FUTURE INDIAN SPACE – IMPLICATIONS FOR INTERNATIONAL COOPERATION

Mukund Rao (mukund.k.rao@gmail.com)
&
K R Sridhara Murthy (krsmurthy09@gmail.com)
National Institute of Advanced Studies (NIAS), Bangalore, India

PRESENTATION AT INTERNATIONAL WORKSHOP
US-JAPAN RELATIONS AND SPACE COOPERATION IN ASIA PACIFIC REGION
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INDIAN SPACE – STATUS

- INDIAN SPACE ACTIVITIES STARTED IN 1963 - JUST "~50 YEARS YOUNG"
  - FOUNDED ON BASIS OF INTERNATIONAL COOPERATION
- 1970 STATEMENT OF DR VIKRAM SARABHAI – STATED VISION AND POLICY TENET FOR INDIAN SPACE:
  - KEY EMPHASIS ON "SPACE FOR NATIONAL DEVELOPMENT"
- NATIONAL 5–YEAR PLAN: A PROFILE OF SPACE MISSIONS

2012-17 5 YR PLAN:

- STRENGTHENING/EXPANDING OF OPERATIONAL SERVICES IN COMMUNICATIONS AND NAVIGATION
- DEVELOPING ENHANCED IMAGING CAPABILITY (WITH FINER RESOLUTION) FOR NR MGMT, WEATHER AND CLIMATE
- SPACE SCIENCE MISSIONS FOR BETTER UNDERSTANDING OF THE SOLAR SYSTEM AND THE UNIVERSE
- PLANETARY EXPLORATORY MISSIONS
- DEVELOPMENT OF HEAVY LIFT LAUNCHER, REUSABLE LAUNCH VEHICLES AND THE HUMAN SPACE FLIGHT PROGRAMME
- FASTER DELIVERY OF EO AND OTHER INFORMATION TO REMOTE AREAS

2012 – 2017 (12TH FYP)	
Missions	58 (33 satellites)
Outlay	~INR 370 B

INDIAN SPACE – MAIN GOALS

NATURAL RESOURCES MGMT.
- CROPS, WATER, LAND
- FORESTS & ENVIRONMENT
- MINERALS AND ENERGY

DISASTER MANAGEMENT
- EMERGENCY COMMN – VOICE/DATA
- WARNING & ALERTS
- DAMAGE ASSESSMENT & REHAB

GOVERNANCE & SOCIAL APP
- TELE-EDUCATION
- TELE-MEDICINE & HEALTH NETWORKS
- PUBLIC INFORMATION INFRA
- NATIONAL GIS

EARTH SCIENCE
- WEATHER AND CLIMATE
- OCEANS
- ATMOSPHERE

CORE NATIONAL CAPABILITY

- SPACE FOR NATIONAL DEV
- HIGH-END TECHNOLOGY CAPABILITY
- AUTONOMOUS ACCESS TO SPACE
- SPACE COMMERCIAL ENTERPRISE
- SPACE INTERNATIONAL COOP

POSITIONING AND NAVIGATION
- NATIONAL POS SERVICE
- NAVIGATION APPS AND LBS
- GEODYNAMICS

TECHNOLOGY
- LAUNCH VEHICLE TECHNOLOGY
- SATELLITES TECHNOLOGY
- HSF TECHNOLOGY
- GROUND SEGMENT

NATIONAL COMMUNICATIONS
- TELEVISION/RADIO – DTH/CABLE/SATRADIO
- REMOTE-AREA COMM
- VSAT & DATA CONNECTIVITY
- SEARCH AND RESCUE

