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LA CARRERA CIENTÍFICO-TECNOLÓGICA POR EL ESPACIO ULTRATERRESTRE EN EL SIGLO XXI

CONFERENCISTA MAGISTRAL

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RESUMEN

La ciencia, la tecnología y la innovación (CTI) han sido siempre un aspecto fundamental de las relaciones internacionales, especialmente en el avance de las actividades espaciales. El sector espacial ha sido un área pionera dentro del campo de la ciencia, la tecnología y la innovación (CTI), con un impacto significativo y de gran alcance en el orden mundial. La carrera espacial entre Estados Unidos y la Unión Soviética desempeñó un papel importante en el contexto de la Guerra Fría. Desde la conclusión del siglo XX, el orden internacional ha experimentado un proceso de transformación sistémica, durante el cual la ciencia, la tecnología y la innovación (CTI) han asumido un papel fundamental. En este contexto de nuevo sistema internacional, asistimos al advenimiento de una nueva era espacial. Esta nueva era espacial se caracteriza por la aparición de nuevas tendencias, actores, tipos de interacciones y procesos en el espacio, que están ejerciendo un impacto significativo en la configuración del orden mundial. Esta presentación examina los múltiples retos a los que se enfrenta la comunidad científica a la hora de comprender la conexión entre la CTI, las relaciones internacionales y las actividades espaciales.

Palabras clave: CTI en el espacio ultraterrestre, sistema espacial, relaciones científicas internacionales, relaciones espaciales internacionales, carrera espacial.

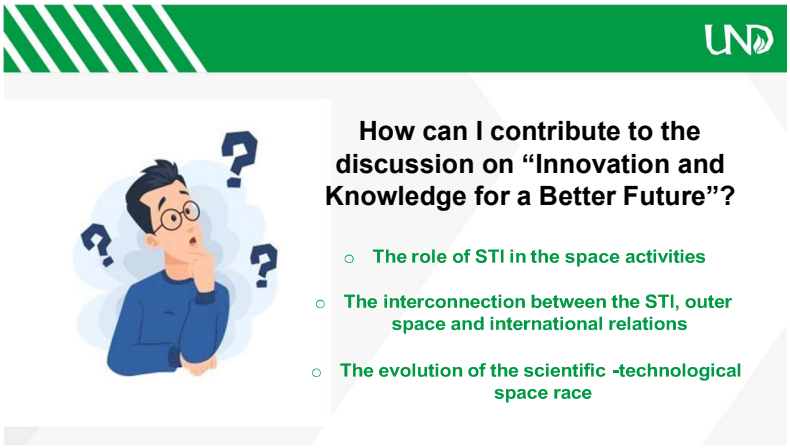
ABSTRACT

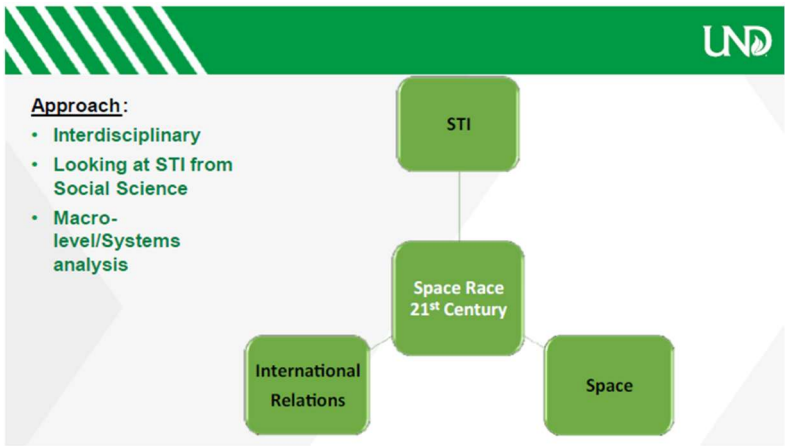
Science, technology, and innovation (STI) have consistently been a pivotal aspect of international relations, particularly in the advancement of space activities. The space sector has been a pioneering area within the field of science, technology, and innovation (STI), having a significant and far-reaching impact on the global order. The space race between the United States and the Soviet Union played a significant role in the context of the Cold War. Since the conclusion of the 20th century, the international order has undergone a process of systemic transformation, during which science, technology, and innovation (STI) have assumed a pivotal role. In this context of a new international system, we are witnessing the advent of a new space age. This new space era is characterized by the emergence of new trends, stakeholders, types of interactions, and processes in space, which are exerting a significant impact on the configuration of the world order. This presentation examines the multiple challenges facing the scientific community in understanding the connection between STI, international relations, and space activities.

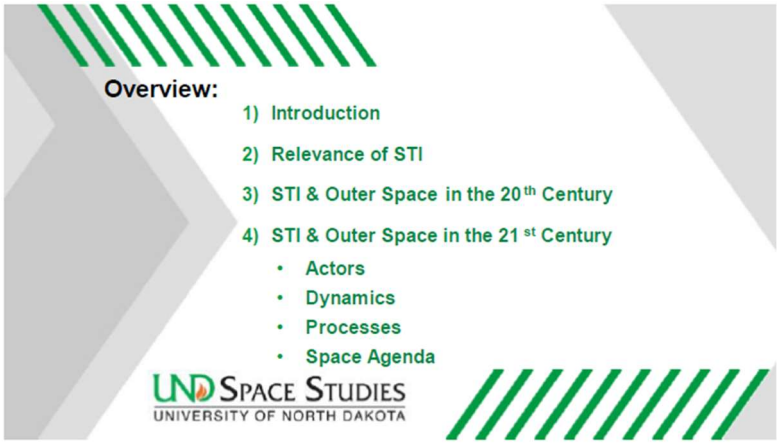
Keywords: STI in outer space, space system, International scientific relations, International space relations, space race.

CONFERENCIA

Esta sección es opcional, en la cual puede presentar en formato de texto y/o imágenes el desarrollo de su conferencia.






