



*Promoting Cooperative Solutions for Space Sustainability*

# **Small Satellites - Opportunities & Challenges for New Actors in Space**

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Small Satellites Tech, Business & Regulatory Industry Workshop

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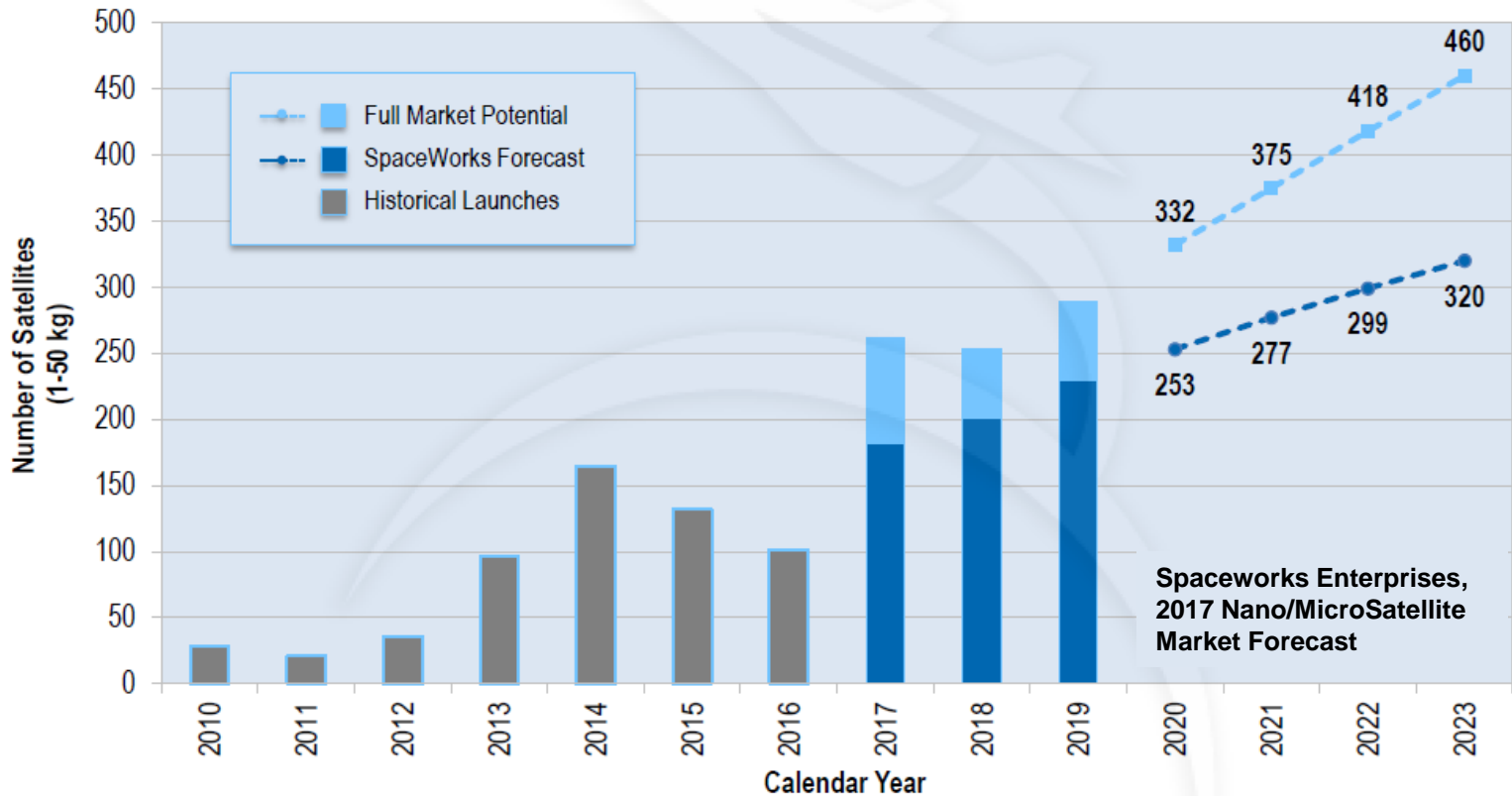
- Secure World Foundation *is a private operating foundation* that promotes cooperative solutions for space sustainability
- Why **space sustainability**? Increasing reliance on space assets coupled with potentially destabilizing trends
- **Our mission:** SWF works with governments, industry, international organizations and civil society to develop and promote ideas and actions for international collaboration that achieve the secure, sustainable, and peaceful uses of outer space for the socioeconomic and environmental benefits to Earth