SCIENCE
- ASTRONOMY & ASTROPHYSICS
- PLANETARY EXPLORATION

NATIONAL SECURITY & DEFENCE
- INTELLIGENCE/SURVEILLANCE/ OPERATIONS

HUMAN SPACE FLIGHT
- STUDIES, TECHNOLOGY DEV

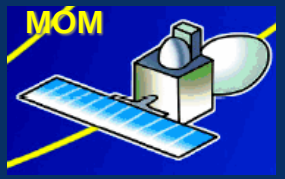
INDIAN SPACE – 50 YEARS ACCOMPLISHMENTS

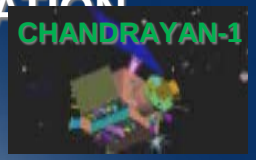
- SUCCESSES – 161 NISSIONS
  - 69 INDIAN SATELLITES
  - 45 LAUNCH MISSIONS
  - 47 FOREIGN SATELLITES
- FAILURES
  - 14 LAUNCH/SAT MISSIONS
- WIDE RANGE OF APPLICATIONS - ~50+ MINISTRIES; 30+ STATES; 200+ UNIV
- INDUSTRY INVOLVEMENT
- ACTIVE INTERNATIONAL COOPERATION

INVESTMENT OF INR 480 B

~20000+ PEOPLE

GLOBAL PRESENCE





IRS

SCIENCE

INSAT

COST-EFFECTIVENESSS ……
BUSINESS PROFITABILITY …….

PSLV

GSLV

GSLV Mk III

INDIAN SPACE – CHALLENGES AHEAD…..

- **BUILDING FURTHER FOCUS FOR AN UN-INTERRUPTED FUTURE NATIONAL SPACE SERVICE**
  - **BRIDGE INCREASING GAP IN DEMAND VS SUPPLY OF (INDIAN) SPACE SERVICES – TRANSPONDERS, EO, POSITIONING**
  - **INNOVATIVE SOCIAL AND ECONOMIC APPLICATIONS**
  - **ADVANCED TECHNOLOGICAL INGEST**
    - **ROBUST NEXT-GEN SPACE TRANSPORTATION SYSTEM**
    - **BUILD HOLISTIC HUMAN SPACE-FLIGHT CAPABILITY**
    - **LONG-TERM PLANETARY PROGRAMME PROFILE**
- **A "NATIONAL SPACE ECO-SYSTEM" - COMBINATIVE OF ISRO, INDUSTRY AND ACADEMIA - CRITICAL FOR FUTURE SPACE SUCCESS**
  - **ISRO – ADVANCED/NEXT-GEN SPACE TECHNOLOGY AND APPLICATIONS**
  - **INDUSTRY – INNOVATION, LICENSED MANUFACTURING, OPERATIONS, GLOBAL BUSINESS**
  - **ACADEMIA – ADVANCED RESEARCH AND INNOVATION**
- **STRATEGY FOR INTERNATIONAL COOPERATION**

…..NATIONAL SPACE POLICY

NATIONAL SPACE POLICY …..POSSIBLE FRAMEWORK

POLICY RESEARCH STUDY BY NIAS

NATIONAL VISION/GOAL (WHAT INDIA AIMS TO BE)

NATIONAL SPACE POLICY (WHAT INDIA AIMS FOR SPACE)

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INTERNATIONAL COOPERATION
- SPACE INFRASTRUCTURE
- JOINT MISSIONS
- ADVANCED TECHNOLOGY
- SPACE GOVERNANCE

7

SPACE COMMERCIALISATION
- SPACE INDUSTRY
- GLOBAL SPACE COMMERCE

6

- **SPACE APPLICATIONS**
  GOVERNANCE, ENTERPRISE, ACADEMIA

1

SATCOM POLICY (COMMITMENT FOR COMM SAT SERVICES)
- ASSURED CIVILIAN SATCOM SERVICES
- PRIVATE COMM SATELLITES
- ADVANCED SATCOM R&D
- SOCIETAL SATCOM APPS
- GLOBAL MARKET SERVICES

2

EO IMAGE/DATA (COMMITMENT FOR EO SAT SERVCIES)
- ASSURED EO IMAGE/DATA SATELLITES
- EO IMAGE/DATA ACCESS
- INPUT TO NATIONAL GIS
- INPUTS TO NDM
- INPUT TO NATIONAL WEATHER SERVICE
- PRIVATE EO SATELLITES
- ADVANCED EO R&D
- NEW NATIONAL APPS
- GLOBAL EO IMAGE/DATA BUSINESS
- .

3

SATELLITE POSITIONING SYSTEMS
- ASSURED SATPOS/SATNAV SYSTEMS
- NATIONAL/REGIONAL POSITIONING SERVICE
- ADVANCED TIMING TECH
- GLOBAL POSITIONING SYSTEMS
- .