Overview:
1) Introduction
2) Relevance of STI
3) STI & Outer Space in the 20th Century
4) STI & Outer Space in the 21st Century
• Actors
• Dynamics
• Processes
• Space Agenda
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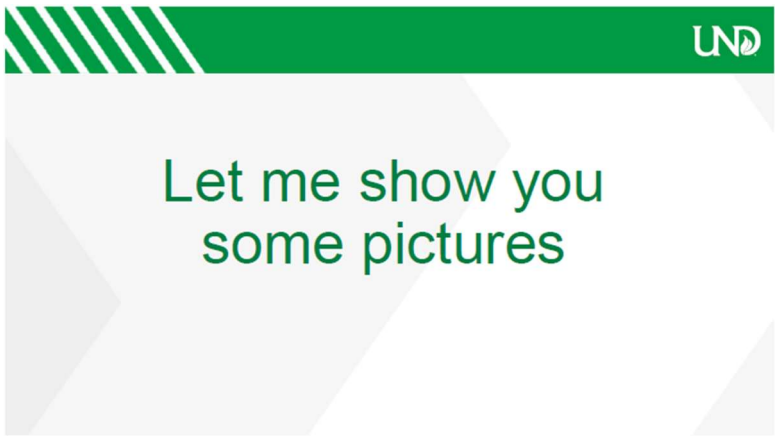
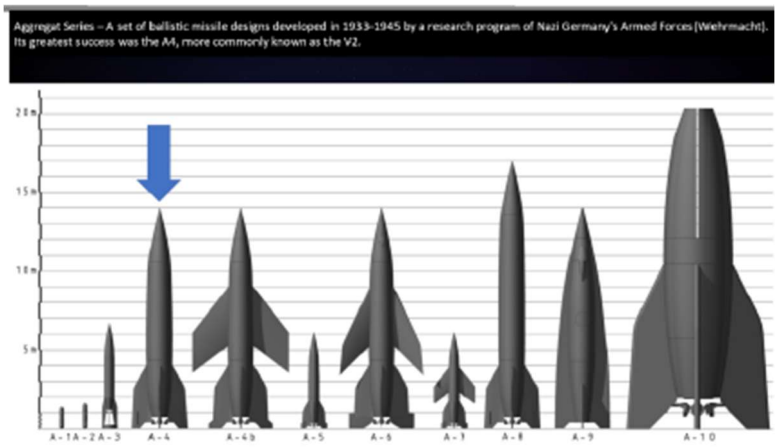
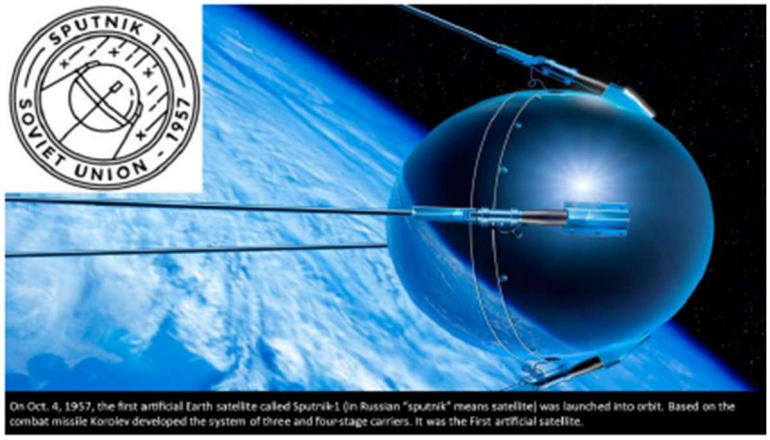
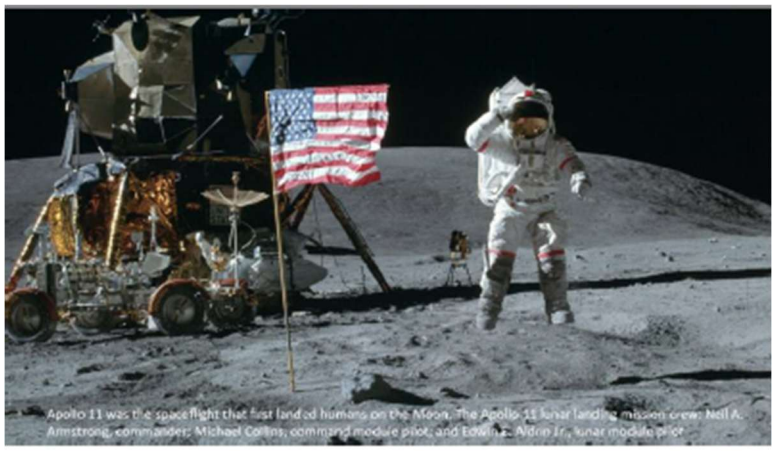
1. Introduction


UND
Let me show you some pictures


Aggregat Series – A set of ballistic missile designs developed in 1933-1945 by a research program of Nazi Germany's Armed Forces (Wehrmacht). Its greatest success was the A4, more commonly known as the V2.
A-1 A-2 A-3
A-4
A-4b
A-5
A-6
A-7
A-8
A-9
A-10

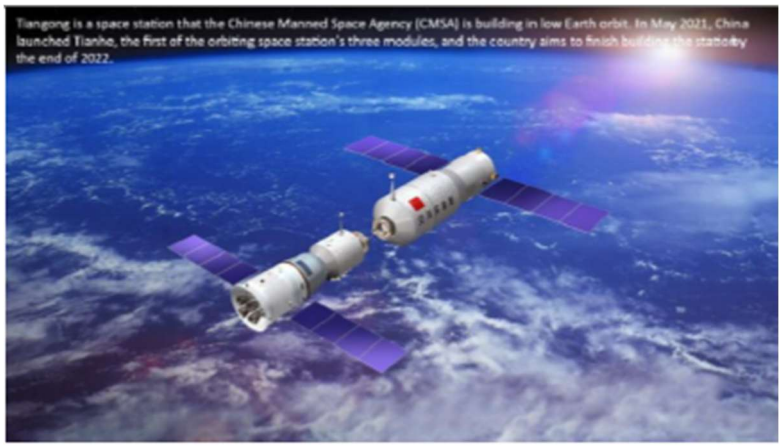

SPUTNIK 1
SOVIET UNION - 1957
On Oct. 4, 1957, the first artificial Earth satellite called Sputnik-1 (in Russian "sputnik" means satellite) was launched into orbit. Based on the combat missile Korolev developed the system of three and four-stage carriers. It was the First artificial satellite.

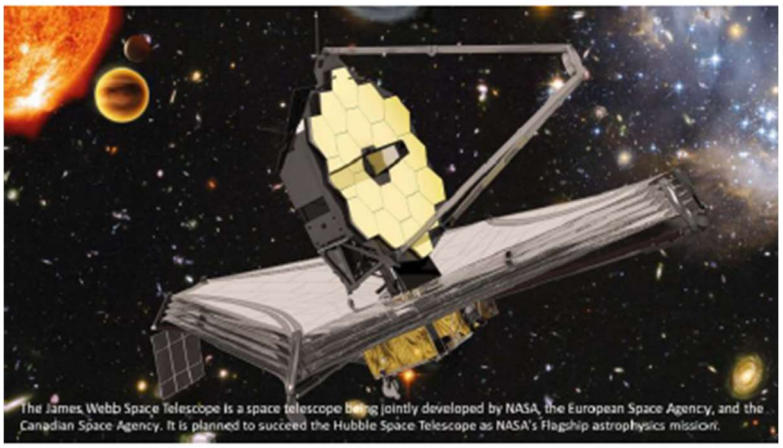

On April 12, 1961, aboard the spacecraft Vostok 1, Soviet cosmonaut Yuri Alekseyevich Gagarin becomes the first human being to travel into space.
TIME
THE WEEKLY NEWSMAGAZINE
MAN IN SPACE
RUSSIA'S YURI GAGARIN


Apollo 11 was the spaceflight that first landed humans on the Moon. The Apollo 11 lunar landing mission crew: Neil A. Armstrong, commander; Michael Collins, command module pilot; and Edwin E. Aldrin Jr., lunar module pilot


Apollo–Soyuz was the first crewed international space mission, carried out jointly by the United States and the Soviet Union in July 1975. Millions of people around the world watched on television as a United States Apollo module docked with a Soviet Union Soyuz capsule.

