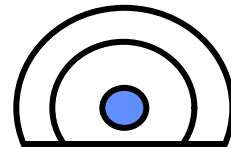




Commercialization Update

Current Trends and Issues

CSP Japan Seminar
December 2000



CSP Associates, Inc



Overview

- **Space Commercialization Overview**
 - Overall policy on commercialization
 - Commercialization 'success' by market sector
- **Sector Overview**
 - Communications
 - Remote Sensing
 - Launch Services
 - Navigation
 - Space Environment Utilization

Overall Commercialization Policy

- U.S. public and government are strongly supportive of efforts to develop commercial space business
- However, there is no consensus regarding the appropriate role of the federal government in that process
 - A small minority favor active government support (via direct or indirect subsidy) to stimulate commercial space investments
 - E.g. government-guaranteed loans and financing
 - A 'weak majority' favor indirect government support of commercial space initiatives
 - E.g. non-binding policies that favor procurement of commercial services
 - A small minority does not believe that commercial space activities should receive any favored position
- If there is any agreement regarding government policy, it is that commercial space businesses should be supported when it is also beneficial to the government
 - Procurement of commercial goods and services rather than (expensive and slow) government development
 - Joint investment in dual use systems and technology

U.S. Space Commercialization Policy has become increasingly pragmatic in its objectives and implementation

Commercial Space Policy



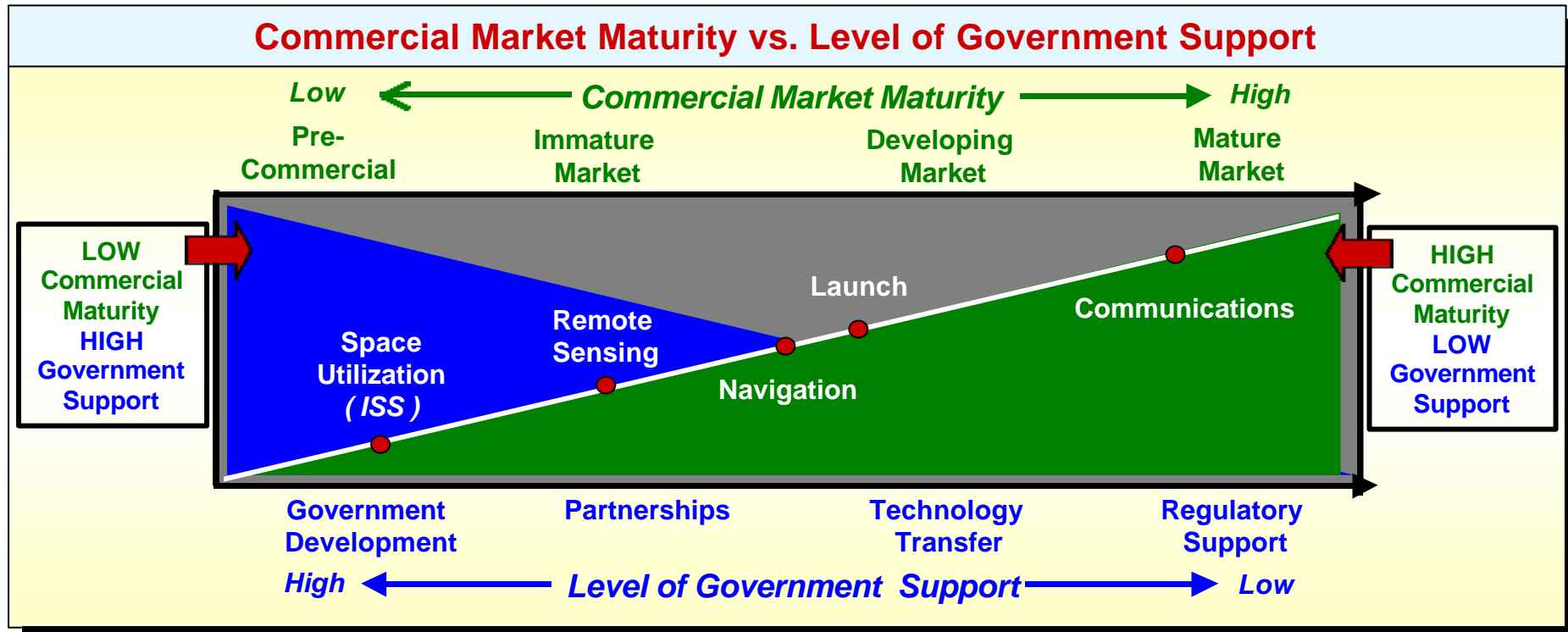
Key U.S. Space Policy Statements Related to Commercialization