4

TECH DEVELOPMENT (LV, ADVANCED TECHNOLOGY)
- ASSURED LV SERVICES
- PRIVATE LV
- ADVANCED LV R&D
- RE-ENTRY TECH DEVELOPMENT
- GLOBAL LV SERVICES
- .

5

SPACE SCIENCE (SCIENCE AND PLANETARY)
- SPACE SCIENCE MISSIONS
- PLANETARY MISSIONS
- RESEARCH AND EDUCATION INITIATIVE
- ADVANCED R&D
- GLOBAL DATA INTEGRTAION
- AO PROPOSALS AND STUDIES
- .

9

SPACE FOR NATIONAL SECURITY
- SPACE SYSTEMS
- ADVANCED TECHNOLOGIES
- .

NATIONAL SPACE LEGISLATION??

10

HUMAN SPACE-FLIGHT & PLANETARY EXPLORATION
- MAN-RATED SPACE SYSTEMS
- RE-ENTRY & LANDING TECH
- CREW & CARGO MODULE
- .

INDIAN SPACE – INTERNATIONAL COOPERATION…..

- **INDIAN SPACE STARTED ON BASIS OF INTERNATIONAL COOPERATION (1970s):**
  - **TERLS ESTABLISHMENT AND APACHE SOUNDING ROCKETS**
  - **ATS-6 SATELLITE FOR SITE … STEP**
  - **NASA TECHNOLOGY FOR IR-IMAGING FOR COCONUT-WILT IDENTIFICATION**
  - **THERMAL SENSOR DEVELOPMENT WITH FRANCE**
  - **ROCKET ENGINE DEVELOPMENT**
  - **…AND OTHERS**
- **INDIAN SPACE – <u>RECENT INTERNATIONAL COOPERATION INITIATIVES</u>:**
  - **LAUNCH AND TTC COOPERATION - RUSSIA**
  - **JOINT MISSIONS WITH CNES – MEGHA-TROPIQUES, SARAL**
  - **JOINT MISSIONS WITH DLR – MOS, OCM**
  - **CHANDRAYAN-1 INTERNATIONAL INSTRUMENTS**
  - **LAUNCH OF AGILE, SPOT-6 FOR EUROPE/CNES**
  - **COMMERCIAL LAUNCH OF ~45 INTERNATIONAL SATELLITES**
  - **ANTRIX-ASTRIUM ALLIANCE**
  - **JOINT ISRO-NASA NISAR – SAR-BASED EO MISSION AND COLLABORATION FOR MARS**
  - **ISRO-CSA ULTRA-VIOLET IMAGING TELESCOPE FOR ASTROSAT**
  - **MULTI-LATERAL FORUM – COPUOS, UN-ESCAP, CEOS, GEO, CHARTER ON DISASTER, UN-CENTRE FOR SPACE TECHNOLOGY EDUCATION FOR AP (ALMOST 2000+ AP STUDENTS BENEFIT)**
  - **OFFER/ANNOUNCEMENT OF A SAARC-SATELLITE BY HON'BLE PM**

INDIAN SPACE – INTERNATIONAL COOPERATION…..

- **INDIAN SPACE INTERNATIONAL COOPERATION – MULTI-DIMENSIONAL:**
  - **SCIENTIFIC/TECHNOLOGICAL**
  - **COMMERCIAL, INDUSTRIAL AND TRADE RELATIONS**
  - **POLITICAL/POLICY COORDINATION**
  - **CULTURAL (EDUCATION/CAPACITY BUILDING EXCHANGE)**
  - **HUMANITARIAN (DISASTER MANAGEMENT)**
- **INDIAN SPACE INTERNATIONAL COOPERATION "GROWTH" TENETS (2015):**
  - **SHARE – JOINT MISSIONS, COLLABORATIVE DEVELOPMENT**
  - **LEARN – TECHNOLOGY ACQUISITION/TRANSFER PROGRAMMES**
  - **PROCURE – COMMERCIAL ARRANGEMENTS**
  - **PARTICIPATE – INTERNATIONAL AND MULTI-LATERAL FRAMEWORKS**
  - **ASSIST – CAPABILITY TO DEV COUNTRIES, EDUCATION, TRAINING**

UN/ MULTI-LATERAL TREATIES

BI-LATERAL COOP (~38 NATIONS) **COMMERCIAL PARTNERSHIPS**

UN-SCSTEAP: AP SPACE EDN CENTRE

INDIAN SPACE – DRIVERS FOR INTERNATIONAL COOPERATION STRATEGY…..