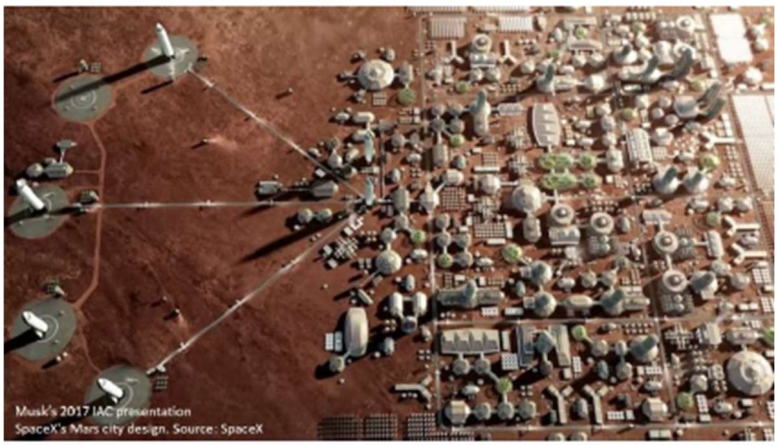

The International Space Station is a modular space station in low Earth orbit. It is a multinational collaborative project involving five participating space agencies: NASA, Roscosmos, JAXA, ESA, and CSA. The ownership and use of the space station is established by intergovernmental treaties and agreements.


Tiangong is a space station that the Chinese Manned Space Agency (CMSA) is building in low Earth orbit. In May 2021, China launched Tianhe, the first of the orbiting space station's three modules, and the country aims to finish building the station by the end of 2022.


The James Webb Space Telescope is a space telescope being jointly developed by NASA, the European Space Agency, and the Canadian Space Agency. It is planned to succeed the Hubble Space Telescope as NASA's flagship astrophysics mission.


Artemis 1, officially Artemis I and formerly Exploration Mission-1, was an uncrewed Moon-orbiting mission.
Dates: Nov 16, 2022 – Dec 11, 2022


On October 13 2024, the 71-metre-tall (242 ft) Super Heavy booster propelled a 3,000-tonne rocket into orbit before being safely caught back on the launch pad.
© AFP via Getty Images


Musk's 2017 IAC presentation
SpaceX's Mars city design. Source: SpaceX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What do all these pictures have in common?
Historical Evolution of the STI and Space Activities
Role of STI in International Space Relations

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2. Relevance of STI

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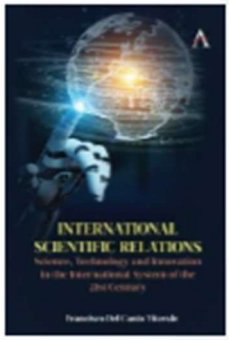
Science, Tech & Innovation always had significant Implications for the World Order

Science, Technology and Innovation (STI) is defined as a set of scientific tasks linked together, and with other socioeconomics dimensions within the international system with enormous consequences to actors, interactions, processes, parameters and global configuration of the international system. It is considered a unique and complex empirical phenomenon that has become in a key factor within the international relations" (Del Canto Viterale, 2019: 33-34).



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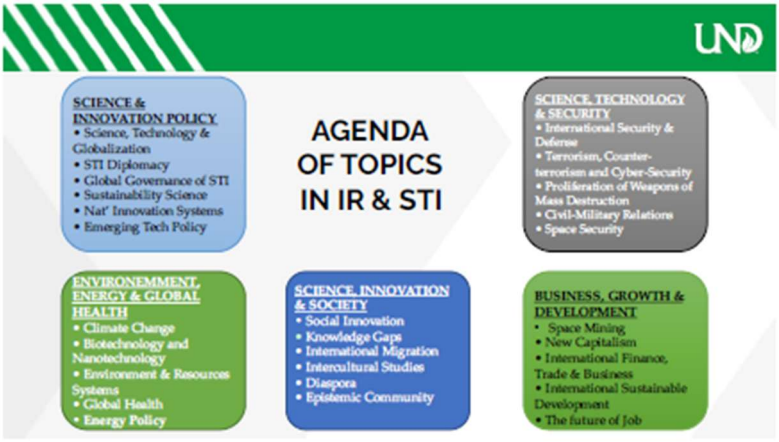
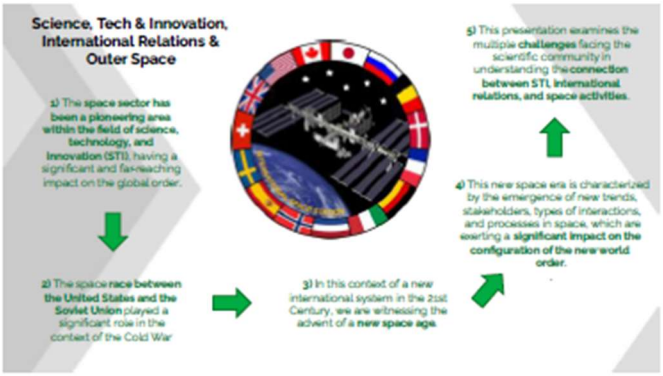
The relative strengths of the leading nations in world affairs never remain constant, principally because of the uneven rate of growth among different societies and of the technological and organizational breakthroughs which bring a greater advantage to one society than to another."

Paul Kennedy
"The Rise and Fall of the Great Powers Economic Change and Military Conflict from 1500 to 2000"
(1987)

INTERACTION BETWEEN IR & STI

RESEARCH FOCUS: Intersection between Science, Technology, Innovation and International Studies (Mutual interaction, and impact).