- **“National Aeronautics and Space Administration Act” (1958)** – Does not specifically mention commercialization as a primary goal of U.S. Government space activity
- **PDD/NSC-37 “National Space Policy” (1978)** – First mention of economic and industrial space goals
- **NSDD-42 (1982) and “Presidential Directive on National Space Policy” (1988)** – Commercial space goals increased during Reagan administration; Military, Civilian and Commercial space sectors identified to avoid duplication of activities
- **NSPD-3 “U.S. Commercial Space Policy Guidelines” (1991)** – Stated commercialization goals for launch systems, satellite communications, remote sensing, and commercial infrastructure
- **NSTC-4 “National Space Transportation Policy” (1994)** – Encouraged private launch service procurement and international industrial competitiveness
- **NASA’s “Agenda for Change” (1994)** – Set blueprint for NASA R&D cooperation with private sector
- **“National Space Policy” (1996)** – First post-Cold War assessment of space goals, including support for private sector investment and purchase of commercially available space services
- **“U.S. Global Positioning System Policy” (1996)** – Announced intention to terminate ‘selective availability’ and broaden GPS commercial applicability
- **“Commercial Space Act” (1998)** – Definitive policy statement on current NASA and U.S. Government commercial space policy, encouraging commercialization of ISS, GPS, and data acquisition, as well as improving regulatory environment for RLV use, launch vouchers, and commercial spaceports
- **NPD 7500.2 (2000)** – Established NASA-wide technology commercialization policy
- **White House Statement on GPS Policy (2000)** – Termination of selective availability

Transition from strict government domain to increasing commercialization took place chiefly within the last decade

Market Maturity vs. Government Support



- Amount of US government support contingent upon level of commercial market maturity
- Immature space markets require direct government technology and/or product development until market matures
- Developing markets aided through partnerships and technology transfer
- Government "hands off" in fully mature markets, save for regulatory support

Commercial Space markets are in different stages of maturity, implying different issues and impediments

Communications

- **Satellite communications are the oldest and most mature commercial space industry**
- **U.S. government policy is generally 'passive'**
 - **No perceived need to invest in commercial comsat technologies**
 - **Potential gov't benefit from expanded use of comm'l systems**
- **Key issues:**
 - **Export Controls: General recognition that the recent changes in export authorization process have been damaging to U.S. manufacturers**
 - **Key issue: Manufacturing Base: There is still too much global (and U.S.) capacity in the manufacturing sector**
 - **Market Requirements: While traditional GEO broadcast market looks secure, other applications have not proven their viability; Financial markets have become much more wary of satellite ventures**

Prognosis: A good environment for established companies; a tough market for entrepreneurs and new entrants



Declining Cost of Capacity

- New generation of satellites continue to yield economies of scale
 - Higher power (10+kW)
 - More transponders (60+)
 - Longer life (15+ yrs.)
 - Lower operating costs (Automated TT&C)
- Cost per transponder year for new large C/Ku satellites is as much as 50% lower than previous generation
 - Increased power per transponder also yields increase in footprint, throughput, or ability to operate with smaller aperture CPE

