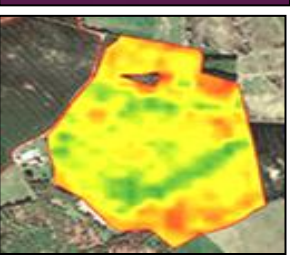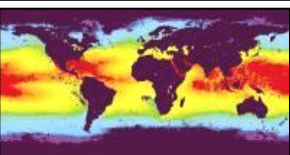# SURREY

DOING SPACE DIFFERENTLY.

Capacity Building in Space Capabilities
for National and Regional Benefit
Lessons Learned

31st UN/IAF Workshop on Space Technologies for Socio-Economic Benefit:

"Space Sustainability as a Game-Changer for Development

Alex da Silva Curiel | acuriel@sstl.co.uk

@SurreySat   @surreysatellites

The relevance of space today

- Space is increasingly accessible and relevant to ordinary citizens in all nations
  - Resilient infrastructure
  - Supports informed policy making
  - Border monitoring, environmental monitoring, Climate monitoring, disaster monitoring, food and water security

- Economic Benefits
  - Return-on-Investments of 3-5x not uncommon
  - Encourages companies to invest and innovate leading to GDP and export growth
  - Encourages students into STEM areas
  - Can foster bilateral and regional partnerships

- Challenges
  - Low Return On Investment for upstream activities
  - Low volumes with long time periods and high quality requirements
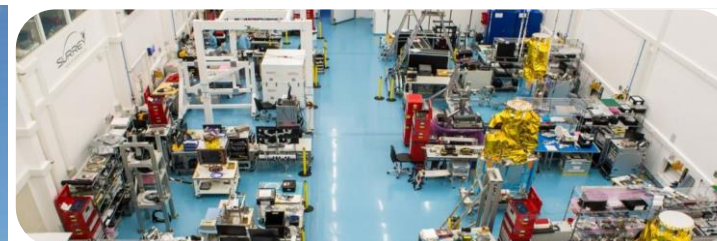 - Access to global markets

Surrey Satellite Technology Ltd.
Pioneer of the Smallsat Revolution

Space mission prime |Small satellites and constellations |Manufacturer and operator| On-the-job training.
Supplier to governments and commercial operators

Doing Space Differently.

SSTL EMPLOYS 400 STAFF | 74 SATELLITES LAUNCHED

SSTL is vertically integrated, with full capability to design from component parts, build, test, launch and operate space missions.This gives control over Cost, Schedule and Risk.

With IP ownership, SSTL can licence its designs, or provide comprehensive hands-on and on-the-job training for its customers wanting to build their own spacecraft with small teams.

Our focus on value-for-money and return-on-investment makes us the leading provider of commercial operational LEO spacecraft for smallsat owner-operators.

Established in 1985
Based in the United Kingdom with space mission partners worldwide
An Airbus Defence and Space company

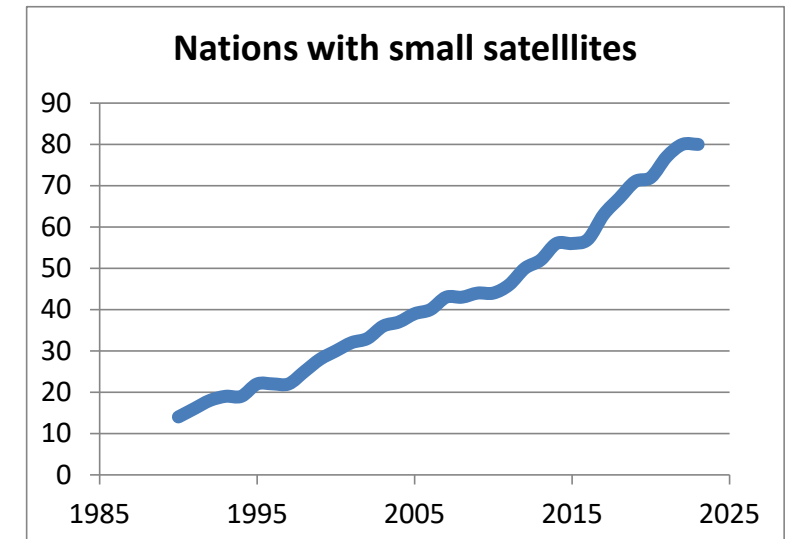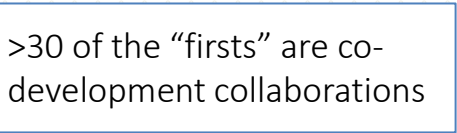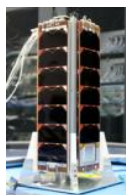ISO9001:2015
ISO14001:2015
ISO27001:2013