AGENDA OF TOPICS IN IR & STI
SCIENCE & INNOVATION POLICY
• Science, Technology & Globalization
• STI Diplomacy
• Global Governance of STI
• Sustainability Science
• Nat' Innovation Systems
• Emerging Tech Policy
SCIENCE, TECHNOLOGY & SECURITY
• International Security & Defense
• Terrorism, Counter-terrorism and Cyber-Security
• Proliferation of Weapons of Mass Destruction
• Civil-Military Relations
• Space Security
ENVIRONEMMENT, ENERGY & GLOBAL HEALTH
• Climate Change
• Biotechnology and Nanotechnology
• Environment & Resources Systems
• Global Health
• Energy Policy
SCIENCE, INNOVATION & SOCIETY
• Social Innovation
• Knowledge Gaps
• International Migration
• Intercultural Studies
• Diaspora
• Epistemic Community
BUSINESS, GROWTH & DEVELOPMENT
• Space Mining
• New Capitalism
• International Finance, Trade & Business
• International Sustainable Development
• The future of Job


Science, Tech & Innovation, International Relations & Outer Space
1) The space sector has been a pioneering area within the field of science, technology, and innovation (STI), having a significant and far-reaching impact on the global order.
2) The space race between the United States and the Soviet Union played a significant role in the context of the Cold War
3) In this context of a new international system in the 21st Century, we are witnessing the advent of a new space age.
4) This new space era is characterized by the emergence of new trends, stakeholders, types of interactions, and processes in space, which are exerting a significant impact on the configuration of the new world order.
5) This presentation examines the multiple challenges facing the scientific community in understanding the connection between STI, international relations, and space activities.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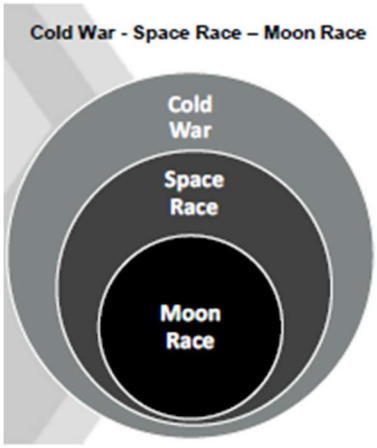
3. STI & Outer Space in the 20th Century


Fathers of Space
Konstantin Tsiolkovsky– Russia
Hermann Oberth- Rumania, Germany
Robert Goddard– United States
Robert Esnault-Pelterie - France
Wernher von Braun – Germany
Sergei Korolev– Soviet Union
First Space Organizations
GIRD / GDL – Russia (1928-1931)
VfR – Germany (1934)
American Interplanetary Society and JPL - United States (1930-1936)
British Interplanetary Society – United Kingdom (1933)


UNED
A4 / V2
On October 3, 1942, German rocket scientist Wernher von Braun's brainchild, the A-4 (V-2) missile, is fired successfully from Peenemunde. It traveled 118 miles.
The liquid-propellant rocket was the world's first long-range combat-ballistic missile and first known human artifact to enter outer space.
It was the progenitor of all modern rockets, including those used by the United States and Soviet Union's space programs.
It proved extraordinarily deadly in the war and was the precursor to the Intercontinental Ballistic Missiles (ICBMs) of the postwar era.

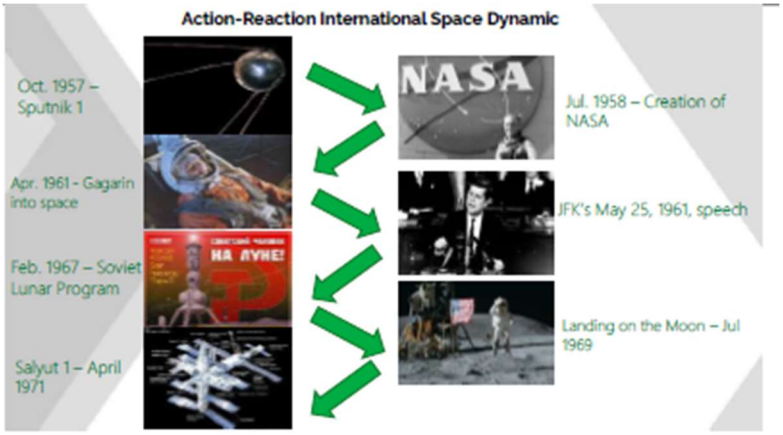

New International Context: Cold War – Space Race
US
Soviet Union
France
Brazil
Japan
China
Cuba
Poland


The New York Times.
SOVIET FIRES EARTH SATELLITE INTO SPACE;
IT IS CIRCLING THE GLOBE AT 18,000 M. P. H.;
SPHERE TRACKED IN 4 CROSSINGS OVER U. S.


Cold War - Space Race – Moon Race
Cold War
Space Race
Moon Race


СОВЕТСКИЙ ЧЕЛОВЕК
НА ЛУНЕ!


Geopolitics of Space in the Cold War - Phases
PHASE 1: Beginning of the Cold War/Space Race (1947/1961)
PHASE 2: The Space Race (1961/1972)
PHASE 3: Post Apollo Era (1972/1981)
PHASE 4: Star Wars (1981/1985)
PHASE 5: End of the Cold War (1985/1991)


Action-Reaction International Space Dynamic
Oct. 1957 – Sputnik 1
Apr. 1961 - Gagarin into space
Feb. 1967 – Soviet Lunar Program
Salyut 1 – April 1971
NASA
Jul. 1958 – Creation of NASA
JFK's May 25, 1961, speech
Landing on the Moon – Jul 1969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Space Cooperation
Cold War (1947-1991)
International Astronautical Federation (1951)
International Geophysical Year (1957 -58)
UN Institutions COPUOS/UNOOSA (1959)
Dryden-Blagonravov agreement (1962)
Interkosmos (1967)
Space Law (1967 -79)
Outer Space Treaty - OST (1967)
Rescue Agreement (1968)
Liability Convention (1972)
Registration Convention (1975)
Moon Agreement (1979)
Apollo-Soyuz Project (1975)
European Space Agency (1975)


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Toward the End of the Cold War
On March 23, 1983, President Ronald Reagan proposed the Strategic Defense Initiative, also known as the Star Wars Program, which involved sending arms into space to protect the US from missile attacks.
Main hypothesis: Collapse of the Soviet Union
The Soviet Union's failure to compete with the United States in the new dimensions offered by the scientific and technological revolution, fundamentally in the development of new technology.
Two main Space Projects:
The SDI
Space Station Freedom
STRATEGIC DEFENSE INITIATIVE
DEPARTMENT OF DEFENSE
TIME
DEFENDING DEFENSE

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U.S. Hegemony in the '90s (Moltz, 2019)

- **U.S. winner of the Cold War** -George H.W. Bush-State of the Union Address (28/01/1992)
- The United States **technocratic dominance in space**.
- The **United States space accomplishments** included:
  - The successful operation of the **Space Shuttle program**.
  - The **successful partnership with Russia** in the Shuttle/MIR program,
  - Leadership in organizing the agreement and construction of the **International Space Station (ISS)**,
  - Commercialization of the military **GPS system** (a vast windfall for US companies),
  - The reestablishment of military space launch reliability under the **Evolved Expendable Launch Vehicle program**.