Satellite Class	Technology	Representative Bus	Design Life (Yrs)	Deployed Cost ROM	Average TR Cost/Yr (\$M)		
					C	KU	BSS
Small	1980-1990	HS-376	8-10	\$95M	0.4	1.2	1.9
Medium	1985-1995	Satcom 5000	10-12	\$175M	0.2*	0.4*	0.9
Intermediate	1990-2000	HS-601HP	12-15	\$235M	0.2*	0.3*	0.5
Large	2000-	HS-702	15+	\$260M	0.1*	0.3*	0.3

Note: 'Deployed Cost'=Spacecraft+Launch+Insurance; does not include financing, pre-operating or operating costs
**Calculation based on hybrid C/Ku band payload*

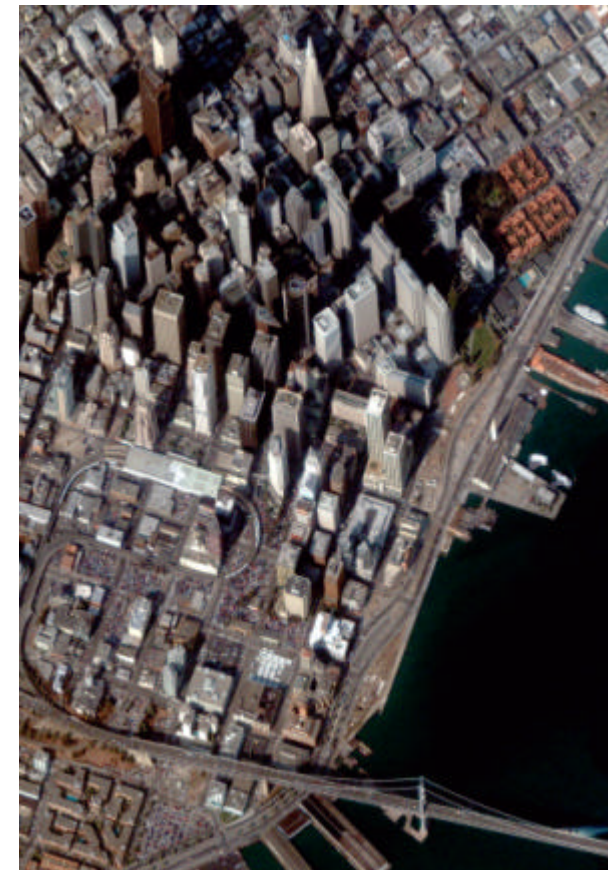
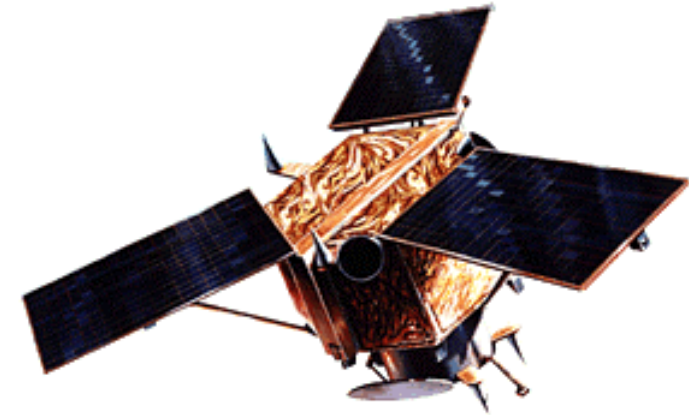
Remote Sensing

- Commercial remote sensing industry is just getting started
 - Space Imaging launched in
 - Earthwatch expecting to launch very soon
- Market is still very immature; governments are the largest customers
- Satellite data providers moving into value-added services in effort to capture greater value and stimulate the market
 - Boeing acquisition of Autometric
 - Space Imaging acquisition of Pacific Meridian
- New remote sensing ventures now in formative stage
 - Astrovision
- Key issues:
 - Export Controls: Terms that enable US ventures to offer high resolution data are generally hostile to international markets and/or international investment
 - Financing of replacement satellites in the current market

Prognosis: Uncertainty and 'Rough Sledding' Ahead

In Transition...

