TRANSFER OF TECHNOLOGY CONTRACTS AND SPACE SECTOR

TRANSFER OF TECHNOLOGY IN SPACE SECTOR

- ToT in Space Industry – On a rise – Globally and Domestically increasing focus on space applications and their potential for generating socio-economic benefits beyond space missions, for the economy and society.
- ToT in space technology – no longer spin off / accidental by-products of space research but now as a means to maximum output in space research
- India and space faring nations are striving to promote integration of space technologies in the mainstream space research
- ToT – a Commercial means to extend the benefits of space R&D investments and maximizing their returns
- For the general public, such transfers are also very useful, as the space R&D can appear as contributing other socio-economic benefits beyond initial space missions, building a case for increasing public and private space investments.
- OECD - Technology transfers act as a strategic channel to stimulate and trigger innovation creation and propagation mechanisms, by means of knowledge spillovers through industry-science collaborations and technology transactions among various actors

Scheme of Discussion

PART – A – Conceptual Background	PART – B – Approaches to ToT	PART – C - Drafting	PART – D – ToT, ISRO and India
ToT – Concept & Elements	Types of ToT	Nature of ToT Agreements	ToT – Pros & Cons National Goals?
Significance of ToT in Space Sector	Strategies for ToT	Pre ToT Arrangements	ISRO and Technology Transfer
Technology Absorption Timeframe	Structure for ToT	Standard ToT Clauses	Outcome of ISRO ToT Scheme

PART – A – CONCEPTUAL BACKGROUND

TRANSFER OF TECHNOLOGY - MEANING

Generic Meaning -

'Transfer of Information and Hardware which allows the buyer to independently build up on future upgrades or even superior designs'

UNCTAD –

'technology is the knowledge that goes into the creation and provision of a product or service'

Sakti & Indrani Mukherjee –

'a set of instruments or tools, materials, know-how and abilities' which may be 'bought and sold as capital goods, human labour and information'.

National Academy of Engineering - *(functional perspective)*

'including all the infrastructure necessary for designing, manufacture and repair of technological artifacts—engineering know-how, manufacturing expertise and various technical skills—all are equally important part of technology'.

TRANSFER OF TECHNOLOGY – Elements

KNOWLEDGE	EQUIPMENT	ABILITIES
Information or Technical Data – A Step by Step Guide on Usage	Primary Equipment / Capital Goods	Technical Skills – Designing, Development, Production, Use, Maintain, Repair, Overhaul and Improvise
Methods of Using	Infrastructure for Usage – eg: Water or Industrial Power	Human Element – Variable Factor Technical Capabilities between seller and buyer
Improvisation		Differing Educational and Work Environment
Maintenance		Resulting in differing absorption capabilities

- Above Elements – Ideal ToT
- A Typical ToT – is a mix & match of these elements
- Therefore TOT is often viewed as a means to empower the technology recipient to design, develop its own products
- The term indicates every "movement of know-how, skills, technical knowledge, procedures, methods, expertise or technology from one organisational setting to another" (Roessner, J, 2000[15])

Technology Adoption Time frame

Prototype Phase	Production Phase	Commercial Phase
Phenomenon is discovered in lab through fundamental research Concept developed into Prototype and tried in real life conditions If successful, it is productionized	Technology is improvised upon in order to increase their utility, abilities and reliabilities	Technology is optimally exploited for commercial reasons

TECHNOLOGY TRANSFER IN SPACE SECTOR – SIGNIFICANCE

- Space Technology – Crucial role in developmental objectives of a nation
- Eg: Earth observation (geospatial information, satellite imagery, remote sensing), satellite telecommunication and broadband, as well as global positioning and navigation technologies find many applications specifically targeted for development.
- Assistance in setting up of infrastructure esp in areas of transport and telecom, contribute to natural resources management and tackling environmental issues, as in the case of land cover changes and disaster risk prevention and response.
- Growing consensus on the potential scope of satellite technologies to examine the implementation of developmental policies at local, regional and national level esp in densely populated areas and growing urbanization dynamics.
- Satellite remote sensing has already been game-changing in several sub-Saharan countries for providing epidemiology information to help contain malaria outbreaks.

Selected benefits derived from space technology transfers

Jobs created	Number of people hired to produce or use a space-derived product or service.
Revenues generated	Estimation of revenues generated by a company producing or offering a product or service that is a spin-off of space technology.
Productivity/efficiency gains	Quantification of saved and/or avoided costs due to the use of space-derived products or services, either by the company or by its customers.
Lives saved/not lost	Number of lives not lost as a result of a product or service that is a direct application or spin-off of space technology.
Lives improved	Number of people whose lives have been extended, enhanced and/or improved by a product or service that is a direct application or spin-off of space technology.

