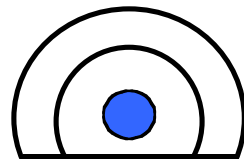
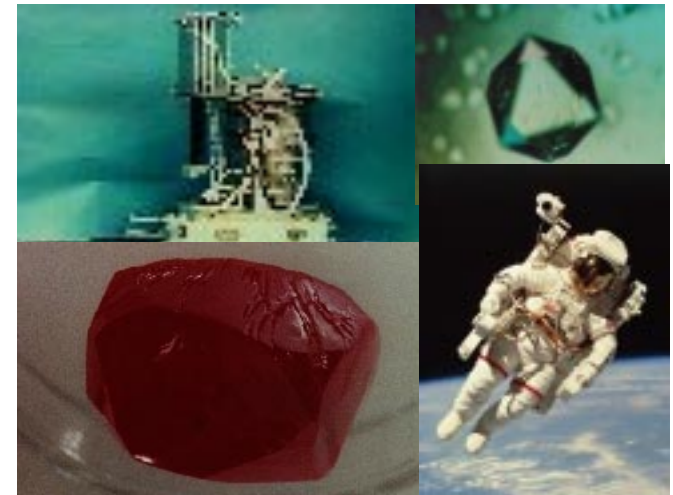




ISS and Space Commerce



**CSP Japan Seminar
Tokyo, Japan
24 February 1999**



CSP Associates, Inc.

The Political Landscape

- λ ISS is finally a secure *political* reality
 - λ There is virtually no serious discussion of canceling the program
 - λ Despite on-going schedule and budget issues, everyone now agrees that the ISS will exist

- λ Congress and the Administration are now shifting their attention to the issue of ISS operations and utilization
 - λ How do we ensure that the ISS is affordable to operate
 - λ How do we ensure that it is used as effectively and efficiently as possible?

- λ A continuing element of this discussion are the mechanisms by which NASA can increase the role of private industry:
 - λ In operating and maintaining the International Space Station
 - λ In supporting International Space Station users
 - λ In building new capabilities and upgrades to the ISS system
 - λ In using the ISS for commercially-relevant and economically-useful activities

NASA is now paying serious attention to long-term ISS operations and utilization issues

NASA's ISS Objectives

- λ **Industrial exploitation of near-Earth space is a fundamental objective of the U.S. investment in the International Space Station**
 - λ Several studies forecast *potential* economic benefits from space-based microgravity R&D and production facilities
 - λ Shuttle-based R&D activities have offered positive results, but limited flight opportunities preclude systematic investigation or exploitation
 - λ ISS will provide a quantum change in the microgravity infrastructure



- λ **NASA has reaffirmed its commitment to commercial utilization of ISS**
 - λ R&D breakthroughs provide the American taxpayer with a 'return on investment'
 - λ Private sector users paying a 'fair share' of ISS operations costs will enable NASA to reallocate funds to new missions/challenges (30% of ISS operations costs = ~\$400 million)

NASA wants and needs a vibrant Space Station user community!

The Commercial Equation

- λ **NASA has two interrelated challenges:**
 - λ **Convincing industry that space-based research activities can play an important scientific or technical role in their businesses**
 - λ **Convincing industry to pay for ISS resources**

- λ **Industry must be able to define a positive cost-benefit calculus, *in the context of alternative uses of capital***
 - λ **Most companies have well-defined (and under-funded) R&D programs**
 - λ **ISS experiments must be attractive enough to displace other activities**

- λ **In order to articulate a compelling reason for ISS projects, users require:**
 - λ **Knowledge of what the ISS environment offers**
 - λ **Ability to relate that environment to specific corporate technology objectives**
 - λ **Opportunity to exploit the results for competitive or financial advantage**

***Industry will evaluate ISS in the context of its needs, not NASA's
Corporate Utilization of ISS = f(potential benefits, anticipated costs)***

Industry Investments in R&D

- λ Industry R&D investments typically move through three phases
 - λ Exploratory (basic) research in which 'promising hunches' are pursued
 - λ Applied/Demo where successful 'hunches' are tested in a prototype or testing environment
 - λ Production phase in which successful Applied/Demo products move into full scale development leading to production

