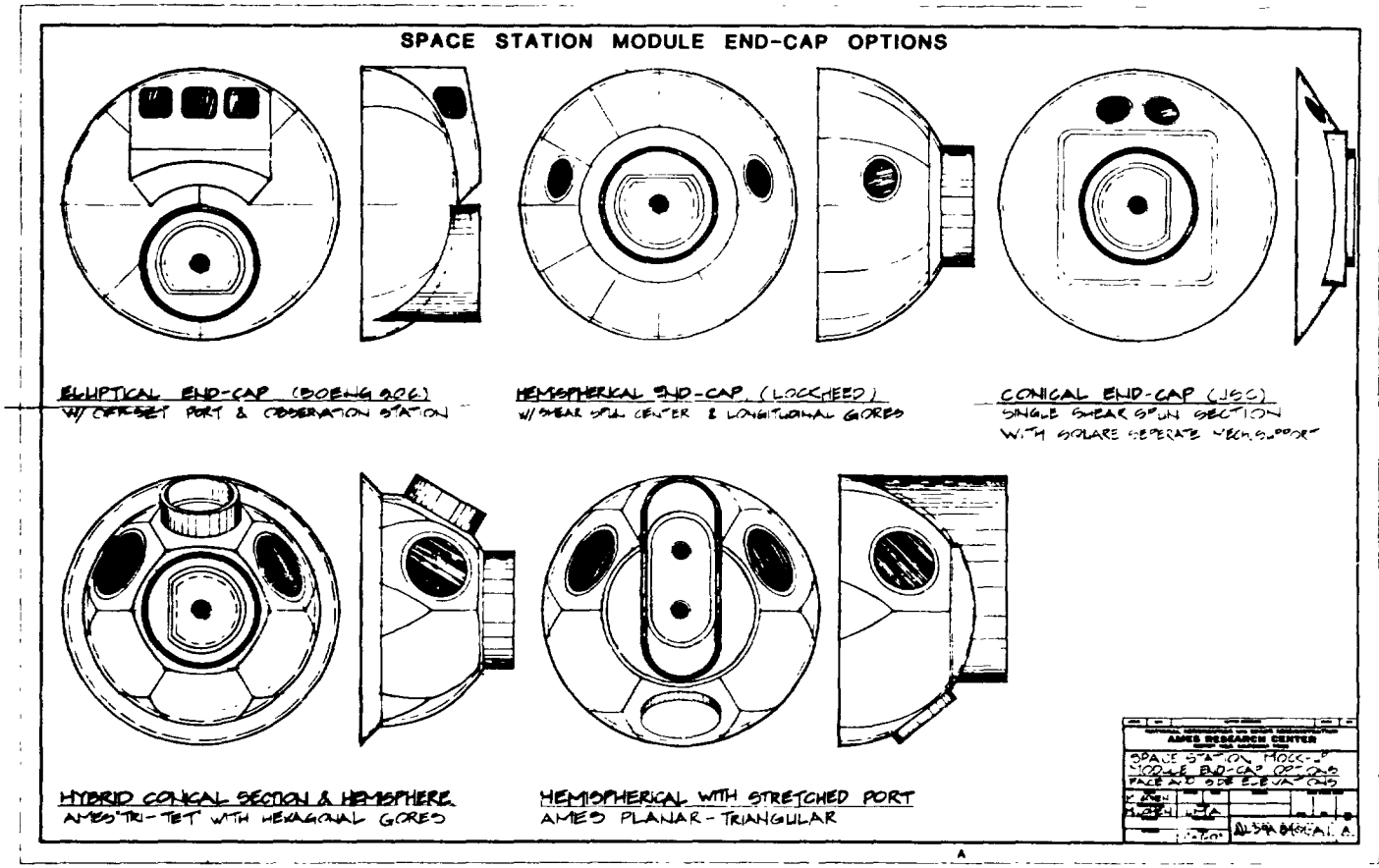
VGM111



FRIDAY

AMES MOCK-UP IDEAS
FOR SPACE HUMAN FACTORS RESEARCH

MARC M. COHEN
ARCHITECT
MARCH 2, 1984



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