International Space Station Lessons Learned by JAXA

NASA Project Management Challenge 2010

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Executive Director
JAXA

Lessons Learned

1) Need for quick achievements for sustainable political and public support

- Considering your ISS experience, how can this best be done for exploration?

Lessons Learned for Japan:

（ 1 ） Japan’s ISS program met substantial delays until the launch of the Japanese Experiment Module (Kibo : means hope).

（ 2 ） The start of Kibo utilization and long-duration missions of Japanese astronauts took about 20 years since the beginning of development in 1989.

（ 3 ） Though funded by taxpayers, outcomes of the ISS Program to show to the Japanese public have not occurred for a long time.

（ 4 ） Consequently, the Japanese public’s understanding and support of the ISS program declined until the recent launches.

Application for the future space exploration program:

It is essential to establish a sustainable program through which the outcomes from contributions and investments can be accomplished, and become visible to the national public in a timely manner.

Large and Complex Space System Construction Approach (1/2)

1. Complexity of the ISS Program

(1) International program composed of five agency's participation, NASA, FSA, ESA, CSA and JAXA.
This includes fifteen(15) country's governments.

(2) The largest permanent manned endeavor never built before.

- Composed of over 20 segments each launched by the Space Shuttle or Russian launch vehicles.

- Those segments are assembled by the robotics and EVAs on-orbit, and finally completed as the overall configuration.

2. ISS Design Approach and the Issues

(1) Overall design and the centralized subsystem architectures are defined first.
There were a lot of unknown "requirements" at the beginning, which were essential to define the overall systems and to develop the architectures.
Defining the "requirements" was a major activity of Systems Engineering then.

Large and Complex Space System Construction Approach (1/2)

(2) It took a long time to finalize overall system configuration and the subsystem architectures.
The already delayed program faced political and technical environmental changes, which imposed further delays.

(3) The US provides major parts of the subsystems including resource segments
such as the power, thermal, data, and life support systems, etc.

(4) Japan provides the Laboratory Module “Kibo,” which cannot be launched and
assembled until major parts of the US segments and the subsequent system supporting functions are prepared on orbit.

(5) As a result, “Kibo” has to wait 13 years to be launched, while investing the funds for design and development without showing any outcome.

Large and Complex Space System Construction Approach (1/2)