- λ Process is typically one of winnowing down to a few good ideas
 - λ Cost of each progressive step rises several factors or orders of magnitude

TYPICAL R&D INVESTMENT PARAMETERS			
MARKET	EXPLORATORY	APPLIED/ DEMO	PRODUCTION
ELECTRONICS	<\$1.0M	~\$25M	~\$500-1000M
BIO/PHARM	\$0.7-3.0M	~\$5M	~\$200-250M
MATERIALS	<\$1.0M	~\$25M	~\$500-600M
REMOTE SENSING	\$0.5M	\$0.5M	~\$100-300M
ENTERTAINMENT	NA	NA	<\$10M

Sources: KPMG Industry Survey; NSF Survey of Industrial Research and Development; KPMG/CSP estimates

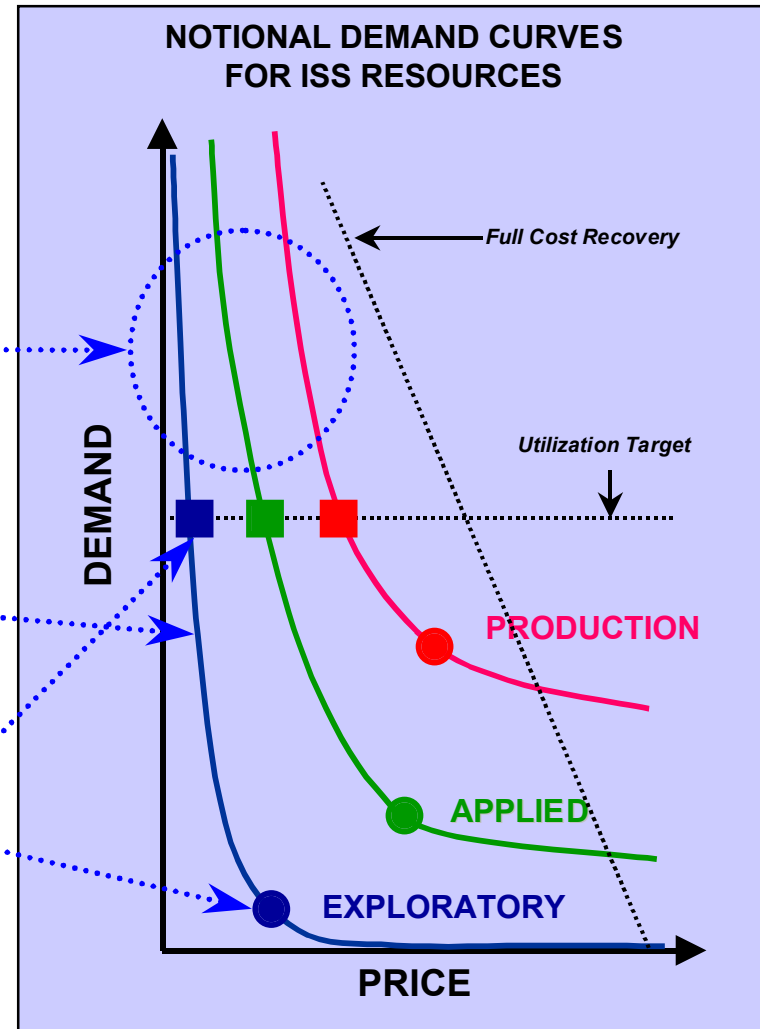
Items in red type indicate activities unlikely to occur on the ISS (e.g. application of exploratory research on the ground)

- λ Exploratory phase *projects* must be achieved at extremely low cost (~\$1M)
 - λ Inclusive of all variable costs (does not include brick and mortar)
 - λ Suggests that industry willingness to pay the additive costs of space research will be extremely low, until 'success stories' emerge