International Space Station (1998)

- January 29, 1998, senior government officials from 15 countries met in Washington DC and signed agreements establishing the **framework for cooperation** among the partners on the design, development, operation and utilization of the **International Space Station.**
- **Original Participants**:
  - ✓ Germany - DLR
  - ✓ Italy - ASI
  - ✓ Netherlands
  - ✓ Norway - NSC
  - ✓ Spain - INTA
  - ✓ Sweden - SNSB
  - ✓ Switzerland
  - ✓ United Kingdom
  - ✓ United States - NASA
  - ✓ Russia - Roscosmos
  - ✓ Canada - CSA
  - ✓ Japan – JAXA
  - ✓ Europe – ESA
  - ✓ Belgium
  - ✓ Denmark – DNSC
  - ✓ France - CNES
- Construction began **1998** / First Crew **2000**

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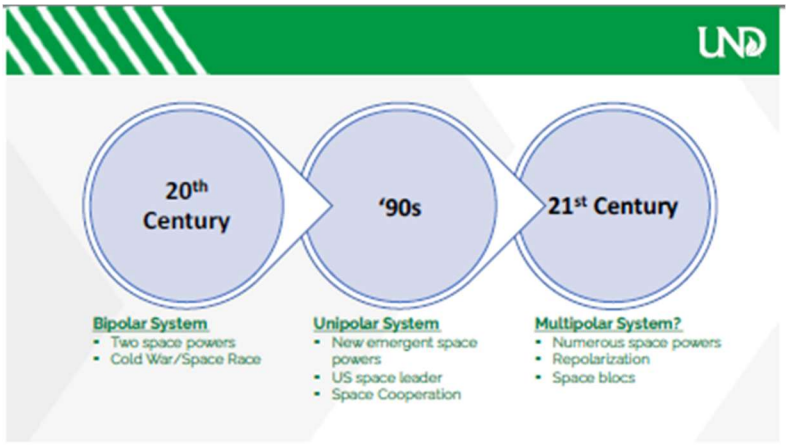
4. STI & Outer Space in the 21st Century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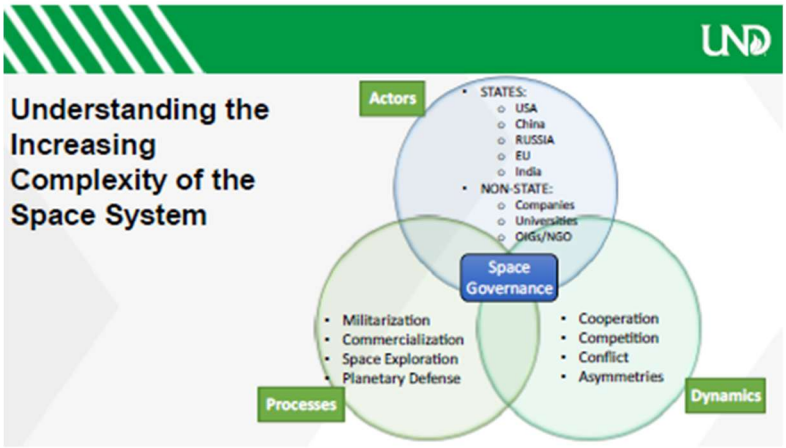
20th Century
'90s
21st Century
Bipolar System
Two space powers
Cold War/Space Race
Unipolar System
New emergent space powers
US space leader
Space Cooperation
Multipolar System?
Numerous space powers
Repolarization
Space blocs


Current and Emerging Geopolitical "Hot Spots"
Iran's regional reach
IRAN
NORTH KOREAN STRATEGIC NUCLEAR THREAT
CHINA
RUSSIA
UKRAINE


UND
The Economist
The alternative world order


Space Diplomacy
Space Policy
Space Economy
Space Geopolitics
The new
SPACE AGE
Astropolitik
Space Law
Space Race 2.0
Astrosociology
Space Governance


Understanding the Increasing Complexity of the Space System
Actors
STATES:
USA
China
RUSSIA
EU
India
NON-STATE:
Companies
Universities
OIGs/NGO
Space Governance
Militarization
Commercialization
Space Exploration
Planetary Defense
Processes
Cooperation
Competition
Conflict
Asymmetries
Dynamics


ACTORS
DYNAMICS
PROCESSES
SPACE AGENDA
UND SPACE STUDIES
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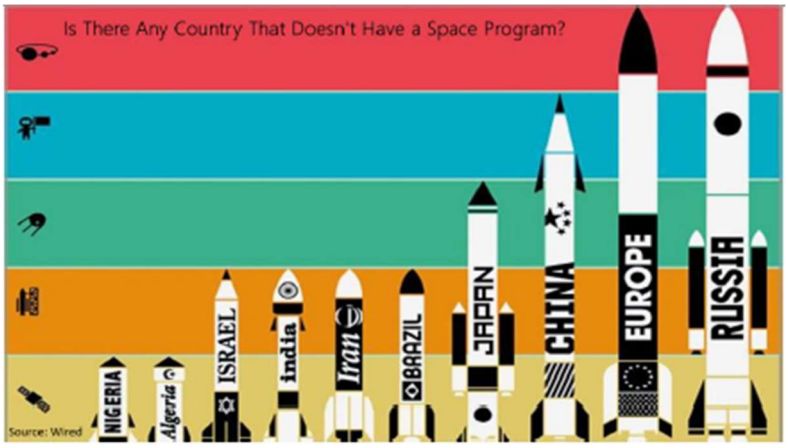
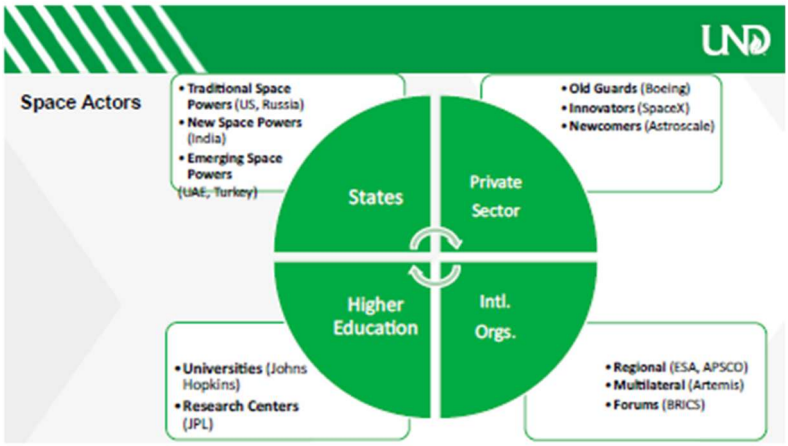