3. Alternate Approach - Building Block Approach

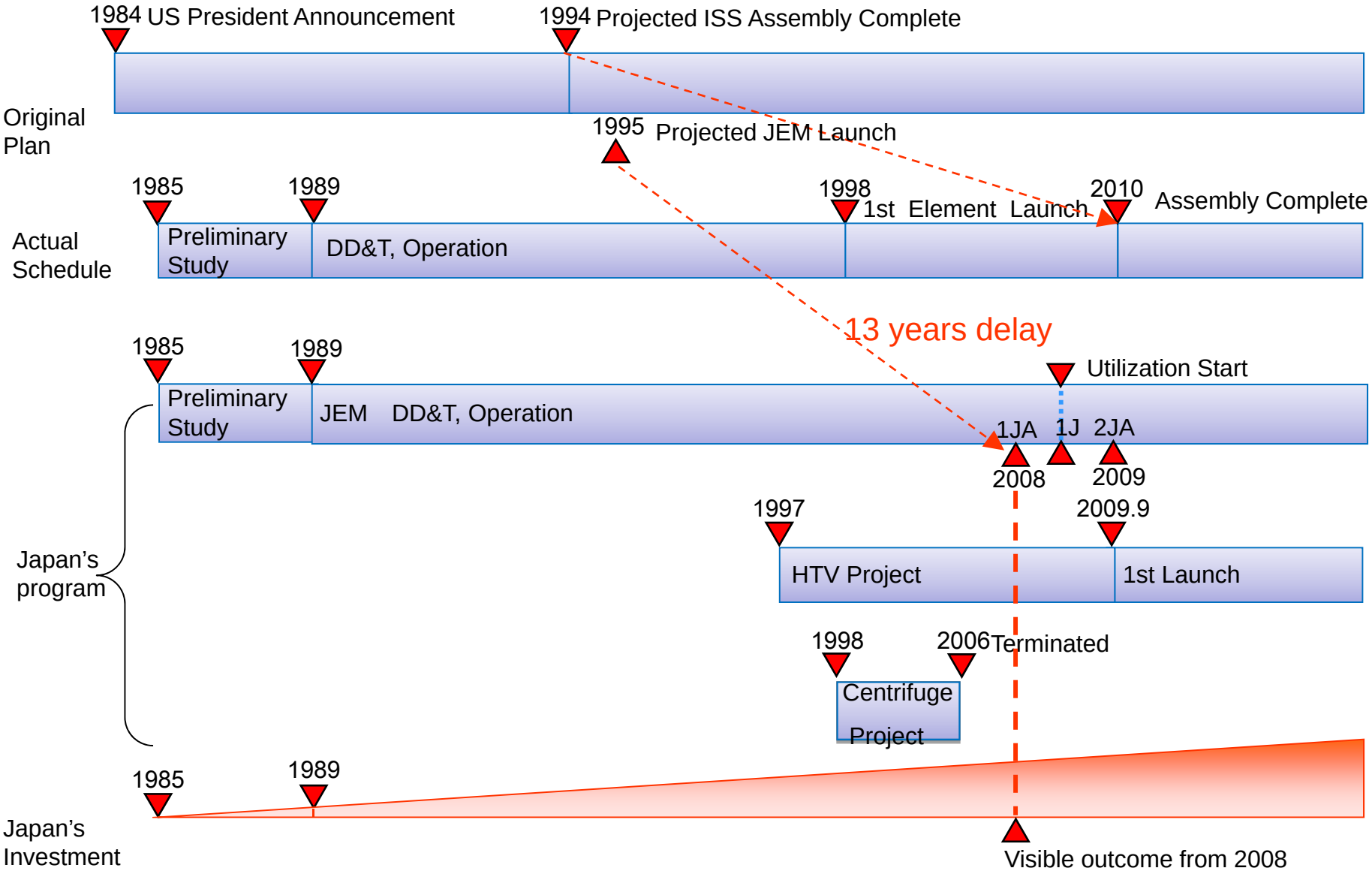
(1) Each segment has some level of functionality to support its own system.

(2) Each segment can be assembled by segment.

(3) The overall system will be constructed step by step, maintaining the functionality at each step.

The overall system requirements needed at the beginning are “the flexible” evolution capability and robustness”.