KEY DRIVERS	OPPORTUNITIES
HIGH-LEVEL NATIONAL AND POLITICAL SUPPORT FOR SPACE	SPACE INFRASTRUCTURE COOPERATION (EO, SCIENCE, MET, CLIMATE, PLANETARY ……) SPACE GOVERNANCE (DEBRIS MITIGATION, CoC …)
STRONG DOMESTIC DEMAND FOR SPACE-SERVICES	COMMERCIAL/INDUSTRIAL TIE-UPS (SATELLITE-SERVICES, GROUND EQPMTS …..)
EXCELLENT TECHNOLOGICAL CAPABILITY	JOINT MISSIONS AND SHARING KNOWLEDGE (SATELLITES, SCIENCE, POSITIONING, LV ….)
NEED FOR ADVANCED TECHNOLOGY AND MANUFACTURING	TECHNOLOGY OFFERING/TRANSFER AND INDUSTRIAL TIE-UPS (NEW-SATELLITE BUS, ROBOTIC MISSIONS, MICRO-GRAVITY, HSF TECHNOLOGIES, PLANETARY, ISS+ PARTICIPATION …..)
COST-EFFECTIVE	REDUCED COSTS OF SPACE MISSIONS – PROFITABILITY AND BETTER RETURNS (PLANETARY, SATCOM, EO, HSF, LAUNCH…)
LARGE TALENT-POOL – ENGINEERS, SCIENTISTS, “THINK-TANK”	DESIGN AND MANUFACTURING – SPACE-RELIABLE SYSTEMS (EO, SATCOM, SMALLSAT, LAUNCHERS, MISSION MGMT….)

NATIONAL SPACE ….. FUTURE SCENARIO TO CONSIDER

IFFF IN NEXT 10-12 YEARS…. ANYWHERE AROUND

~100-150 MISSIONS	HUMAN SPACE-FLIGHT PROG INITIATED	++PLANETARY/ SCIENCE MISSIONS	LARGER GLOBAL BUSINESS ACCESS	~INR 2000 B INVESTMENT

SEGMENT	FUTURE	POTENTIAL FOR INTERNATIONAL COOPERATION
Advanced Technology Development/Investments	• Government • Academia • Indian Space Industry	Bi-lateral Commercial
Satellites – build, operate	• Government (Advanced, Science, Planetary, HSF) • Industry (Operational Satcom, EO)	Bi-lateral Commercial
Launch – build and market	• Government (Advanced) • Industry (Operational)	Commercial
Ground Systems development	• Industry	Commercial
Space based Services	• Government (Societal, Advanced) • Industry (Operational, Commercial) • Academia (Science, Planetary)	Bi-lateral
Planetary Exploration and HSF	• Government (National/Intl. Coop Missions) • Academia (Science) • Industry (Tech Dev Support)	Bi-lateral Multi-lateral Commercial
Investments	• Government • Industry	Bi-lateral – Sharing Commercial - Business

…..IN CONCLUSION

- NEED FOR A HOLISTIC NATIONAL SPACE POLICY
  - GOVERNMENT (ISRO) + INDUSTRY + ACADEMIA “ECO-SYSTEM”
  - INTERNATIONAL COOPERATION – AN IMPORTANT ELEMENT
- BUILD AN INDUSTRY MANUFACTURING BASE
  - COMPETITIVENESS IMPROVEMENT
- INGEST OF NEXT-GEN TECHNOLOGIES
  - TECHNOLOGY AS A LEVER FOR INCREASED TRADE RELATIONS
- ACTIVE INVOLVEMENT IN SPACE GOVERNANANCE AND LONG-TERM SUSTAINABILITY OF SPACE

Further National Technological Capability, Participate in International Regimes, Bring Mutual Bi-lateral Benefit, Increased Global Commercial Presence, Sharing Knowledge

Thank you