Most smallsat programmes start as bi-laterals

>30 of the "firsts" are co-development collaborations

Small satellite projects

Training and development projects

Nations with small satellites

Smallsat	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Russia	20	26	22	12	7		6	7	6		6	7	4	4	2	5	3		4	9	3	1	7	11	12	9	3	10	9	11	11	3	30	43
Japan	4	1		1			1		1			1	4	3		2	3	2	2	5	7		6	2	21	1	4	9	9	8	4	21	19	8
India	0		1	0	1										1				2	2	1	3		1			4	3	4	2		5	8	2
US	8	13	2	6	7	8	6	14	48	53	19	9	2	6	3	3	24	26	11	12	16	17	13	68	101	106	72	186	127	239	950	###	###	2050
China	2	0	0	0	1	0	0	0	0	1			3	3	6	1	2	1	1	4	4	3	1	3	28	18	14	44	51	39	70	118	136	
UK	2	1			2					1	3			1		2				1			1	2	9	13	51	34	26	124	304	128	177	
Israel	1	0			1	2			2		1			1				1		1		1		1		2		1	3		3	1	4	11	6
Italy	0	0		1	2					1	3			1		1	1	2	1		1	1	1	4	1	2		5	1		1	8	8	6
Czech Repub		1																																3
Argentina	1						2		1		2		2			2		1				2	1			2		2		1	2	13	5	10	14
Pakistan	1												1															1						
Netherlands	1								1								2			1				2					1	3		1	3	1	4
Brazil	1			1					1	2				2						1	2							1	1		1	2	0	
Netherlands	1																2			1				2					1	3		1	3	1	4
France	0	1	1	2		1		1	1	2		1		6		1		2	2	1	4		1				1	3	1	6	4	5	5	11
Germany				2	1		2	3	2	2	1	3			6	2		1			9	1			2	7	10	11	5	7	4	1		
Sweden	0		1			1		1	1		1			1					2							1								
South Korea	0								2				1				2		1	1			3				11		5	5	12			
Portugal																											1							
Mexico						1	1																					2	2					
Spain	0						1									1				2		1	2	1		1		2	2	3	5	19	13	
Chile	0																									1				5	1			
Australia	0							1																		4	5	1	1	7	1	10		
Thailand								1																		1	1	2		1				
North Korea	0																	1		2						1					3			
South Africa	0							1										1			1					2	1			3				
Taiwan	0						1						6								1			1		6	2	1	4					
Denmark	0							1				2					1			2	2	2	1	2	1		2							
Saudi Arabia									1		3			6				1			2		2											
Malaysia																					2						2							
Morocco																																		
Belgium									1								1			1	2		1			1				3				
Algeria																																		
Turkey																1	1	1					2	1			1	2	9					
Nigeria																																		
Canada	0	0	0							3						2			5	4	1	3	1	7		4	17	13	18					