Is There Any Country That Doesn't Have a Space Program?
NIGERIA
Algeria
ISRAEL
india
Iran
BRAZIL
JAPAN
CHINA
EUROPE
RUSSIA
Source: Wired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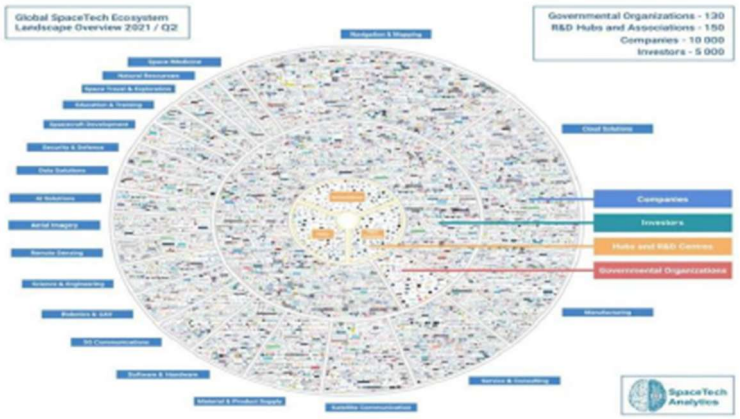
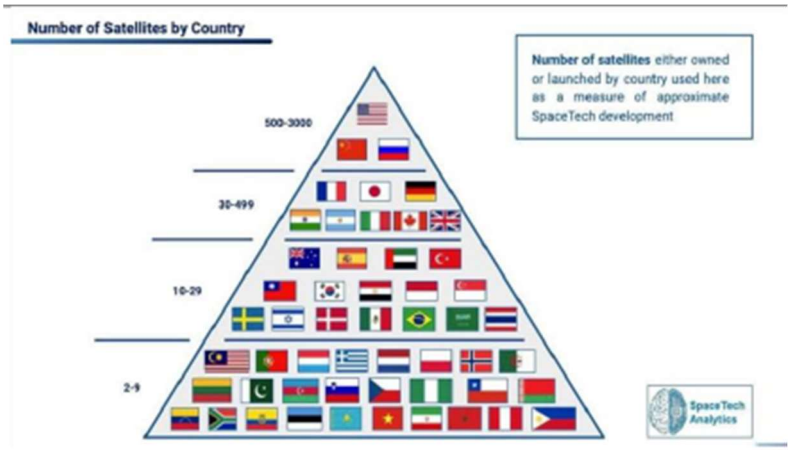
Space Actors
• Traditional Space Powers (US, Russia)
• New Space Powers (India)
• Emerging Space Powers (UAE, Turkey)
• Old Guards (Boeing)
• Innovators (SpaceX)
• Newcomers (Astroscale)
States
Private Sector
Higher Education
Intl. Orgs.
• Universities (Johns Hopkins)
• Research Centers (JPL)
• Regional (ESA, APSCO)
• Multilateral (Artemis)
• Forums (BRICS)

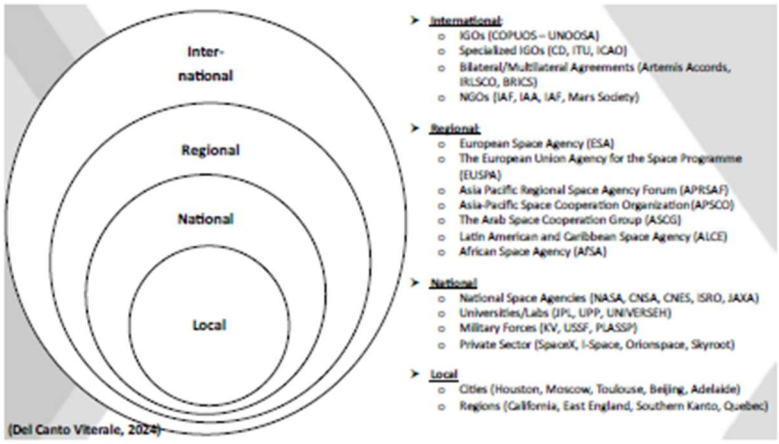

Global SpaceTech Ecosystem Landscape Overview 2021 / Q2
Governmental Organizations - 130
R&D Hubs and Associations - 150
Companies - 10 000
Investors - 5 000
Companies
Investors
Hubs and R&D Centres
Governmental Organizations
SpaceTech Analytics


Number of Satellites by Country
Number of satellites either owned or launched by country used here as a measure of approximate SpaceTech development
500-3000
30-499
10-29
2-9
SpaceTech Analytics


National Space Policy
SUPARCO's space programme 2040
SPACE STRATEGY FOR EUROPE
2021中国的航天


AEROJET ROCKETDYNE
BLUE ORIGIN
SPACEX
FIREFLY
LOCKHEED MARTIN
Top Five Space Companies


U.S. Private Sector
Alliant Techsystems
-Participated in CCDev2
-Unfunded partnership
Blue Origin
-Participated in CCDev1 and CCDev2
-Awarded $25.6 million
Boeing
-Participated in CCDev1, CCDev2, CCiCap, CPC and CCtCap
-Awarded $4.82 billion
Excalibur Almaz Inc.
-Participated in CCDev2
-Unfunded partnership
Paragon Space
-Development Corp. Participated in CCDev1
-Awarded $1.4 million
Sierra Nevada Corporation
-Participated in CCDev1, CCDev2, CCiCap and CPC
-Awarded $363.1 million
SpaceX
-Participated in CCDev2, CCiCap, CPC and CCtCap
-Awarded $3.144 billion
United Launch Alliance
-Participated in CCDev1 and CCDev2
-Awarded $6.7 million


Inter-national
Regional
National
Local
(Del Canto Viterale, 2024)
International
IGOs (COPUOS – UNOOSA)
Specialized IGOs (CD, ITU, ICAO)
Bilateral/Multilateral Agreements (Artemis Accords, IRLSCO, BRICS)
NGOs (IAF, IAA, IAF, Mars Society)
Regional
European Space Agency (ESA)
The European Union Agency for the Space Programme (EUSPA)
Asia Pacific Regional Space Agency Forum (APRSAF)
Asia-Pacific Space Cooperation Organization (APSCO)
The Arab Space Cooperation Group (ASCG)
Latin American and Caribbean Space Agency (ALCE)
African Space Agency (AfSA)
National
National Space Agencies (NASA, CNSA, CNES, ISRO, JAXA)
Universities/Labs (JPL, UPP, UNIVERSEH)
Military Forces (KV, USSF, PLASSP)
Private Sector (SpaceX, I-Space, Orionspace, Skyroot)
Local
Cities (Houston, Moscow, Toulouse, Beijing, Adelaide)
Regions (California, East England, Southern Kanto, Quebec)