- Successful launch of Space Imaging Ikonos 1B marks the start of commercial provision of satellite imagery
 - Landsat, Spot, IRS systems still paid for by government agencies
 - Unfortunately, Earthwatch's Quickbird was lost due to failure of Cosmos launcher
- U.S. industry moving to offer a more 'integrated' service
 - Space Imaging acquisition of Eosat, Pacific Meridian
- Additional remote sensing ventures planned
 - Imagesat Eros A1 launched 5 December 2000
 - Resource 21 (Boeing)
 - Astrovision (startup)
- Key challenge for remote sensing industry is the seamless integration of their data into larger GIS products and services



Analysis Type	Panchromatic 1 meter	Multispectral 4 meters	Panchromatic 5 meters	Multispectral 20 meters	Multispectral 188 meters	Multispectral 25 meters	Radar 8 meters	Radar 30-100 meters
Agriculture	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Civil Government	High	High	Moderate	Moderate	Some	Some	Some	Some
Environmental	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Exploration/Resources	High	High	Moderate	Moderate	Moderate	Moderate	High	Moderate
Forestry	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Insurance	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Mapping	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
National/Global Security	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Real Estate	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Telecommunications	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Transportation	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Utilities	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate



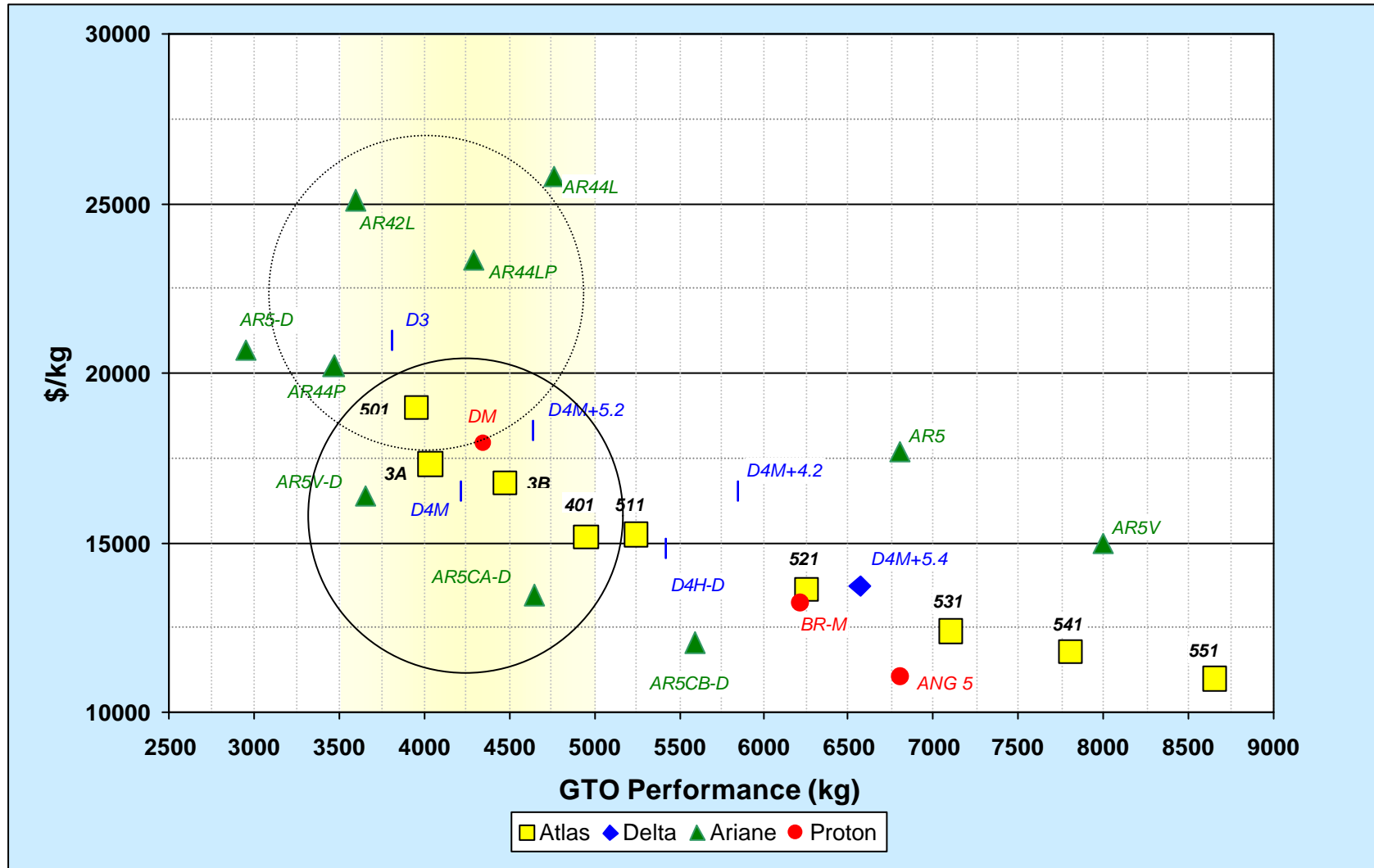
Source: Space Imaging

Launch Services

- Launch services business is transitioning to full commercial status
- Current generation of launchers (Delta 2, Atlas 2) have been funded primarily by the USG (DoD)
- 'Transition vehicles' (Delta 3, Atlas 3) are upgrades in which the upgrade has been funded by the commercial service provider
 - Company nonrecurring investments of \$200-300M
- New EELV vehicles (Delta 4, Atlas 4/5) are 'more new than old', with majority of investment coming from industry
 - Each contractor is receiving \$500M from USAF
 - Each contractor is investing \$1-2B of its own funds