Smallsat	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Ukraine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1							1			1			1					1	1
Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0		1	1				1			1				3				1	3	1
Iran	0	0	0	0	0	0	0	0	0	0	0	0	0	0		1				1	1		1	2		1				1	1	3	2	2
Belarus	0	0	0	0	0	0	0	0	0	0	0	0	0	0			1							1					1					
Indonesia	0	0	0	0	0	0	0	0	0	0	0	0	0	0												1	1							1
Colombia	0	0	0	0	0	0	0	0	0	0	0	0	0	0				1												1				1
Egypt																														2				
UAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0		0	0	0	1	1	1	1	3	1	3
Singapore	0	0	0	0	0	0	0	0	0	0	0	0	0	0								1		1	3			1			2		4	9
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0	0	0								1		1							5	5	4	7
Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0									1	1	1			1	2		2	5		3
Hungary	0	0	0	0	0	0	0	0	0	0	0	0	0	0									1						2		2			1
Romania	0	0	0	0	0	0	0	0	0	0	0	0	0	0									1											2
Vietnam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1			0	0	0	0	1	0	1	0	0
Estonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0										1				1						1
Peru	0	0	0	0	0	0	0	0	0	0	0	0	0	0								2	1											
Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	0											2			1			2		1	
Uruguay	0	0	0	0	0	0	0	0	0	0	0	0	0	0																				
Kazakhstan	0	0	0	0	0	0	0	0	0	0	0	0	0	0														1						
Philippines	0	0	0	0	0	0	0	0	0	0	0	0	0	0													1				3			2
Finland	0	0	0	0	0	0	0	0	0	0	0	0	0	0														2	4	2	2	9	9	11
Ghana	0	0	0	0	0	0	0	0	0	0	0	0	0	0																				
Bangladesh	0	0	0	0	0	0	0	0	0	0	0	0	0	0																				
Slovakia	0	0	0	0	0	0	0	0	0	0	0	0	0	0														1				1		1
Mongolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0																				
Latvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0														1						
Costa Rica	0	0	0	0	0	0	0	0	0	0	0	0	0	0															1					
Kenya	0	0	0	0	0	0	0	0	0	0	0	0	0	0															1					1
Jordan	0	0	0	0	0	0	0	0	0	0	0	0	0	0																				
Bhutan	0	0	0	0	0	0	0	0	0	0	0	0	0	0																			1	
New Zealand	0	0	0	0	0	0	0	0	0	0	0	0	0	0															1			1	1	1
Ecuador	0	0	0	0	0	0	0	0	0	0	0	0	0	0																1				
Nepal	0	0	0	0	0	0	0	0	0	0	0	0	0	0																			1	
Sri Lanka	0	0	0	0	0	0	0	0	0	0	0	0	0	0																				
Rwanda	0	0	0	0	0	0	0	0	0	0	0	0	0	0																				
Ethiopia	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		1		
Slovenia	0	0	0	0	0	0	0	0	0	0	0	0	0	0																			1	

Customer Training Programmes

21 ☑
TRAINING PROGRAMMES

NATION	Phillippines, DOST-ASTI	Thailand, GISTDA	Canada, Urthecast	Kazakhstan, Ghalam	Algeria, ASAL	Kazakhstan, KGS	USA, NASA / MSU
TEAM	13	48	8	15	18	24	3
PERIOD	2021	2018-2022	2017-2019	2014-2016	2014-2016	2012-2013	2007-2008
MISSION	MULA	THEOS-2 SmallSAT	Urthecast	KazSTSAT	AISAT-1B	KazEOSat-2	Magnolia

NATION	Singapore, NTU	Malaysia, ATSB	China, Tsinghua University	Algeria, CNTS	Turkey, Bilten	Nigeria, NASRDA	Nigeria, NASRDA
TEAM	2	9	12	12	12	12	26
PERIOD	1995-1997	1996-1998	1998-1999	2000-2002	2001-2003	2001-2003	2006-2009
MISSION	UoSAT-12 (payload)	TiungSat-1	Tsinghua-1	ALSAT-1	BILSAT-1	NigeriaSat-1	NigeriaSat-2 NigeriaSat-X

NATION	Thailand, MUT	Chile, FACH	Japan, Fujitsu	Portugal	South Korea, KAIST	South Africa	Pakistan
TEAM	12	8	3	6	12	2	10
PERIOD	1995-1997	1994-1998	1992-1994	1992-1994	1989-1993	1989-1992	1984-1988
MISSION	Thai-Paht	FASAT-A&B	FjSAT	PoSAT-1	KITSAT	UoSAT 3/4/5	BADR-1

Training, co-development and licensing

From Nanosats to complex missions

HANDS-ON ACTIVITIES

| Understanding requirements | Select heritage baseline | Determine NRE for mission | How to design | How to build | How to test at a module level | How to integrate and test at s/c level | How to ensure s/c survives environment | Spacecraft operations |

KO — MDR — SSR — PDR — CDR — MRR — TRR — FRR — IOCR

| System Engineering / Req Derivation | Subsystem Design / KO for manufacture | Manufacture | AIT starts | EVT starts | SEET | Launch / Commissioning |