If NASA wants commercial utilization, ISS pricing must be low

/// Pricing and Demand

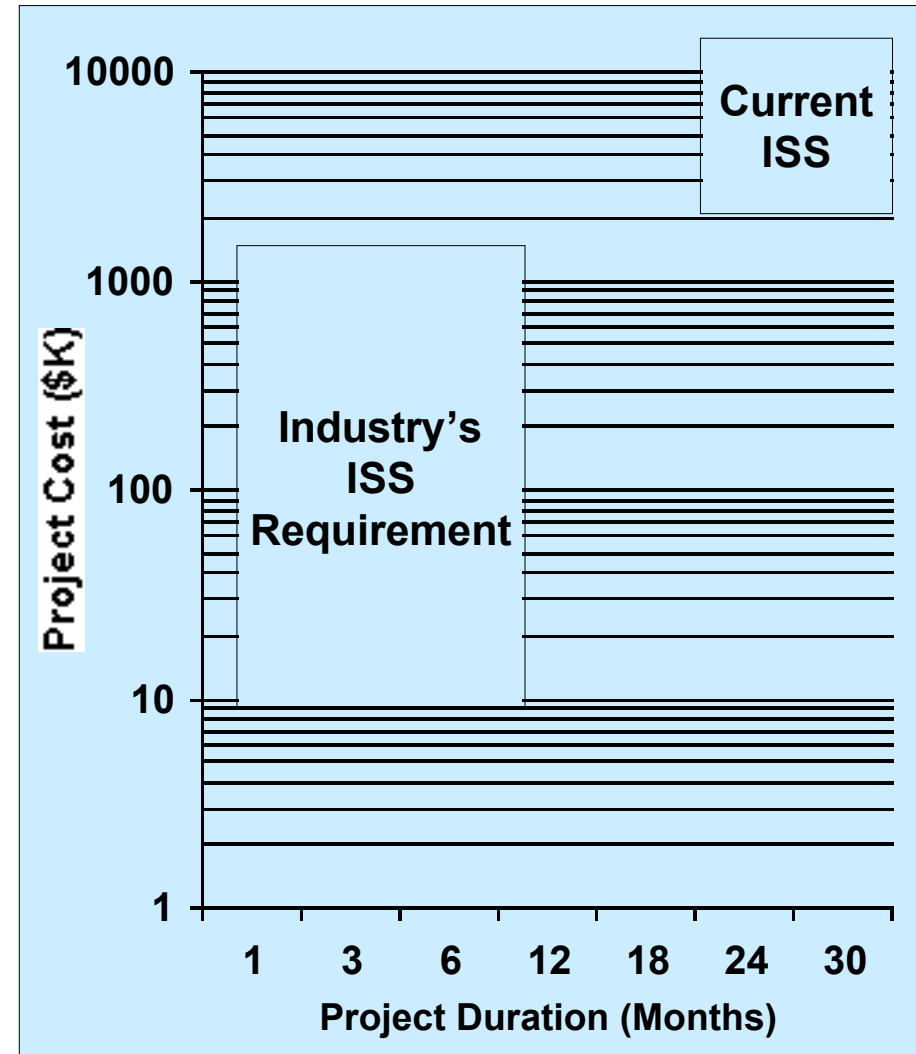
- λ Elasticity of demand for ISS infrastructure cannot be projected with precision, but educated guesses at overall trends can be considered
- λ All classes of activity will be inelastic across most price ranges
 - λ Proximity to market likely to be positively correlated with elasticity
- λ Type of activity will determine user valuation/demand curve
 - λ Today's market is exploratory
 - λ Suggests highly inelastic market
- λ Price at which NASA maximizes revenue and price at which NASA achieves utilization objectives may not be the same



The fundamental choice is whether ISS pricing optimizes utilization or revenue

Industry and the ISS Environment

- λ The current ISS operations regime is not aligned with commercial experience
- λ The 'costs of space' may accurately reflect today's capabilities, but industry's response will be to ignore ISS if terms of access are too onerous
- λ A market-responsive pricing mechanism and manifesting process *must* be developed if NASA wants the private sector to use the Station
 - λ Without these steps, outreach efforts will fall on 'deaf ears'
- λ An effective, sustained, commercially-oriented outreach effort is necessary to develop industry awareness, interest and utilization of the ISS facility
 - λ Without these steps, industry is likely to remain captive to past perceptions and inertia





Commercial Space Act of 1988

Policy Objectives

- λ The Commercial Space Act of 1988 (P.L. 105-303) was signed by the President on 28 October 1998
 - λ Originally proposed in the House of Representatives as H.R. 1702
 - λ Similar legislation had been proposed in 1997, but did not pass the Senate

- λ “The Congress declares that a **priority goal** of constructing the International Space Station is the **economic development of Earth orbital space.**”
- λ “The Congress further declares that free and competitive markets create the most efficient conditions for promoting economic development, and should therefore govern the economic development of Earth orbital space.”
- λ The Congress further declares that the use of free market principles in operating, servicing, allocating the use of, and adding capabilities to the Space Station, and the resulting fullest possible engagement of commercial providers and participation of commercial users, will reduce Space Station operational costs for all partners and the Federal Government’s share of the United States burden to fund operations.”