- SSTO and startup launch companies are receding in importance
 - Renewed focus on TSTO reusable technology for Shuttle replacement
 - Collapse of small satellite market has doomed the launch entrepreneurs
- Key issues:
 - Market demand: Launch forecasts used by Boeing and Lockheed Martin to justify investments in new vehicles were overly optimistic
 - Oversupply: There are far too many commercial launch services suppliers; some form of (transnational?) consolidation is needed

Prognosis: Renewed International Friction Likely

Performance Comparison



Supply dynamics are creating a new 'sweet spot' in the 3.5-5 ton range

Navigation

- **Market for navigation and GIS data is growing rapidly**
 - Telematics, wireless communications, all using location/position data
 - Knowing where something is is becoming as important as knowing what time it is
- **USG has agreed to expand commercial utility of GPS by adding a new frequency (L3) that can provide increased position accuracy while preserving a separate DoD frequency (L2)**
- **International proposals to develop alternatives to, or augmentations of, the USG/DoD's Global Positioning System (GPS) are likely to occur, but may prove counterproductive in the short term for market development**
 - European alternative likely to move forward (Galileo)
 - Commercial augmentations of GPS have been proposed (e.g. Boeing)
 - Proliferation of signal standards may fragment the market
- **Navigation as an 'identified market' is likely to disappear, as navigation technology becomes embedded in larger systems**

***Prognosis:
Growing market on the ground, limited profit opportunities in space***

Navigation

- 12 GPS 2R (Lockheed) and 12 GPS 2F satellites to carry additional frequencies for military and civilian use
 - GPS 3 studies underway
- Market for GPS (ground) hardware and software expected to grow from ~\$2B in 1999 to as much as \$15B by 2005
 - Intelligent Vehicle Navigation Systems expected to be the largest single application
- Commercial utilization of GPS has 'swamped' military use
 - Commercial applications becoming pervasive, forcing USAF to further 'subdivide' the GPS payload
- Key issue is whether additional space segment providers are viable, since GPS is a free service