Selected benefits derived from space technology transfers

SOME INDIRECT BENEFITS : -

- Technological effects: effects produced by the direct application of the new space-related technology by the recipient actors.
- Commercial effects: can appear as network effects – i.e. impact of the space Programme on the network in which the recipient actor operates – and reputation effects – i.e. boost in an actor's relative prestige and reputation within its network.
- Organisational effects: Capacity Building - increased experience and know-how, as well as learning, derived from the collaboration between space and non-space actors in developing and exploiting new technologies.
- Work factor effects: impacts on employees acquiring new skills, capabilities and expertise with the potential of feeding that into other departments of the organisation for which they work.

Space programme	Technologies transferred	Applications outside space	Areas of application
NASA investments in life sciences research	Investments in life sciences research and development of related technologies	Development of more efficient medical and research equipment and research activities	Health and medicine
Italian Microfluidics project	Micro-propulsion system to control and regulate a satellite's tilt	Technologies for healthcare and membrane filtration and research activities	Health and medicine
Italian Mach-Zehnder project	Microinterferometer, technology to analyse planetary gases	First: technology for the monitoring of air quality and the presence of atmospheric pollutants Second: technology for monitoring fermentation and various chemical processes in wine production	Environmental monitoring and agriculture and food sectors
Research from the Max Planck Institute for Extra-terrestrial Physics (MPE) on ROSAT X-rays	Mathematical algorithm (SIM) used to analyse data from X-ray satellite ROSAT	Development of a computer-aided early recognition system (MELDOQ) to recognise melanomas through digital image analysis	Health and medicine
ESA work on robot calibration	Creation of a new system, the so-called Rodym, exploiting multiple cameras to measure the movement of infrared LED markers on space robots	Rodym is now part of many car manufacturers` production lines to enhance precision, with significant returns in terms of higher production rates and better quality	Transports and manufacturing

DLR Institute for Robotics and Mechatronics work on remotely controlled robots for the International Space Station (ISS)	Development of robots remotely controlled from Earth or from the ISS giving the operator the impression of being there (e.g. telepresence)	MIRO is a robot remotely controlled by doctors to perform a surgeon's movements with high precision through numerous sensors via partial or total automation	Health and medicine
ESA's Rosetta mission	Technology used in the Ptolemy Instrument for analysing comets	Development by a UK company of a detector that enables the hospitality industry to reproducibly and accurately monitoring for the presence of bed bug infestations	Hospitality industry
CNES human spaceflight	Ultrasound probes tested by universities during the first French human spaceflights	Development of innovative echocardiography probes	Health and medicine
Canadian Space Agency's technology tested on the International Space Station (ISS)	Portable Canadian technology that analysed cells and hormones in blood or other biological samples.	Microflow could be used to perform rapid, real-time testing and analysis anywhere in the country, including areas with limited medical	Health and medicine

PART – B – APPROACHES TO TRANSFER OF TECHNOLOGY

TYPES OF TECHNOLOGY TRANSFER

CATEGORY – I - Complete Transfer of Technology (CToT) – Enables recipient to carry out fabrication, assembly and testing of the item provided by the OEM – Falls under the procurement category of Buy (IDDM) – Indigenous Production

CATEGORY – II – Items manufactured by the OEMs sub-contractor based on direction and documentation provided by the OEM – the same documents are transferred further

CATEGORY – III – Where the manufacturer and the development of the system have been sub-contracted by the OEM to some other vendor based on the procured drawing and specification provided by the OEM - Intermediary

CATEGORY – IV - Item sourced by the OEM against his procurement specification as 'fully furnished' may be considered as brought out. OEM will only be able to provide the procurement specification and the source of the supply to ensure availability during the life cycle of the product. In case OEM, in collaboration with his vendor the document for maintenance and training then such transfer might be categorized as M-TOT.