THEOS-2 Training Satellite – Operational Earth Observation

2 groups of 24 trainee customer engineers

1m RGB video +AIS/ADS-B

Instrument manufacture & test

GISTDA AIT/EVT facilities

Satellite testing in Thailand

GISTDA has worked with local industry and will have a licence to reproduce the satellite

Supporting industry development – THEOS-2

- Working with GISTDA in Thailand to develop local industry under the THEOS-2 programme
  - Established understanding and appreciation of space manufacturing in local industry
  - Provided a sustainable supply chain for GISTDA
  - Supported and strengthened spacecraft team training
  - Supported establishment of smallsat AIT/EVT facilities, used on THEOS 2 training spacecraft (due to be launched 2024)

- Evaluating local supply chain
  - Short listed 14 companies
  - RFI/RFP process
  - 33 parts (23% by satellite weight)

- Technologies included
  - Mechanical structural components
  - Composites production
  - PCB manufacturing
  - Electrical module manufacture

MULA Satellite for the Philippines

PHILSA

- "Multi-Spectral Unit for Land Assessment" (MULA)

- For Philippines Space Agency (PhilSA)

- SSTL-TrueColour wide-swath multispectral imaging mission
  - 130kg microsatellite
  - AIS/ADS-B secondary payload

- Includes comprehensive training and technology licensing programme
  - 16 customer engineers

- The combination of resolution, swath and spectral bands, allows the mission to address a broad range of applications across a number of sectors including:
  - Forestry
  - Agriculture
  - Maritime
  - Mapping and planning
  - Disaster support
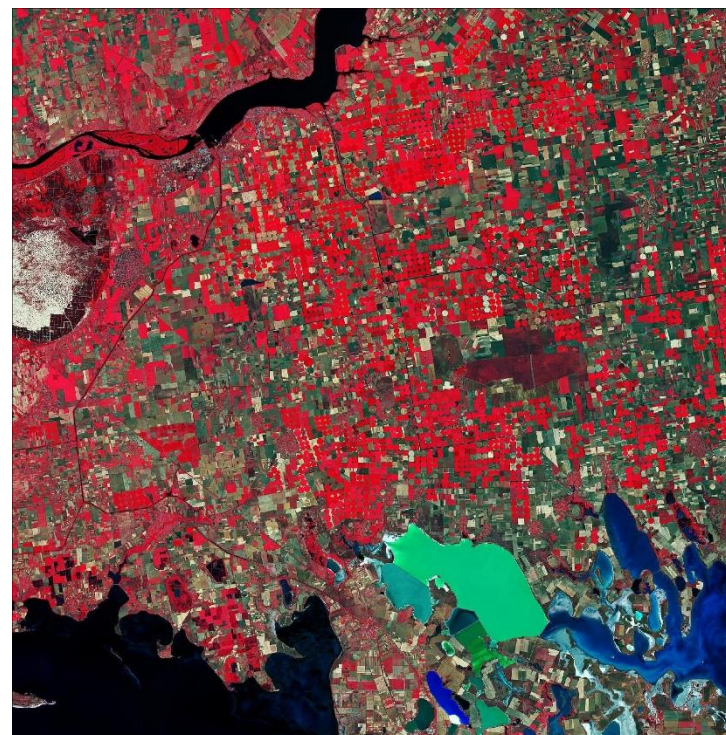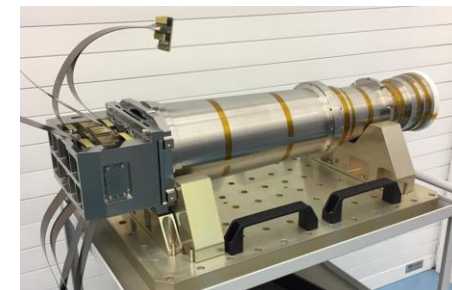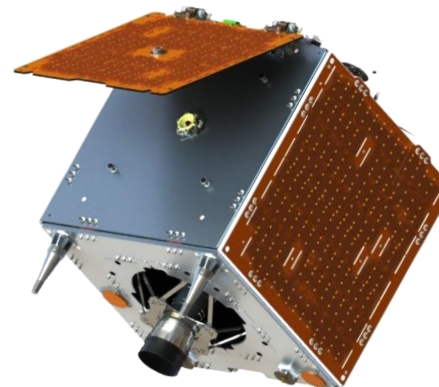
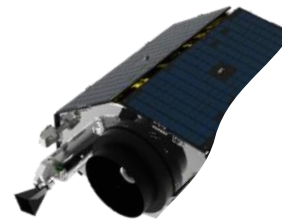| Parameter	Specification
GSD	5 m
Scene Size	120 km
Spectral bands	Multispectral 9 bands Based on Sentinel-2
Throughput	> 120,000 km² daily coverage