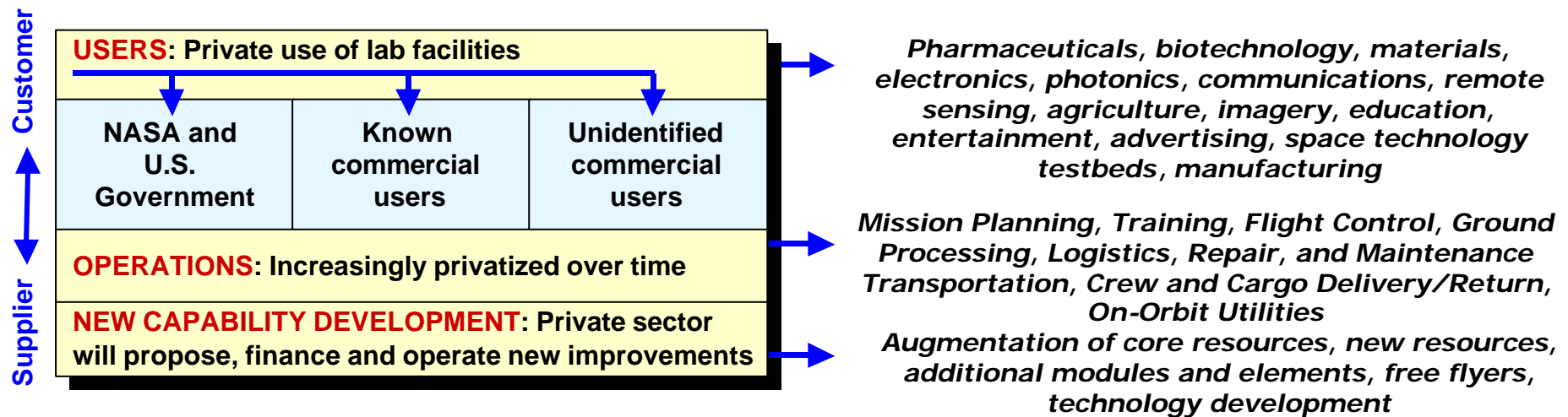
Space Environment Utilization

- **This market is still pre-commercial**
 - Costs of performing activities is still extraordinarily high, and economic benefits have yet to be proven
- **NASA 'new' Biological and Physical Research Enterprise is a belated realization that there are no commercial users for ISS**
 - NASA is still paying people to use their facilities (funded PI's, NRAs etc)
 - True commercial market is still (at least) ten years away
- **Commercial space infrastructure ventures (e.g. Spacehab) help to lower the cost of government space infrastructure, but have no commercial market customers**
- **NASA's new ISS pricing policy likely to 'exist by exception'**
 - No commercial customers will pay the list price
 - NASA will have to offer reduced/free access to stimulate usage

Still in the exploratory phase....

Scope of Commercial Opportunities

- NASA identifies three categories of commercial opportunity: *Users; Operations; and New Capability Development*
- NASA acts as both customer and service provider in stimulating business
 - ⇒ As commercial utilization grows, NASA will become just one of many customers for commercial operations and new capabilities
- Evolution Data Book (EDB) details potential changes to current ISS design (a good resource for users for description of current and future ISS infrastructure)



NASA hopes that commercialization will include ISS operations and evolution, and not just utilization

Summary

- **Commercial space activities in the U.S. continue to grow, but progress across markets is uneven**
 - Greatest evolutionary change is now evident in remote sensing and launch services sectors
- **Government policy is becoming (relatively) less important, since pro-active support is unlikely**
 - Fiscal pragmatism is the dominant approach
 - However, space advocates continue to push for special measures or incentives
- **Global overcapacity in most market sectors portends potential frictions**
 - US policy favoring corporate investment is generally ahead of other space-faring nations
 - As US private sector comes into increasing global competition, they will turn to USG to help them deal with 'unfair government subsidies'
 - Transnational consolidation is needed

***Significant risk and change in the next ten years
Commercial Space remains a long term investment***

Follow-Up

- For questions or comments regarding this presentation, please contact:

Mr. Hiroshi Yoshida
General Manager
CSP Japan Inc.
2-2-6 Kaigan, Minato-ku
Tokyo 105-0022

Phone: 03-5441-8954
Fax : 03-5441-8959
URL: www.csp.co.jp
E-mail: yoshida@csp.co.jp