# DISRUPTION

**Disruptive Innovation: “a process by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves up market, eventually displacing established competitors” (Clayton Christensen)**

<http://www.claytonchristensen.com/key-concepts/>

# A fundamental change?



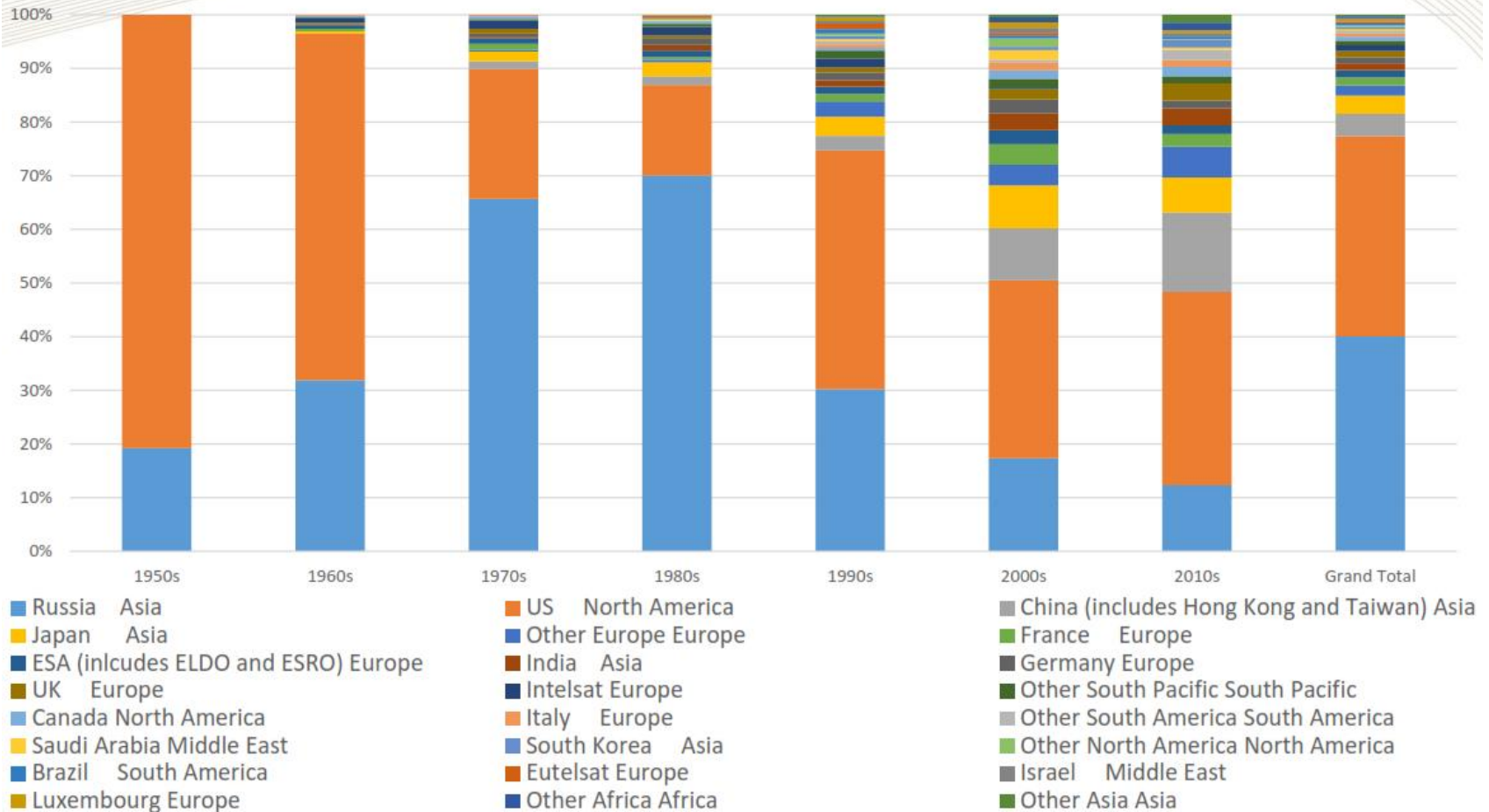
As of June 2016: Total number of operating satellites: 1,419