ACTORS
DYNAMICS
PROCESSES
SPACE AGENDA
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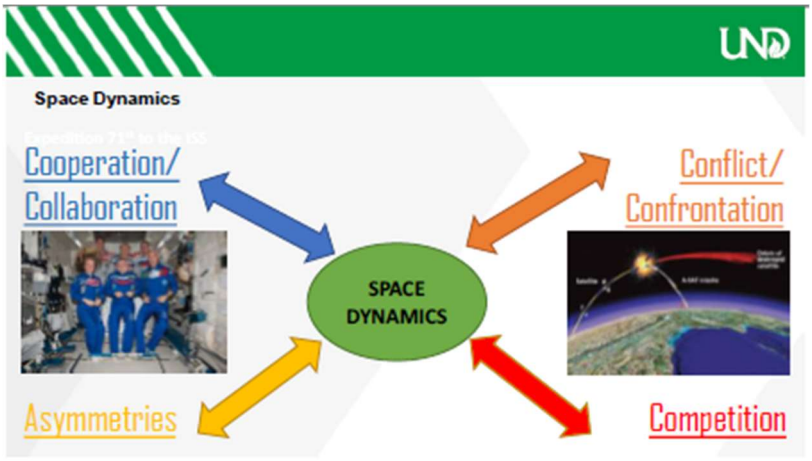
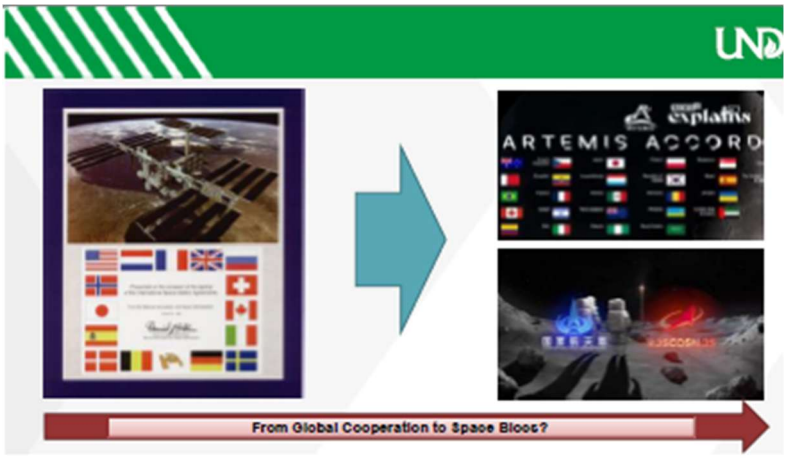

UND
Space Dynamics
Cooperation/ Collaboration
Conflict/ Confrontation
SPACE DYNAMICS
Asymmetries
Competition


UND
Space Organizations - Blocs
ALCE

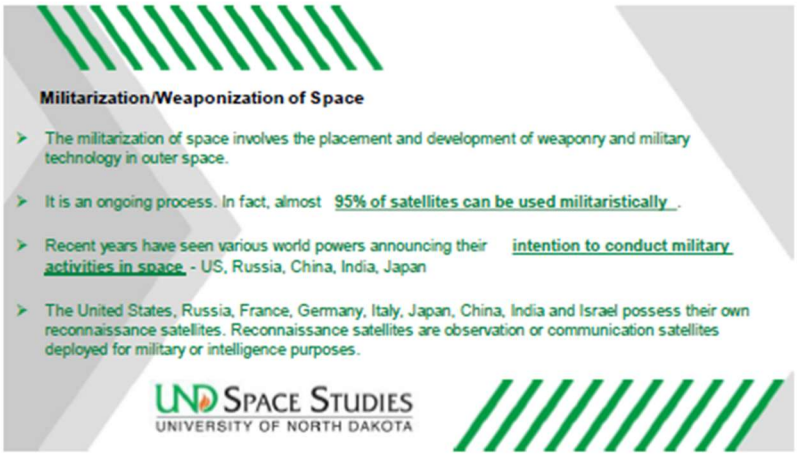

UND
New Balance of Space Power
ARTEMIS ACCORDS
Artemis Accords
ESA
ILRS
BRICS


UND
ARTEMIS ACCORD
From Global Cooperation to Space Blocs?


UND
At this very moment...
Expedition 71st to the ISS
Ukraine's War – since Feb. 2022


ACTORS
DYNAMICS
PROCESSES
SPACE AGENDA
UND Space Studies
University of North Dakota


UND
Space Processes
Militarization/Weaponization
Commercialization & Privatization
Global/ National Governance and Regulation
Tech Development and Application


Militarization/Weaponization of Space
The militarization of space involves the placement and development of weaponry and military technology in outer space.
It is an ongoing process. In fact, almost 95% of satellites can be used militaristically.
Recent years have seen various world powers announcing their intention to conduct military activities in space - US, Russia, China, India, Japan
The United States, Russia, France, Germany, Italy, Japan, China, India and Israel possess their own reconnaissance satellites. Reconnaissance satellites are observation or communication satellites deployed for military or intelligence purposes.
UND Space Studies
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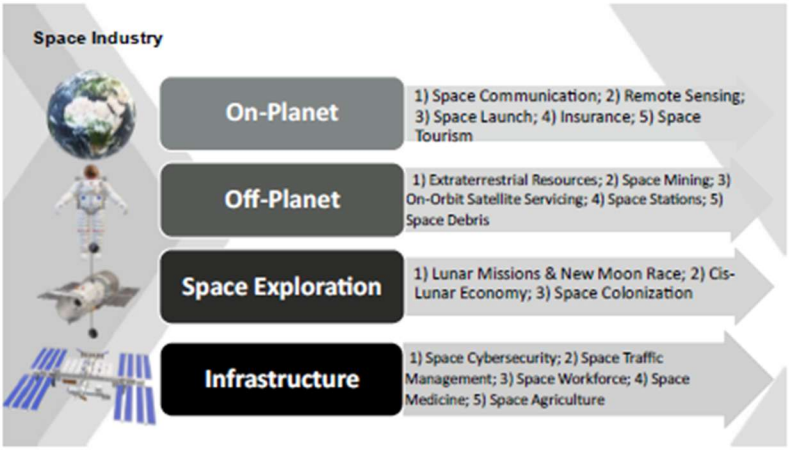
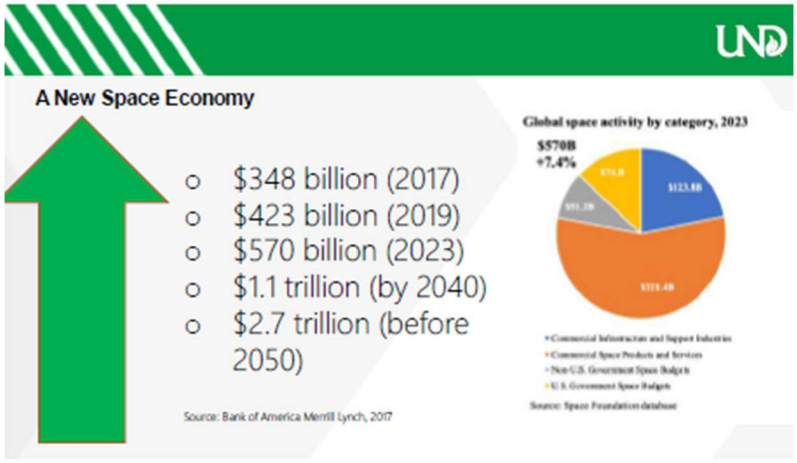
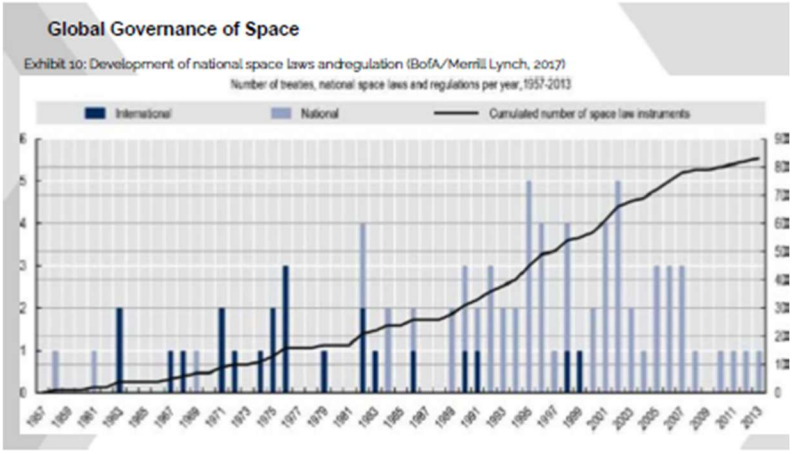
UND
"I am not confident that we can achieve victory or even compete in a modern conflict, without space power."
Gen. John W. Raymond (2020), Former Chief of Space Operations, US Space Force
"To explore the vast cosmos, develop the space industry and build China into a space power is our eternal dream."
President Xi Jinping – China's Space Vision White Paper- January 2022