Commercial Space Act of 1998

Major Provisions Related to ISS

- λ **Directs NASA to deliver a series of studies to the Congress**
 - λ **Opportunities for commercial providers to play a role in ISS operation, use, servicing and augmentation**
 - λ **A market study that examines and evaluates potential industry interest in providing commercial goods and services and interest in using the ISS**
 - λ **A report on the number of proposals NASA received during 1997 and 1998 regarding commercial operation, utilization, servicing or augmentation of the ISS, and NASA's actions on those proposals**
 - λ **A report on the potential for, and issues associated with, full privatization of the Space Shuttle**

- λ **Expands federal policy/legislation for commercial launch services**
 - λ **Includes provisions for re-entry vehicles and operations**
 - λ **Permits continuation of NASA's launch voucher program**
 - λ **Requires the Federal government to procure space transportation services from US commercial providers**

NASA is being pushed towards privatization and commercialization of the ISS

NASA Responses/Actions

- λ **During 1998, NASA management began to consider many of the issues embedded in the Commercial Space Act of 1998**

- λ **Developed a new Commercial Development Plan for the International Space Station (released November 1998)**
 - λ **Identified 'Pathfinder Areas' for Commercial Development (October 1998)**
 - λ **Explored use of a 'Non-Governmental Organization' for Space Station Utilization Management (October 1998)**

- λ **Commissioned a study to consider alternatives for reducing NASA's cost of human space access**
 - λ **'Hawthorne Report' (September 1998)**

NASA is being pushed towards privatization and commercialization of the ISS



Commercial Development Plan

λ Objectives

- λ Short Term: Begin the transition to private investment and offset a share of the public cost for operating the space shuttle and space station
- λ Long Term: “To establish the foundation for a marketplace and stimulate a national economy for space products and services in low-Earth orbit, *where both supply and demand are dominated by the private sector.*” (emphasis added)

λ Determine cost/feasibility of a ‘Commerce Lab’ project that would provide one STS flight per year during ISS assembly for utilization activities

- λ Requires updates of 1980s era assessments of marginal and average costs of STS flights

λ Identify ‘Pathfinder’ business opportunities (activities which could be operated/sustained on a commercial basis) that can begin the transition phase

- λ Identify policy, procedural, and legislative changes that may be required to facilitate Pathfinder opportunities

λ NASA internal study (1998) identified nine ‘pilot businesses’