Forecast: Up to 2400 micro/nanosatellites to launch by 2023

Mega-constellations: 16,000+ planned satellites, many not included in above

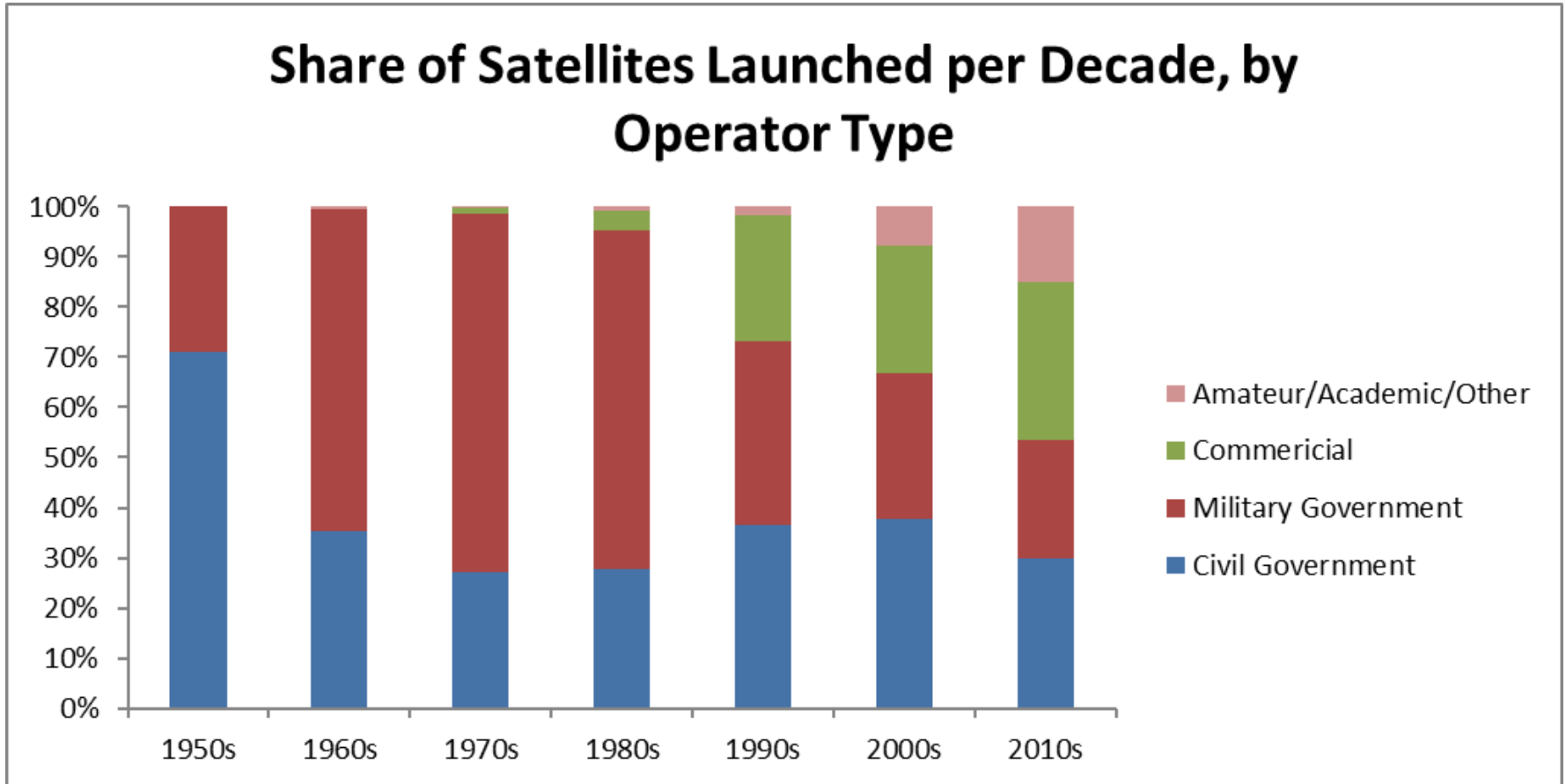
# Space is becoming more international

Satellites by Owner Country -1950s-today



Adapted from [IDA Global Trends in Civil and Commercial Space Study](#)

# Space is becoming more commercial

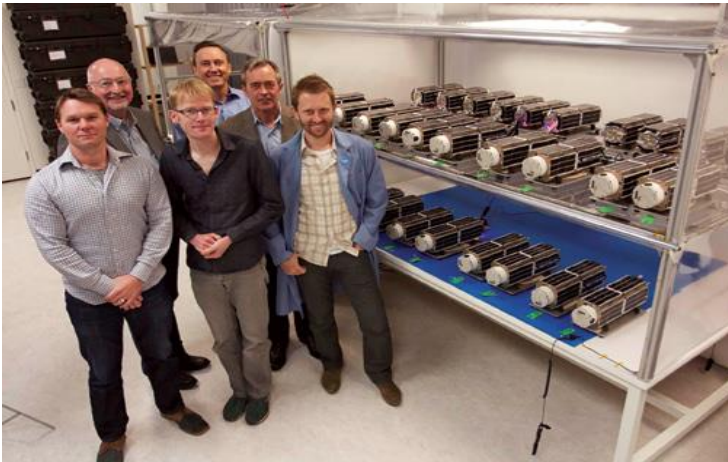


Source: McDowell, Jonathan C, 2017—*Satellite Statistics*  
[http://www.planet4589.org/space/log/stats2/own\\_categ.txt](http://www.planet4589.org/space/log/stats2/own_categ.txt)