On March 2019, India tested an ASAT weapon that took out a target satellite in LEO. Prime Minister Narendra Modi addressing be nation after India's A-SAT missile shoots down a live satellite in Lower Earth Orbit. India is only the fourth country to have used such a weapon.


Space Industry
On-Planet
1) Space Communication; 2) Remote Sensing; 3) Space Launch; 4) Insurance; 5) Space Tourism
Off-Planet
1) Extraterrestrial Resources; 2) Space Mining; 3) On-Orbit Satellite Servicing; 4) Space Stations; 5) Space Debris
Space Exploration
1) Lunar Missions & New Moon Race; 2) Cis-Lunar Economy; 3) Space Colonization
Infrastructure
1) Space Cybersecurity; 2) Space Traffic Management; 3) Space Workforce; 4) Space Medicine; 5) Space Agriculture


UND
A New Space Economy
$348 billion (2017)
$423 billion (2019)
$570 billion (2023)
$1.1 trillion (by 2040)
$2.7 trillion (before 2050)
Source: Bank of America Merrill Lynch, 2017
Global space activity by category, 2023
$570B
+7.4%
$123.8B
$318.4B
Commercial Infrastructure and Support Industries
Commercial Space Products and Services
Non-U.S. Government Space Budgets
U.S. Government Space Budgets
Source: Space Foundation database


EMERGING MARKETS IN THE NEW SPACE ECONOMY
DEEP SPACE
CIS LUNAR SPACE
ORBITAL SPACE
SPACE INDUSTRY
SPACE COLONIZATION
SPACE TOURISM
LUXURY SPACE HOTELS
SATELLITE SERVICING
COMMERCIAL REUSABLE SPACESHIPS
ORBITAL REFUELING
SPACEPORT OPERATIONS
COMMUNICATION SATELLITES
PARABOLIC FLIGHTS
SATELLITE DATA SERVICE
SPACE SOLAR STATION
SPACE DEBRIS REMOVAL
SPACE MANUFACTURING
MOON VACATION
SELF REPLICATING ROBOTS
AUTOMATED MINING
FOOD, WATER AND WASTE MANAGEMENT SYSTEMS
LUNAR SURFACE MOBILITY
AUTONOMOUS ROBOTS
INTERPLANETARY PAY-LOAD DELIVERY
PLANET TERRAFORMING
DOME COVERED ECOSYSTEM
ASTEROID MINING
ASTEROID HAULING
MODULAR NUCLEAR POWER STATION
VERTICAL FARMING
3D PRINTING CONSTRUCTION ROBOTS
punkt The Foresight Company


Global Governance of Space
Exhibit 10: Development of national space laws andregulation (BofA/Merrill Lynch, 2017)
Number of treaties, national space laws and regulations per year, 1957-2013
International
National
Cumulated number of space law instruments


New Space Tech
57,000 satellites planned through 2029
New Shepard: Reusable rocket designed to take passengers into space
Space Shuttle
Delta Heavy
Soyuz
Falcon 1
Saturn V
Long March 5b
Falcon 9
Falcon Heavy
SpaceX
Starship (estimate)
70 m
122 m
111 m


ACTORS
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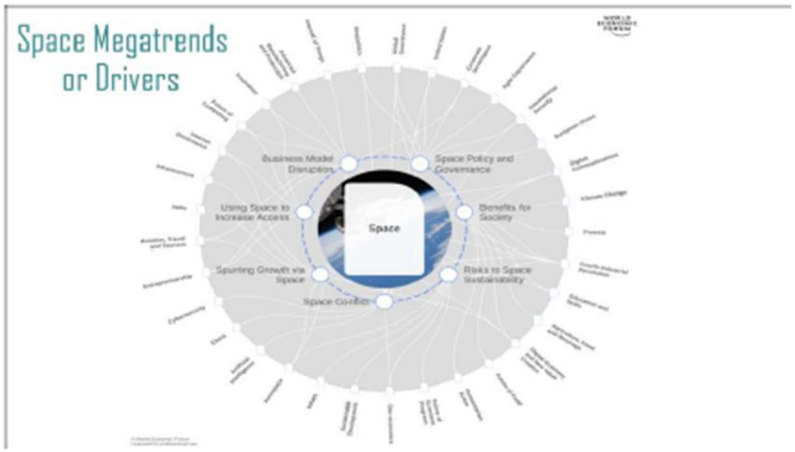
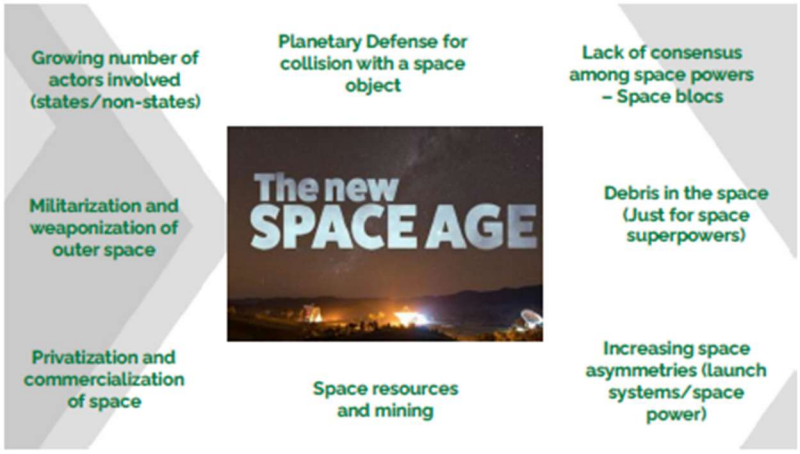

Space Megatrends or Drivers
Space
Business Model Disruptors
Space Policy and Governance
Using Space to Increase Access
Benefits for Society
Spurring Growth via Space
Risks to Space Sustainability
Space Conflict


Growing number of actors involved (states/non-states)
Planetary Defense for collision with a space object
Lack of consensus among space powers – Space blocs
Militarization and weaponization of outer space
The new SPACE AGE
Debris in the space (Just for space superpowers)
Privatization and commercialization of space
Space resources and mining
Increasing space asymmetries (launch systems/space power)