CATEGORY – V - Where the OEM is not willing to transfer the technology (having ownership of design and manufacturing document), same shall be classified as the 'proprietary item' such items are generally not included in the scope of TOT

TRANSFER OF TECHNOLOGY – Types – Based on Operation

Capability Desired	ToT Needed
Operate	OToT
Maintain	MToT (M)
Repair	MToT (MR)
Overhaul	MToT (MRO)
Produce/manufacture/assemble/integrate	PToT
Minor design deviation/modification	DToT (Limited)
Upgrade/develop variants/develop alternate products	D&D ToT

Table 1: Assigning of ToT Variant Definitions

STRATEGIES FOR TRANSFER OF TECHNOLOGY

Path Strategy

Engineering Strategy

- **PATH STRATEGY**
- This strategy comprised of several steps and stages and it depends on country's capacity to decide till which stage it can reach
- Step one - Maintenance & Repair of Transferred Systems - The recipient develops and gains the skill, knowledge and technical know-how as well as attains the needed infrastructure for gaining ability to repair, maintain & rebuild the foreign product. This is done to attain spinoff benefits like developing domestic skills and creation of employment.
- Establish the infrastructure (institutional, HR) for technology absorption

STRATEGIES FOR TRANSFER OF TECHNOLOGY – Path Strategy

- Step two - Assembly of subsystems from imported components This step comprises of the expansion of the manufacturing ability to the recipient of the ToT contract to the assembly stage of the product, this is done under a License Regime by the OEM. Under this step, the recipient is completely dependent on foreign design and information, hence, can't carry their own up gradation, as per their need.
  - Assembling the system with foreign design assistance
- Step three - Final Production of the concerned equipment and production of its basic components This is a crucial step as the recipient develops the capability to manufacture necessary / basic components of the concerned product for which ToT has been entered among the parties, as well as the final assembly of the concerned equipment. Assistance for the establishment, organization and operational facilities to produce necessary component and final assembly line of the concerned product takes place under this step.
  - Production Phase

STRATEGIES FOR TRANSFER OF TECHNOLOGY – Path Strategy

- Step four - Production using Imported design At this step/stage, the production of the concerned product and other similar equipment can start completely in the domestic sphere based on the imported design. The same can be achieved via reverse engineering of the Foreign Product. Here, the recipient entity develops its engineering ability to modify the design provided by the OEM. This knowledge combined with the technical skills & know how, Production and Organizational knowledge acquired via different sources / regime like joint ventures, license etc
  - Develop ability to improvise
- Step five - Capability to design needed product indigenously - At this step it is assumed that the recipient of the ToT has attained the knowledge and capabilities to produce the major components of the concerned product, with minimal dependency on foreign design, technological know-how and know why, organizational knowledge required for production, technical skills & assembly line and other requisite infrastructure for the development, production & maintenance of the concerned product.
  - Develop knowledge and skill set for indigenous production

STRATEGIES FOR TRANSFER OF TECHNOLOGY – Path Strategy

- Step six - Production based of local R&D for new product This is the final step / stage for an entity to achieve in this strategy of independence in the production and development of the needed and desired product. This includes the capability of designing and manufacturing the concerned product completely in the domestic sphere using domestic components. This stage marks the self-sufficiency in the production and achieving the ultimate objective of the ToT.
  - Complete independence in designing, improvising, manufacturing
  - Recipient Country holds the IP Rights

STRATEGIES FOR TRANSFER OF TECHNOLOGY – Engineering Strategy

- Needs a base of technical knowledge and production experience
- Adaptation and development of existing strategy as per the needs of the country

Add On Engineering	Add Up Engineering
Upgrading, Updating, Improvisation and Adaptation of an existing strategy as per the specific use of the user by altering components, features and incorporation of indigenous components	Higher demand of technical know-how and experience from previous production Raise supply chain and integrate the imported components and technical knowledge to develop and produce a new product
For eg: Israel Aircraft Industries; IAI Kfir which is developed from French Dassault Mirage	

STRUCTURE FOR TRANSFER OF TECHNOLOGY

Horizontal Structure

- ToT Contract is restricted to a single product
- Exchange of Rights over the Access to Design, Technical Know-How, Production, Selling and other rights are available but pertaining to only that product

Vertical Structure

- OEM share the rights of multiple products with the recipients
- Purpose – Acquisition of Requisite Knowledge, Skillset and Infrastructure needed for development and production of a particular range of products, rather than adopting a restricted approach

PART – C – DRAFTING OF TOT CONTRACTS

NATURE OF TRANSFER OF TECHNOLOGY AGREEMENTS

Licensed Co-Production Agreement

- The licensee under a series of provisions obtains the rights to deal with the OEM's products
- Effected through bilateral agreements
- In lieu of a license fee