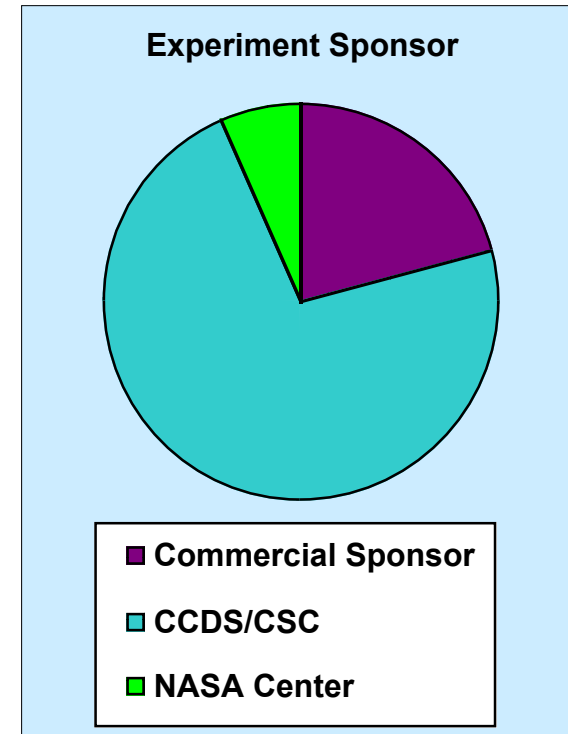
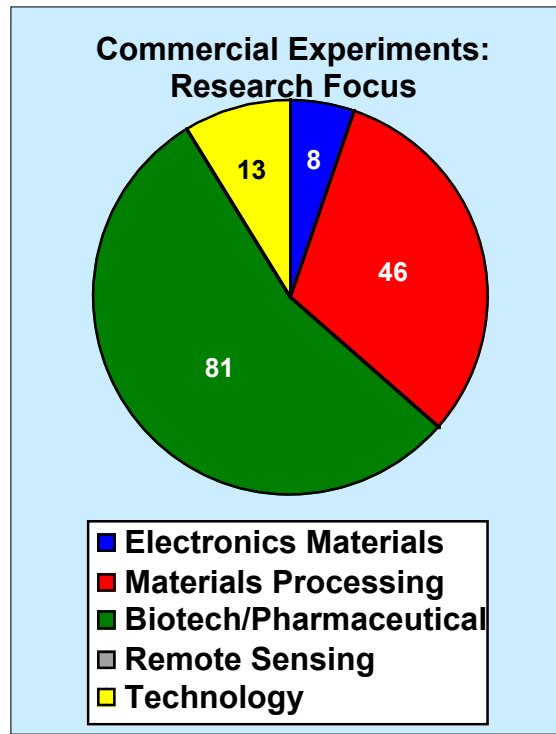
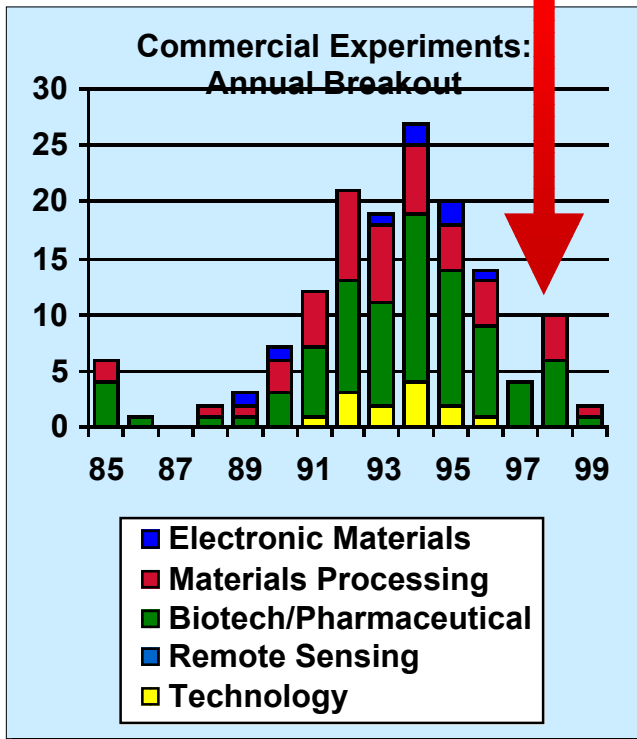
λ Independent market assessment now underway

- | | |
|---------------------------|---|
| λ Harvard Business School | Fee-for-service technology testbed survey |
| λ SpaceVest | Private Investment Potential for space products & services |
| λ United Space Alliance | Utility of STS/ISS as platforms for space products & services |
| λ Boeing Aerospace | Commercial augmentation of ISS systems |
| λ CSCs | Survey members regarding fee-for-service technology testbed |
| λ KPMG | Integrator for above efforts |

Commerce Lab

- λ Commercial microgravity activities remain 'subcritical'
- λ <150 commercial flight experiments since 1985 (<10 per year)
- λ Biotech/Pharmaceutical experiments comprise over half of the total
- λ More than two thirds sponsored by CCDS/CSC program
- λ Utilization is **declining** as ISS assembly begins!