# Disruptive Business Approaches

**“Change is hitting the industry from all sides, and it’s not just technology that’s advancing, although in many ways it is leading the upheaval. There’s also a transformation in manufacturing systems, business models, customer engagement, and management processes.”**

*- Avascent (Space Market Disruption Whitepaper, 2015)*



*Planet founders pose with a flock of Doves.  
Image credit: [SatMagazine](#)*



*\* Satellites not to scale*

# Small satellites as a disruptor

## Opportunities

- Lower costs of access to space technology
- Lower technical and scientific barriers
- Broaden and diversify actors and users
- Enable new (and innovative?) applications and services
- Provide increased societal benefit

## Challenges

- Regulatory fit, efficiency, and scale
- Diverse, heterogeneous set of actors
- Few standards for operations
- Spectrum, SSA, and potential space debris implications



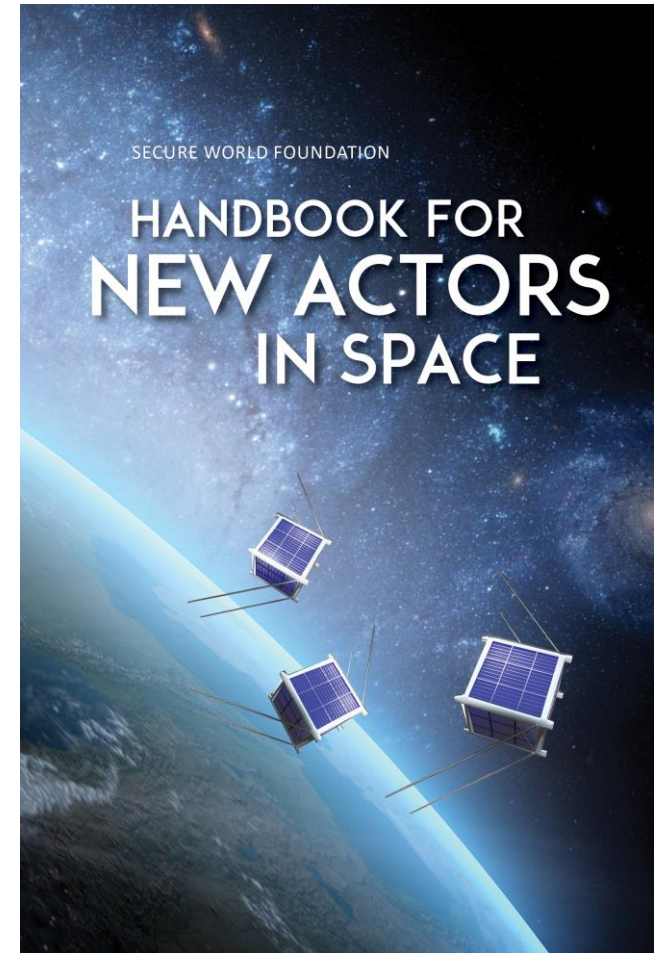


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# SWF HANDBOOK

# SWF Handbook for New Actors in Space

- **Goal:** Create a publication that provides an overview fundamental principles, laws, norms, and best practices for safe, predictable, and responsible activities in space
- **Two specific audiences:**
  - Countries developing space programs and/or having to oversee and regulate their first satellites
  - Universities and start-up companies that are developing/operating satellites



# Chapter 1 – International framework

- Freedom and Responsibility
- Registration of Space Objects
- International Frequency Management
- Remote Sensing
- International Standards
- International Export Control
- International Liability
- Dispute Settlement
- Environmental Issues
- Advanced Issues
- International Organizations