Co-Production Agreement

- Entity to Entity Agreements
- Permits the recipient to acquire technical know-how for the development and production
- This may include right for production of all or some selected components of the product
  - Horizontal – Right to manufacture either whole or part
  - Vertical – Production complex of the recipient entity will not be limited for the production of the concerned product or its component only but will also be producing components for other products of OEM

Joint Venture

- Development or Manufacture of a product by multiple entities
- Inter-firm cooperation in research, design, production and marketing
- Eg: India& Russia's alliance for production of Brahmos missile

Foreign Design Assistance

- This assistance by OEM for designing and developing of a product
- Includes blue print of target product
- Components could be imported or indigenous but assembly to be purely indigenous

PRE-TOT LEGAL INSTRUMENTS

Confidentiality and Non-Disclosure Agreements	Material Transfer Agreements	Licensing Agreement for ToT
The potential recipient does due diligence prior to entering into a ToT Contract This agreement is entered into to protect the information and the research that the potential recipient is given access to and to keep it confidential	When in advanced stages of negotiation but prior to conclusion of ToT Contract, a sample is procured from the OEM MTA is entered into to regulate the use of the sample and protect its IPR	This is the last agreement signed between the OEM and the recipient. This agreement provides details regarding the licensing areas, validity period and arbitration clauses.

KEY NEGOTIATING POINTS FOR TOT CONTRACTS

- DOCUMENTATION –
  - Language – Preferably English
  - Should explain the steps to assemble, maintain, test and refit it when necessary
  - The relevant approvals by certification agencies
- UPGRADES FOR THE PRODUCT –
  - Requisite Information for Upgradation / Improvisation / Modification of the Technology preferably at no additional costs
  - an exhaustive list of all the updates that needs to be provided to the recipient party on a yearly basis
- EXTENSIVE TRAINING
  - Both Classroom and On-the-Job Training to be provided to Recipient Country
  - technical aspects of manufacturing, designing, software, system integration and the installation of the product and testing and maintenance
  - Continuous training on upgrades

KEY NEGOTIATING POINTS FOR TOT CONTRACTS

- MAINTENANCE INFRASTRUCTURE
  - The OEM must provide exhaustive data on the Special Maintenance Tools and the Special test Equipment used by it during the manufacture, assembly and testing the product
- PRODUCT SUPPORT DURING THE LIFECYCLE OF THE TECHNOLOGY
  - Including the provision of spare parts as well as the management of obsolete parts.
  - A Detailed List of commodities which can be used should be provided to the recipient
- DELIVERY SCHEDULE
  - The transfer of all the requisite documents, training period, provision of technical assistance, the supply of spares and proprietary items, must be delivered in a phased manner.
  - In case of nonadherence of the delivery schedule, pre-designated damages must be paid to the recipient.

KEY NEGOTIATING POINTS FOR TOT CONTRACTS

- INDEPENDENT DEVELOPMENT –
  - to seek out local vendors and sub-contractors independently for the supply of requisite parts for the product & not mandatorily depend on OEM
- WARRANTY -
  - Both Material and Documentation Warranty
- PRUDENT IDENTIFICATION OF TECHNOLOGY
  - ToT should strive for critical gaps in commonplace knowledge and promote independency in the recipient party
- CHOICE OF TECHNOLOGY
  - Requirement v Availability
  - Recipient Entity and its Absorption Capacity

STANDARD TOT CONTRACT CLAUSES

Definition and Interpretation Clause	• to bring parties to a mutually agreement upon meaning to certain contract terms, so as to avoid any future contradiction as to the meaning and interpretation of any contract term. • Clarity, Brevity and Precision • Boilerplate Clauses – Commonly accepted and incorporated definitions
Choice of Language & Application of Laws	• Different Language – Possibility of Different Interpretation
Representation and Warranties	• It is a declaration from the party conveying the technology that is free from any liens, security interest or any other encumbrances • Duty of Licensor to indemnify for breach of the same
Financial or Payment and Royalty Clauses:	• The developer of the technology relinquishes the possession of it with the expectation of a potential income that may be generated through the license consideration • License Issue Fee and Up- Front Payment Clauses • Equity Ownership and Other Secondary Payment Provision • c. Term Payment Clauses • d. Royalty Clauses
Dispute Settlement	
Terms of Usage	

PART – D – SPACE TOT and India

TRANSFER OF TECHNOLOGY – PROs and CONs

PROS	CONS
Minimal Gestation Period	Cost – Heavy on country's exchequer – Oligopolistic Nature of the Imperfect High Technology Market
Brings in new machines and processes thereby modernizing the production process	Trade Restrictions – Many anti-competitive
Production Lines require subsidiary firms to manufacture ancillary parts – thus promotes industrial growth	Regulatory Conditions imposed by Laws – FERA / MRTP / Indian Patents and Design Act
Increases employment	

TRANSFER OF TECHNOLOGY – NATIONAL GOALS?