ISS PROGRAM SCHEDULE CHANGES



MAGIK
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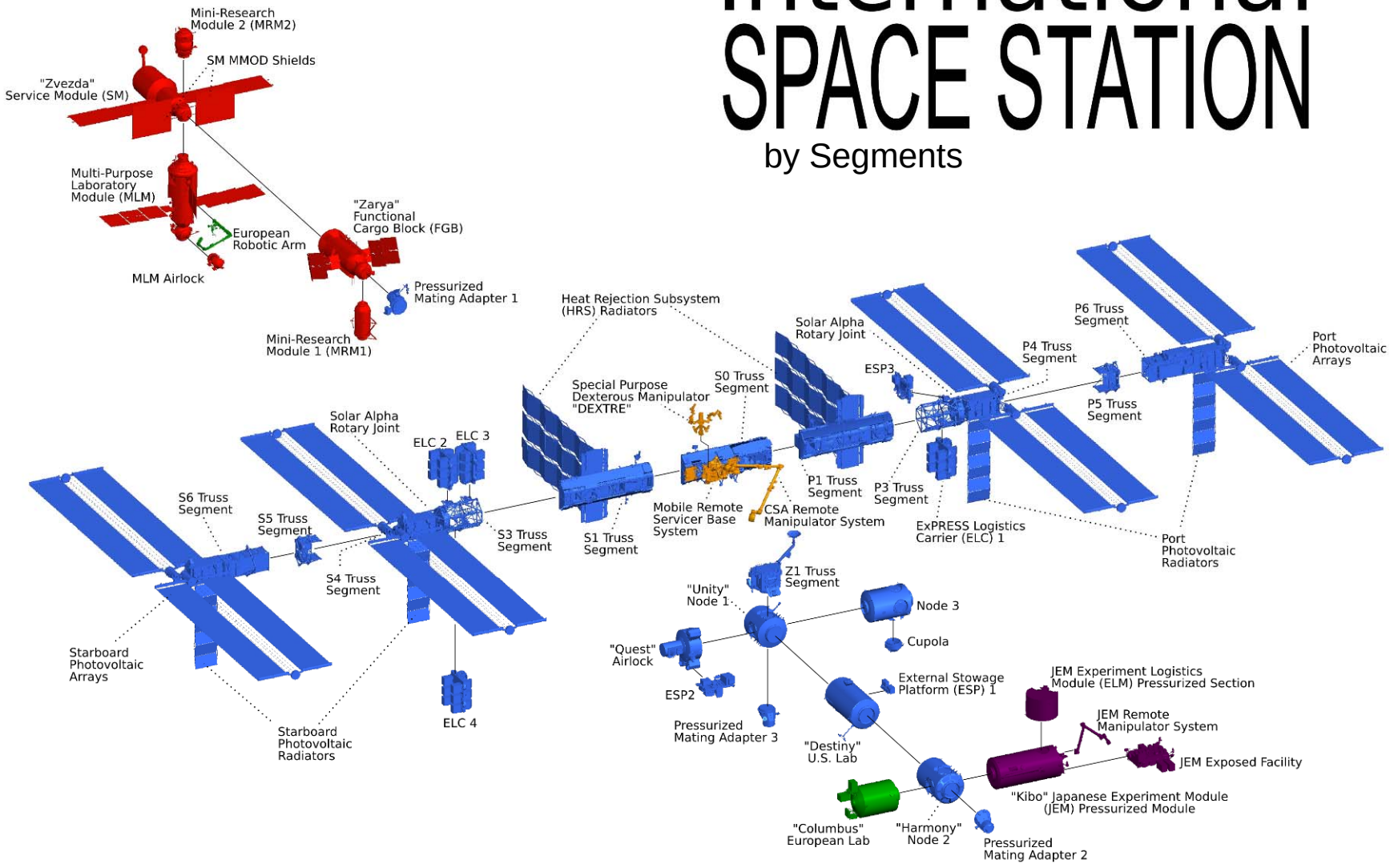
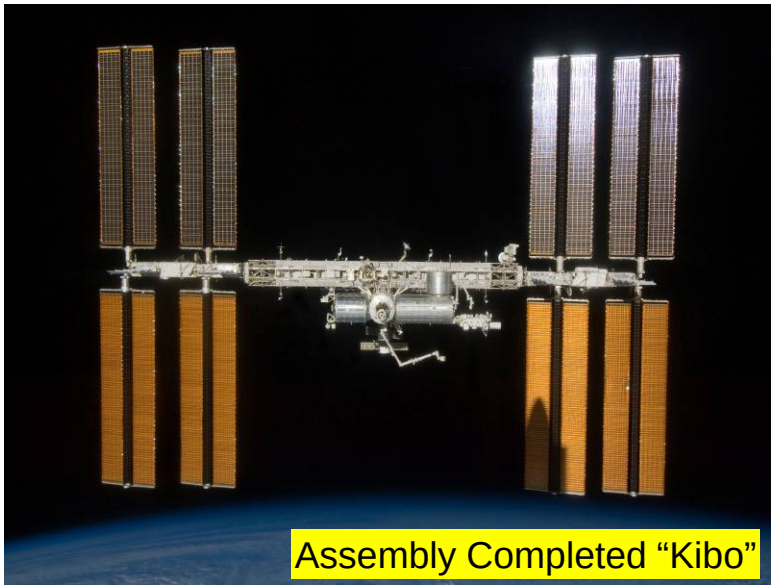
International SPACE STATION