Commerce Lab objective is to ensure that there is a User Community ready to exploit ISS facilities as they become available



Source: NASA Code UX Commercial Experiments Database

Identified Pilot Businesses

λ **NASA's nine identified 'businesses'**

λ **New Commercial Business Opportunities**

- Consumer Goods in Space
- Brand Name Sponsorships
- Educational Products
- Payload Accommodations Auction
- New Product Development (proprietary proposal)
- On-orbit Research Facility (proprietary proposal)

λ **Operations**

- Imagery

λ **New Capability Development**

- Communications
- Ground Operations Facility (proprietary proposal)

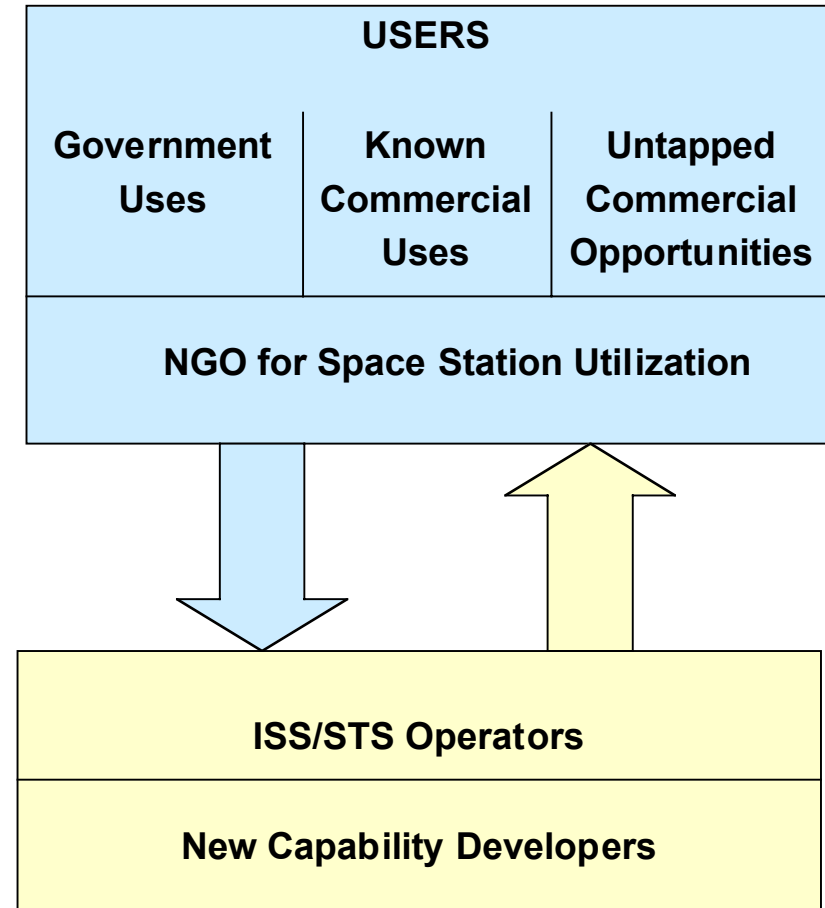
λ **Independent Assessments underway**

- λ **1st drafts of materials now in production**
- λ **Findings to be reviewed by both ISS contractors and outside users**
- λ **Delivery date of final assessment(s) to NASA is not yet finalized**

The NGO Utilization Manager

- λ **NGO has been proposed to address necessary improvements in ISS utilization processes**
 - λ **Extremely long manifesting cycle**
 - λ **'System operations' culture dominates**
 - λ **Inflexible procedures**
 - λ **Limited resources to handle unique requests**