Know How's How to fabricate the concerned parts How to Test Them How to assemble the parts How to inspect them How to test them on an integrated platform	Know Why's
does not include, however, is the knowledge required to carry out major modifications, or upgrades or manufacture future, more capable versions of the product	It is not divulged by the technology seller simply because, by doing so, the technology recipient acquires the knowledge to design and build products which could compete with the original firm. Development of space & military systems necessitates an immense amount of investment in terms of money, time and resources. Why then would a developing firm or country fritter this investment away without securing the maximum returns possible?

INDIA'S SPACE INDUSTRY, ISRO AND TECHNOLOGY TRANSFERS

- Private sector engagement with ISRO – past one decade – Initially – only supply of equipment for space program, despite allowing FDI
- 2019 – Announcement for setting up of Newspace India (Nodal Agency for PSLV production – Private entity)
- ISRO has allowed the Indian National Space Promotion and Authorisation Center (IN-SPACe) programme, which will act as a regulator facilitating technology transfer from ISRO.
- ISRO – had been ToT with limited to few corporation
- Besides, its other commercial arm Antrix — this shall now be responsible for bagging foreign contracts — has been dogged by bureaucratic hurdles.
- Until now, ISRO has been solely engaging with private companies and overseeing the transfer of technology.
- Instilling these private entities will help ISRO focus more on advanced research into interplanetary & human space flight missions.

INDIA'S SPACE INDUSTRY, ISRO AND TECHNOLOGY TRANSFERS

- TOT – key component of ISRO's multifaceted collaboration with Indian industry and
- Initiated in 1970s to assist Indian industries in the commercialization of new technologies developed in the space Programme
- Technology Transfer Mechanism – enables licensing of know-how from various ISRO centers for commercial exploitation
- 3 Categories of TOT – (in the order of reducing direct stake of ISRO)
  - (i) technologies for ISRO buyback (solid and liquid propellants, carbon or silicon fabric used in composite parts, onboard battery cells, etc.); - ISRO largest consumer
  - (ii) technologies for development of space systems utilisation and space applications (disaster warning receivers, reporting terminals, satellite telecommunications/TV/meteorological ground systems, remote sensing utilisation and ground-truth equipment) and
  - (iii) technologies for development of 'spin-off' or non-space applications (automatic weather stations, temperature sensors, pressure and thrust transducers, dry powders used for extinguishing oil fires and software packages for aerodynamic applications) – Potential civilian usage

INDIA'S SPACE INDUSTRY, ISRO AND TECHNOLOGY TRANSFERS

- Primary Objective of Indian Space Programmes – Contribute towards economic & social development through applications of space technology
- Policy to promote spin-off benefit from the technologies developed for the use of space projects
- Till date 280 technologies has been transferred primarily to SMEs
- TOT effectuated through –
  - awareness building measures,
  - licensee selection methods
  - innovative contract systems,
  - diverse transfer processes,
  - post licencing services and
  - feedback mechanisms.

INDIA'S SPACE INDUSTRY, ISRO AND TECHNOLOGY TRANSFERS

- Publication & Awareness Building – ISRO
  - regularly publishes interest exploration notes that contain brief details on the scope, specification and potential applications of technology and widely disseminates among industries
  - information in trade journals and
  - displays such information in exhibitions
  - sponsors preliminary market assessments through surveys.
- Establishment of Inter Disciplinary Review Teams - to assess the readiness of technology and qualification status prior to undertaking actual transfer process.
- Developed Standard ToT Contract – focus on – Committing assistance to transferee through documentation, training, quality control/test assistance and extending any other support to solve the problems encountered in the productionisation phase.
- Mandates that - the licencee will be required to produce/implement the product for commercialization within a specified period. If for no valid reasons the technology is not commercialized, licence will be extended to a new, alternate party.

INDIA'S SPACE INDUSTRY, ISRO AND TECHNOLOGY TRANSFERS

- ToT – Choosing of recipient Entity – Competitive Process –
  - Over 75% of the industrial licensees for technologies from ISRO belong to the category of SMEs.
  - 80% of the total number of licencees were given to industries in the private sector.