by Segments



I S S Assembly Flights

Launch Day	Flight	Launch Vehicle	Segment
1998.11.20	1 A / R	Proton	FGR (Zarya) (Unmanned)
1998.12.04	2 A	STS-88	Node 1 (Unity) 、 P M A-1, 2
2000.07.12	1 R	Proton	Service Module (Zvezda) (Unmanned)
2000.10.12	3 A	STS-92	Z 1 Truss、 P M A - 3 (Wakata)
2000.10.31	2 R	Soyuz	Soyuz (3crew started)
2000.12.01	4 A	STS-97	P 6 Truss (Solar Array)
2001.02.08	5 A	STS-98	U.S. Lab (Destiny)
2001.04.20	6 A	STS-100	SSRMS
2002.04.08	8 A	STS-110	S 0 Truss
2002.11.23	1 1 A	STS-113	P 1 Truss
2005.07.26	L F 1	STS-114	Logistic Flight (Noguchi)
2006.09.09	1 2 A	STS-115	P3/P4 Truss (Solar Array)
2007.06.09	1 3 A	STS-117	S3/S4 Truss (Solar Array)
2007.10	1 0 A	STS-120	Node 2
2008.2	1 E	STS-122	ESA Laboratory (Columbus)
2008.3	1 J / A	STS-123	JEM-ELM-PS、SPDM(Doi)
2008.6	1 J	STS-124	Japanese KIBO Laboratory with Robotics Arm、(Hoshide)
2009.3	1 5 A	STS-119	S 6 Truss (Solar Array) (Wakata)
2009.7	2 J / A	STS-127	JEMEF、JEM ELM-ES
Now 2009.9	H T V 1	H-IIB	HTV-1
2010.2	2 0 A	STS-130	Node 3 、Cupola
2010.3	1 9 A	STS-131	Logistics Flight (Yamazaki)
2010.7	ULF6	STS-134	Logistics Flight