Models of accessing space technology – e.g. EO

Operator and reseller
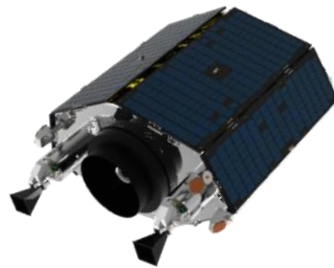
Full Ownership

Leasing fraction of the capacity

Buying Imagery

← Price

← Responsibility

← Independence & Priority

Training and Development is key to get the best value from these options

Why share?

Example:
- Governments typically interested in small fraction of the orbit
- Commercial operators interested in specific worldwide targets

Different Organisations = different objectives

To build a group of national experts to advice government on space

National pride – to be the regional space leader

To get access to more affordable data

As part of a trade deal

To develop a high-tech industry
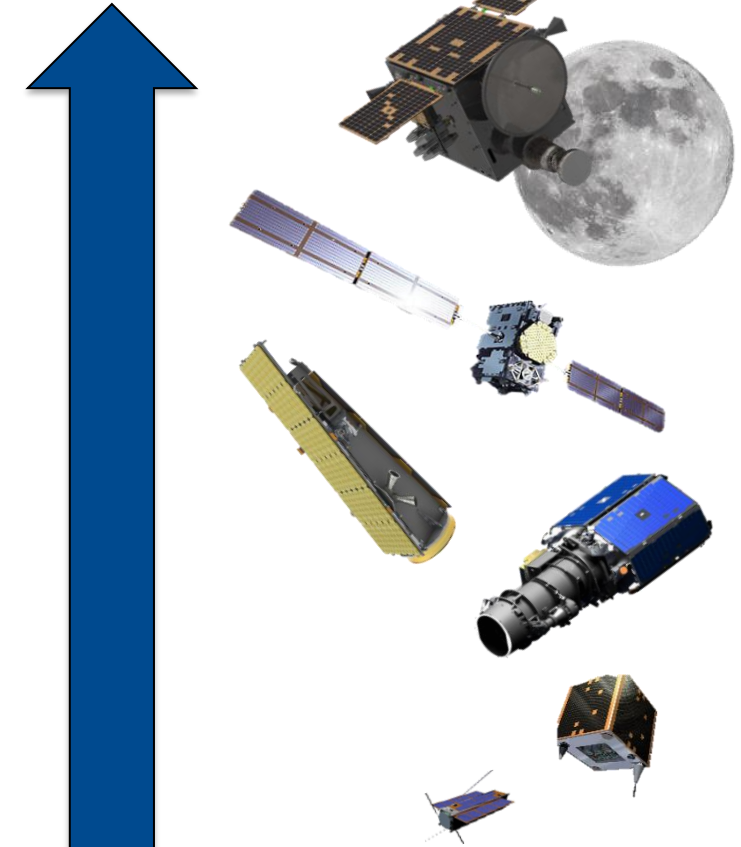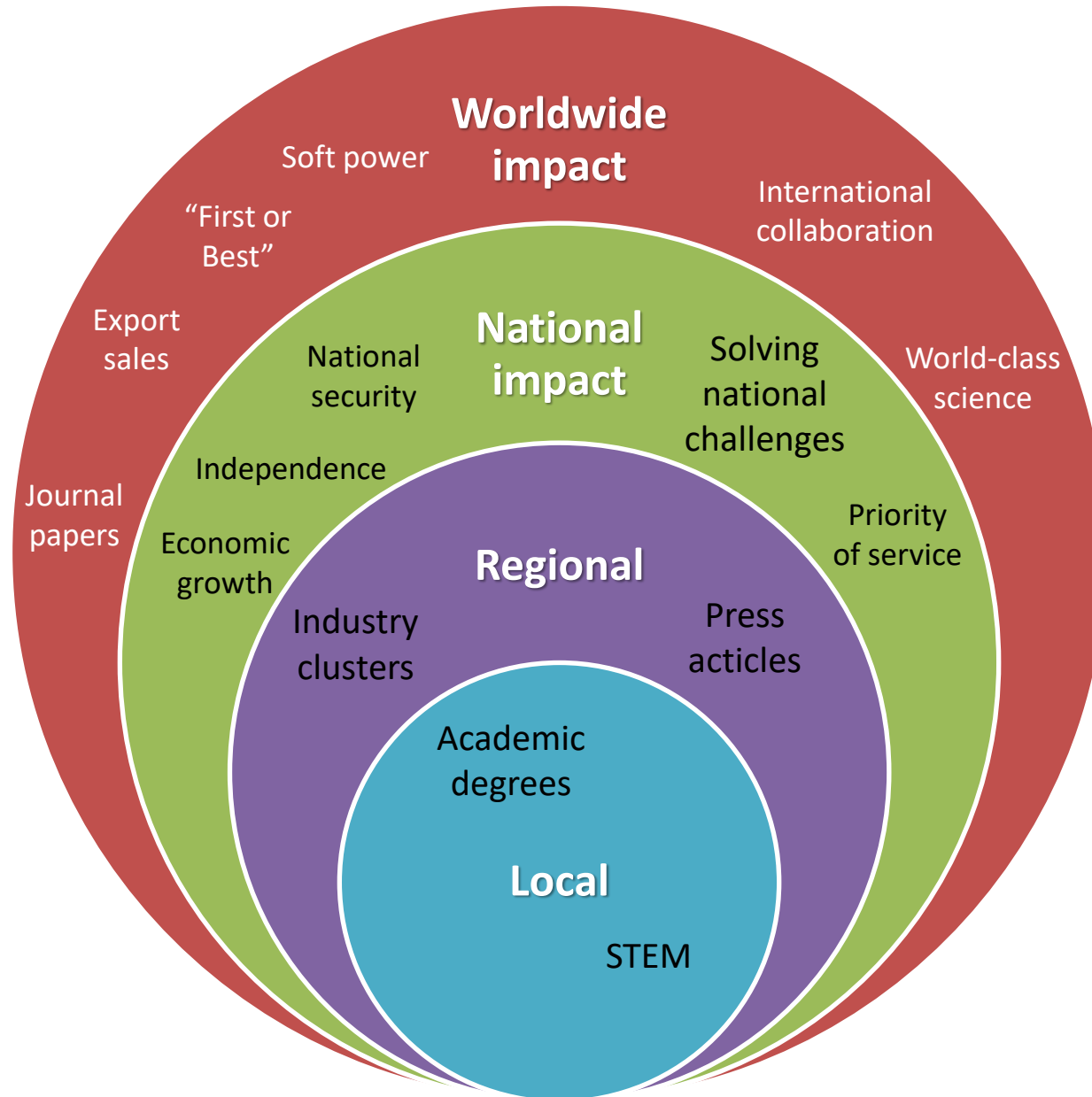
To understand the potential of small satellites