Part A: Information provided in conformity with the Registration Convention or General Assembly Resolution 1721 B (XVI)		
New registration of space object	Yes <input type="checkbox"/>	Check Box
Additional information for previously registered space object	Submitted under the Convention: ST/SG/SER.E/ <input type="checkbox"/>	UN document number in which previous registration data was distributed to Member States
	Submitted under resolution 1721B: A/AC.105/INF. <input type="checkbox"/>	
Launching State/States/international intergovernmental organization		
State of registry or international intergovernmental organization	<input type="text"/>	Under the Registration Convention, only one State of registry can exist for a space object.
Other launching States	<input type="text"/>	
Designator		
Name	<input type="text"/>	
COSPAR international designator	<input type="text"/>	
National designator/registration number as used by State of registry	<input type="text"/>	
Date and territory or location of launch		
Date of launch (hours, minutes, seconds optional)	<input type="text"/> <input type="text"/> <input type="text"/> hrs <input type="text"/> min <input type="text"/> <input type="text"/> sec	Coordinated Universal Time (UTC)
Territory or location of launch	<input type="text"/>	
Basic orbital parameters		
Nodal period	<input type="text"/>	minutes
Inclination	<input type="text"/>	degrees
Apogee	<input type="text"/>	kilometres
Perigee	<input type="text"/>	kilometres

UNOOSA International  
Registry Form

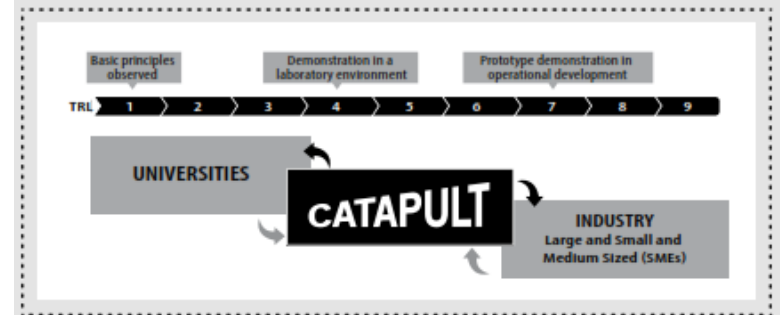
# Chapter 2 – National policy and administration

- Public Policy
  - Rationales, objectives, principles
  - Government roles and responsibilities
- Public Administration and National Oversight
  - National regulators and licensing
  - National frequency administration
  - Export controls
- Case Study: Remote Sensing Policy and Administration

## Case Study:

### The United Kingdom Satellite Applications Catapult

The United Kingdom Satellite Applications Catapult was established by the government of the United Kingdom (UK) in May 2013 with the goal of creating economic growth in the UK through supporting the development, commercialization, and use of satellite applications. According to its Delivery Plan 2015–2020, the Catapult (Figure 8) aims to promote satellite application and technology development and to help domestic industry “bring new products and services more rapidly to market.” The Satellite Applications Catapult is one of 11 “Catapults” operating in the UK, each focusing on different technologies and application areas. The Catapult operates as a private, not-for-profit research organization. It is governed by a board, which includes representation from the United Kingdom Space Agency (UKSA) and from Innovate UK—a government agency focused on fostering technology and economic development.



*UK Satellite Applications Catapult*

# Chapter 3 – Responsible space operations

- Pre-launch
  - Licensing
  - Launch vehicle selection and integration
  - Insurance
- Launch
  - Safety considerations
- On-orbit
  - Orbit determination, propagation, and tracking
  - Conjunction assessment and collision avoidance
  - Anomaly response
- End-of-life

Examples of CA Screening Volumes					
Orbit Regime	Orbit Regime Criteria/Definition	Predict/ Propagate/ Time	Radial Miss (km)	In-Track Miss (km)	Cross-Track Miss (km)
GEO	1300min < Period < 1800 min Eccentricity < 0.25 & Inclination < 35°	10 days	12	364	30
HEO 1	Perigee < 2000 km & Eccentricity > 0.25	10 days	40	77	107
MEO	600 min < Period < 800 min Eccentricity < 0.25	10 days	2.2	17	21
LEO 4	1200 km < Perigee ≤ 2000 km Eccentricity < 0.25	7 days	0.5	2	2
LEO 3	750 km < Perigee ≤ 1200 km Eccentricity < 0.25	7 days	0.5	12	10
LEO 2	500 km < Perigee ≤ 750 km Eccentricity < 0.25	7 days	0.5	28	29
LEO 1	Perigee ≤ 500 km Eccentricity < 0.25	7 days	2	44	51

*Examples of close approach screening volumes*

- The Handbook was officially released in February 2017
- Electronic copies are available through the SWF website, free of charge: [www.swfound.org/handbook](http://www.swfound.org/handbook)
- Printed copies are also available
- SWF plans to curate an electronic library of resources to accompany the Handbook
  - Looking for interested partners to help with sponsorship or contributions
    - Companies
    - Governments
    - NGOs
    - Universities



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# Thank You

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