9/29/2009

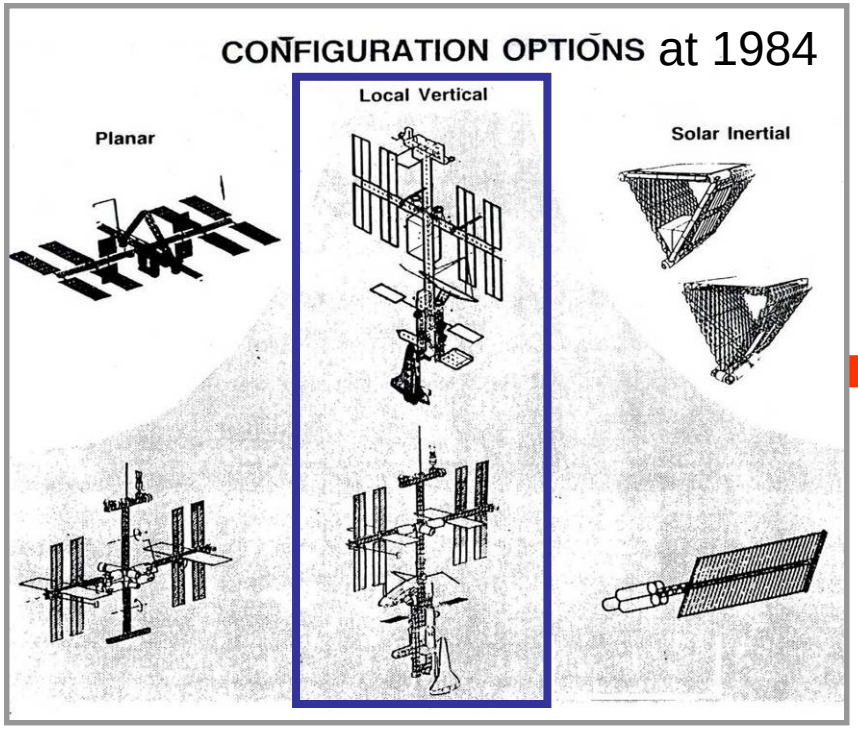
Current Crew 1/25/2010

Left to Right

Timothy Creamer(US) 、Jeffrey Williams (US) 、

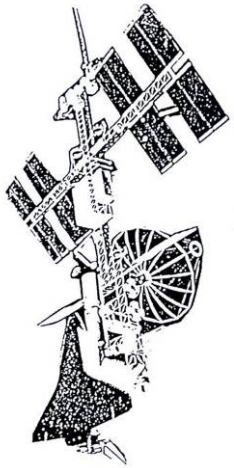
Maxim Suraev(Russia)、Oleg Kotov (Russia) 、Soichi Noguchi (Japan)

ISS CONFLGURATION BEGINNING AND NOW

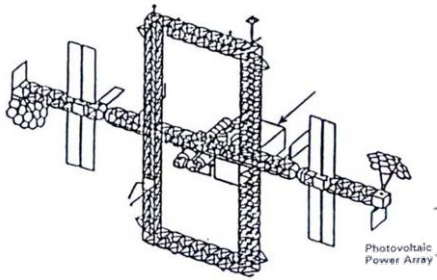


CURRENT CONFIGURATION at 2009

ISS CONFIGORATION CHAGES SINCE 1985

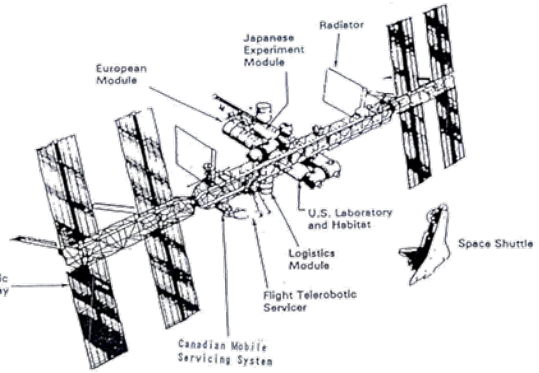


April 1985



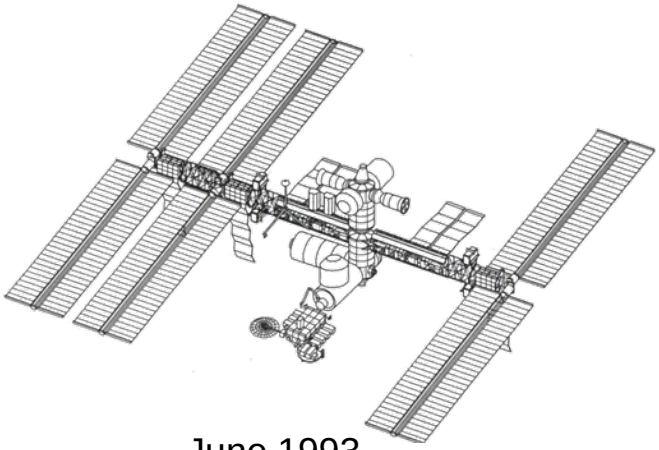
July 1986

Freedom



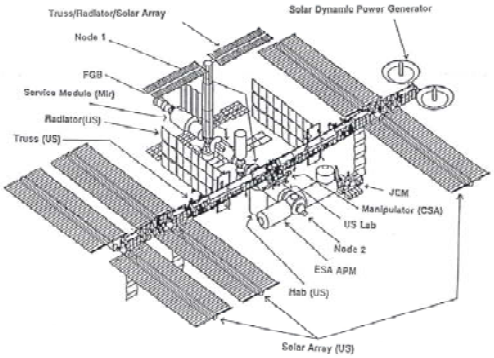
October 1989

(Pephasing)