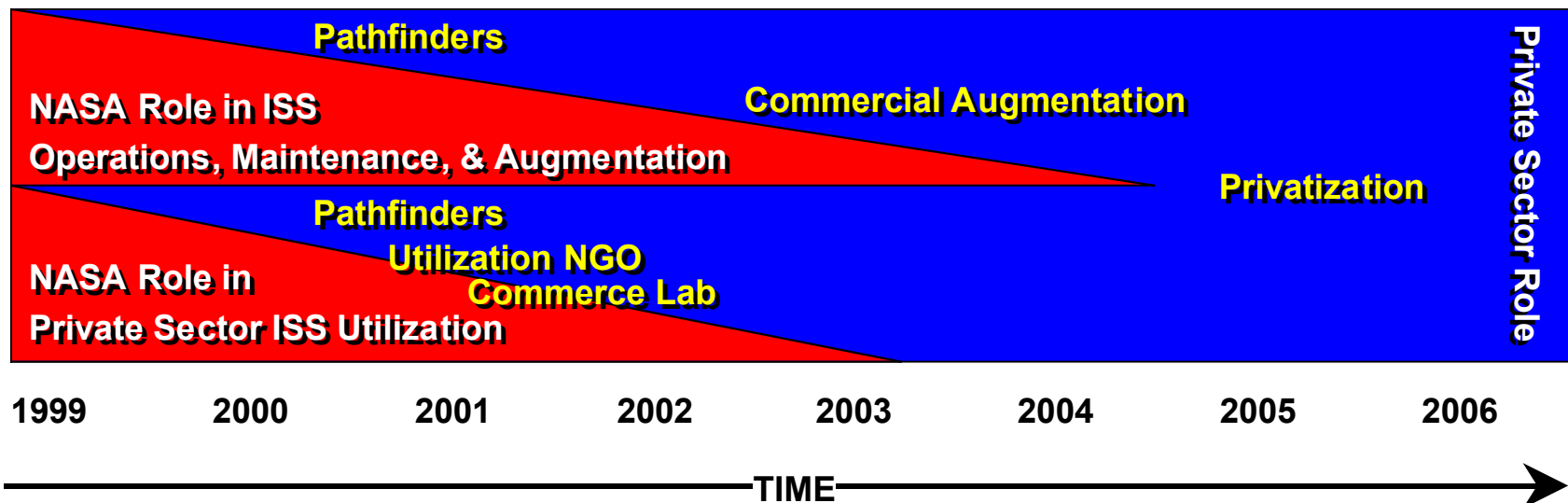
- λ **Objective is to create a new, user-friendly organization that would facilitate and expand ISS utilization**
 - λ **"...a NGO would serve as the interface between users and operators, in order to maximize the range of productive uses, as well as minimize the cost and schedule associated with conducting user operations in low-Earth orbit."**
 - λ **Year 2000 target for establishment**



Schedule Prognosis

- λ **NASA, with Congressional urging, is moving quickly to privatize ISS**
 - λ Consistent with NASA's objective to be ready to move to the 'next project' - i.e. Mars
 - λ Consistent with Congressional desire to have ISS prove its worth

- λ **NASA does not have an official schedule or commitment**
 - λ However, it is clear that transfer of Utilization functions will come first
 - λ Reliance on private sector for system augmentation will come next
 - λ 'USA-like' organization to assume operations responsibility will probably be deferred until after Assembly Complete



CSP Prognosis...

- λ **NASA's efforts to encourage industrial development of space are likely to have mixed results**

- λ **Positives:**
 - λ **Efforts to transfer day-to-day operations and utilization management activities to contractors will reduce costs and improve service**
 - λ **Private sector augmentation of limited ISS resources can probably be done more efficiently and more quickly than if performed under traditional NASA procurement**
 - λ **Efforts to introduce market-based pricing into NASA utilization will provide 'hard' targets for space entrepreneurs in terms of prices Users will pay for access to low Earth orbit facilities**

- λ **Negatives:**
 - λ **It is doubtful that, even with the most efficient commercial management, ISS and STS will ever make sense as fully commercial ventures (that is, with Users paying 'full costs')**
 - λ **The commercial user community in the US is still either ignorant of, or ambivalent towards, the utility of space research given the current cost, schedule and operating constraints**

International Observations

- λ US efforts to actively shift from a government-dominated space economy to a private-sector led space economy continue to accelerate
 - λ NASA's efforts in manned spaceflight and microgravity should be seen in the context of this larger trend
- λ From CSP's perspective, efforts elsewhere are not proceeding as quickly
 - λ Europe is still mired in the politics and issues associated with industry consolidation
 - λ Japan is making some progress in satellite applications, but manned space and infrastructure activities are still government-led

Market Sector	'Pure Gov't	Mixed	Commercial
Space Launch	Japan/Europe →		US →
Manned Spaceflight	Japan/Europe →		US →
Satellite Communications	Japan/Europe →		US →
Earth Observations	Japan/Europe →	US →	
Space Science	Japan/Europe/US →		
Microgravity	Japan/Europe →	US →	