The technology transfers are backed by suitable IPRs obtained by ISRO that protect the interests of licencees.

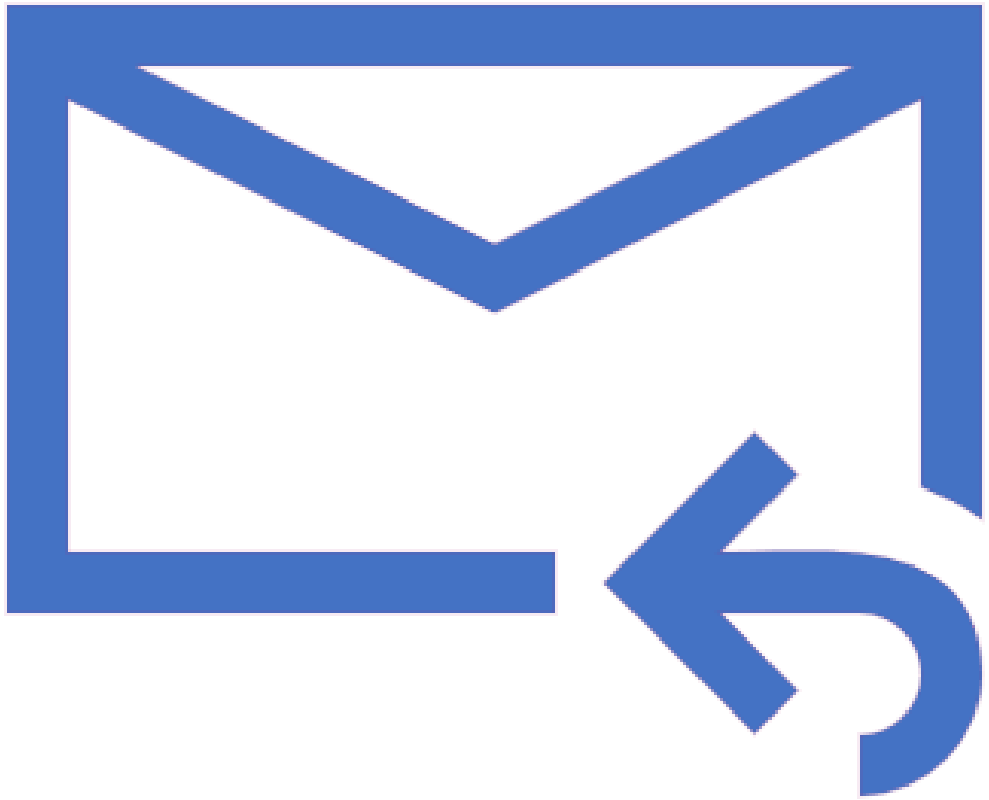
- In Productionization and Buyback Contract – if ISRO is the only consumer, then it gives long-term buy back guarantee
- ISRO supports the licensee industry till the technology has been successfully productionised. – Hand holding approach till the prototype is ready
- This also enables ISRO to focus on its core R&D projects
- ISRO also provides consultancy support in high technology areas to industry.

OUTCOME OF ISRO TOT SCHEME

- A vibrant and dynamic national space industry has emerged, cutting across the small, medium, large, private and public sectors.
- 289 technology transfer agreements between 185 companies including 155 in private sector.
- ISRO has executed 270 consultancy projects in high technology areas to provide support to various industries
- ToT and many have reached the stage of productionisation in the fields of electronic and computer-based systems, speciality polymer chemicals and materials, electro-optical instruments, mechanical equipments and ground systems related to satellite communications, broadcasting and meteorology.
- Many of the technologies transferred were originally for use within the space Programme, but have found applications in the industrial mainstream for the greater benefit of the society
  - For eg: Many items such as earth station equipments such as—antennae, sensitive receivers, high-power and low noise parametric amplifiers, transmit–receive chains, multiplex systems, telecommunication and data transmission and image processing and analysis equipment

OUTCOME OF ISRO TOT SCHEME

- Capacity Building –
  - Recipient entities - found that extreme reliability, rigid technical specifications and rigorous testing and qualification procedures are needed to be produced Space related hardware and adherence to these strict standards have greatly helped in upgrading their own technological skill, which can have a significant impact on their other product lines.
- High precision in fabrication, extreme tolerances, special tooling and manufacturing processes and use of light weight alloy structures and special materials like titanium, beryllium, magnesium and composite materials have enabled Space industry in India, as elsewhere in the world, to acquire new industrial technology having much wider applications



Thank you

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