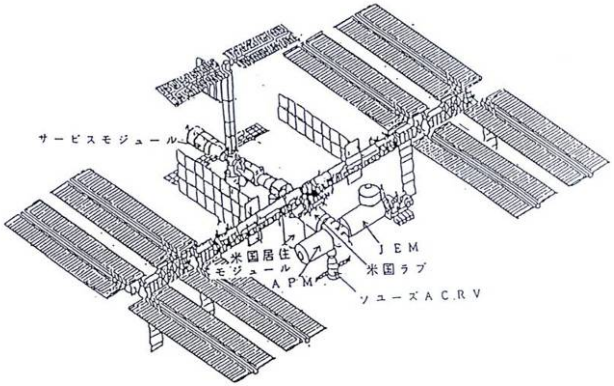
June 1993

(Redesign)



November 1993

Russian Alpha



March 1994

ISS

March 2006

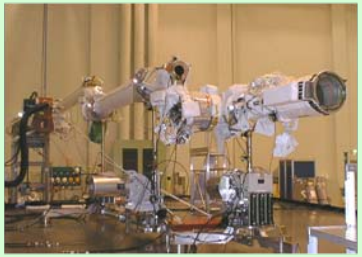
Current ISS

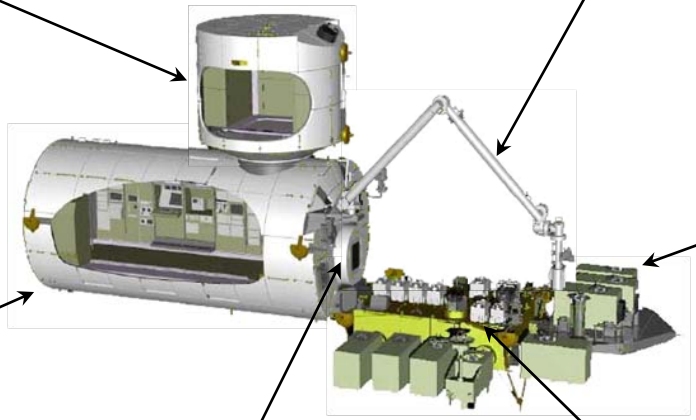
JAPANESE EXPERIMENT MODULE “KIBO” FEATURES

Experiment Logistics Module-Pressurized Section (Pressurized Container and On-orbit Storage Volume)

“Kibo” is a Multi-Purpose Experiment Laboratory built by Japan. Accommodate the Pressurized Experiments and the Exposed payloads.

Robotics Arm -Used for the Exposed Payloads Handling and Exchange

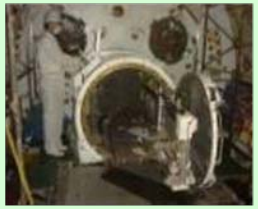




Experiment Logistics Module-Exposed Section (Carrier for the Exposed Payloads)

Pressurized Module-Laboratory (Accommodates 10 Racks)

Airlock-Used for the Equipment Transfer between Inside and Space



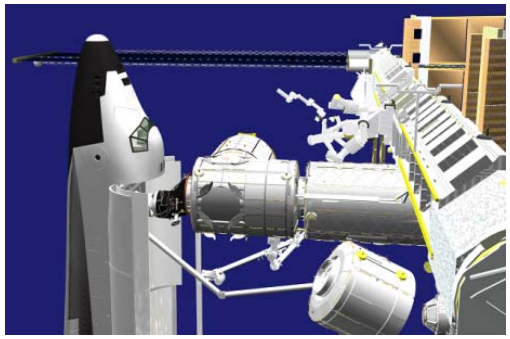
Exposed Facility-Platform for the External Payloads Attachment (Max. 10)

“Kibo” Launches and Assembly Sequence

1st element

Logistics Module (1 J / A)

March 2008



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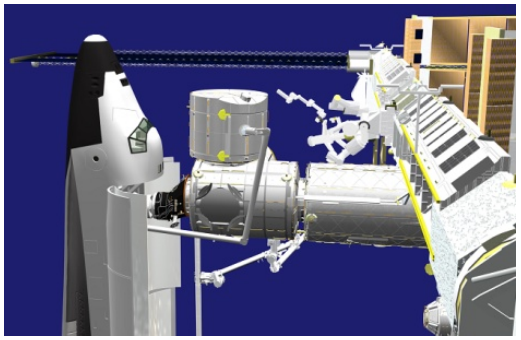

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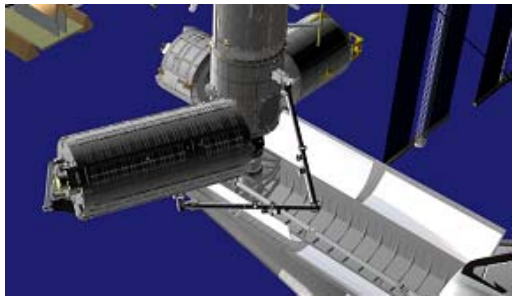
2nd element

Pressurized Module (1 J)

June 2008



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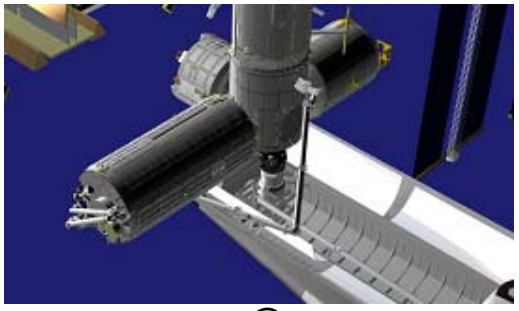

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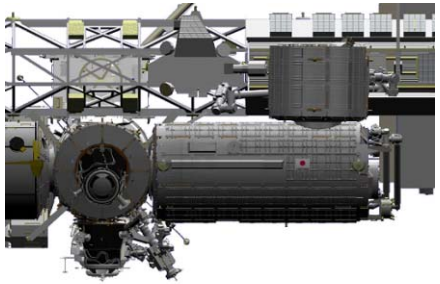

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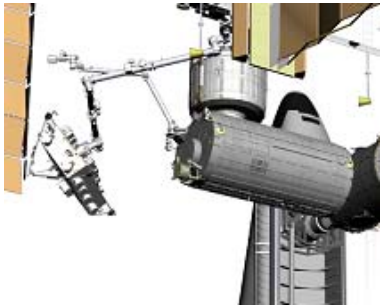
3rd element

Exposed Facility and the Payloads (2 J / A)

July 2009



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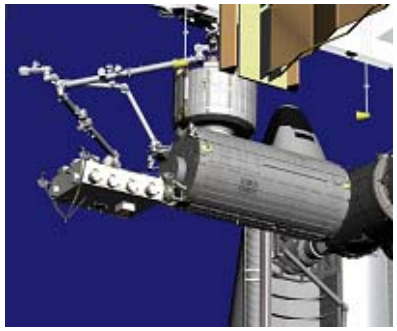

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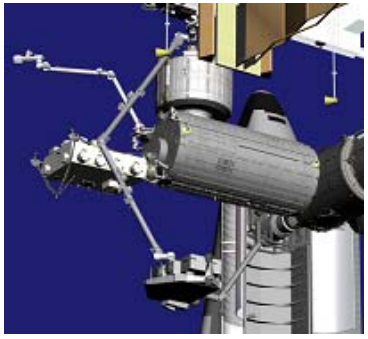

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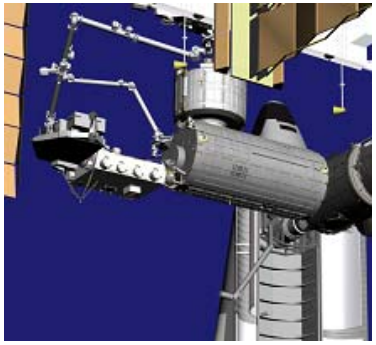

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