To save costs in bigger satellite procurements

To play a role in bigger international space missions

To be the premier space University for the nation

Satellite as a unique research tool

In-country Space Industry manufacture

Intelligent Future Procurement (e.g. geo)

Priority access to space data / comms

Driving Innovation, Science and Education

To attract high-profile operators to set up in-country

Passing the "so what?" test

Worldwide impact
- Soft power
- "First or Best"
- International collaboration
- Export sales
- World-class science

National impact
- National security
- Solving national challenges
- Independence
- Priority of service
- Journal papers
- Economic growth

Regional
- Industry clusters
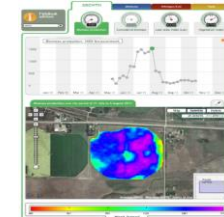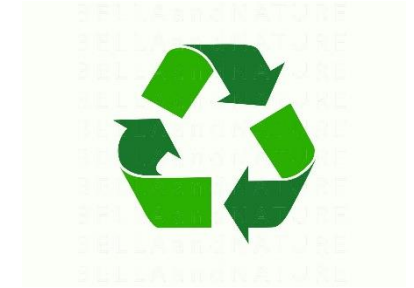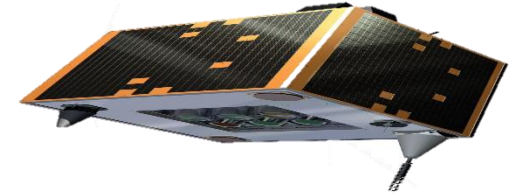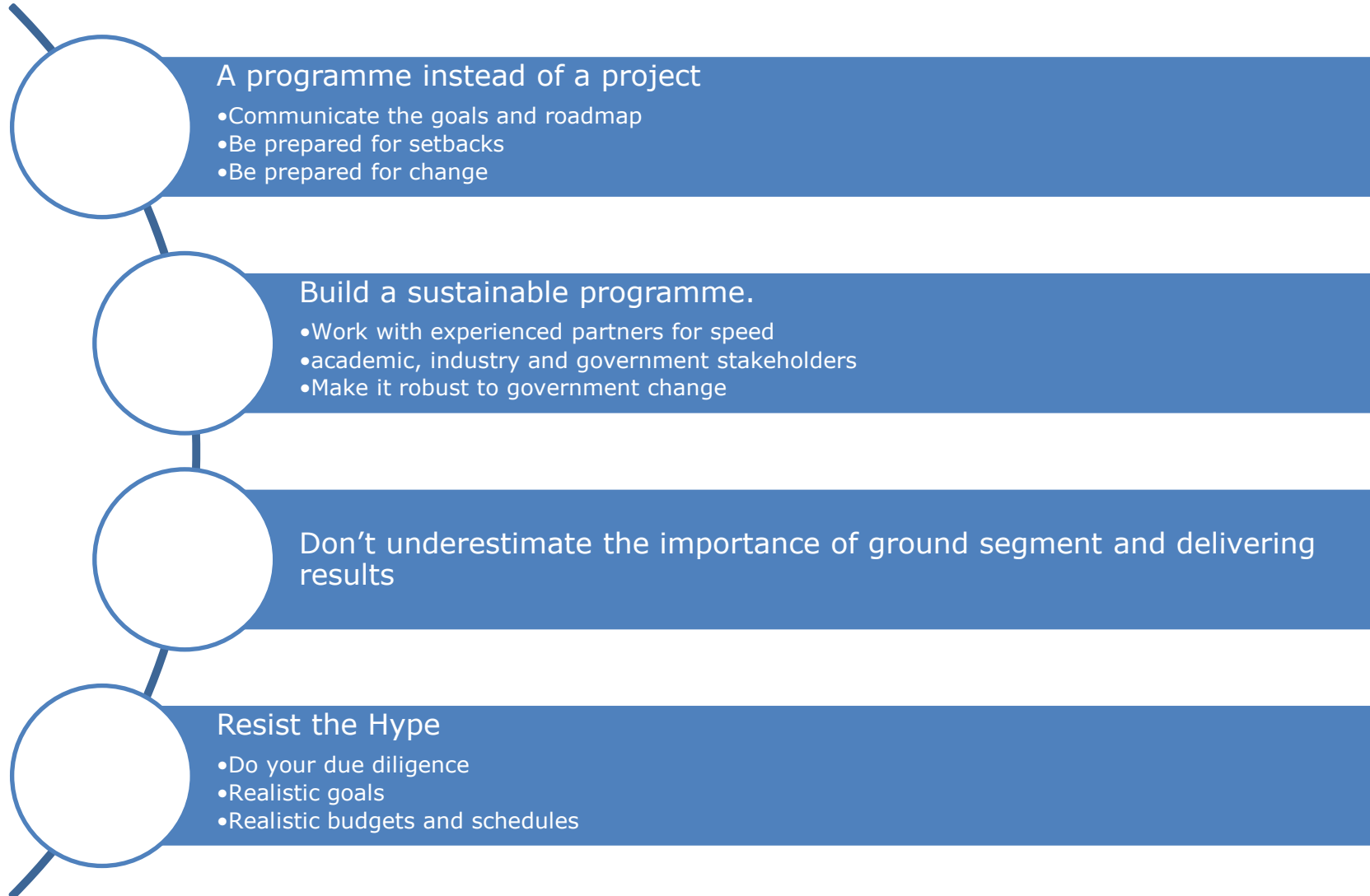- Press acticles

Local
- Academic degrees
- STEM

Greater impact is typically achieved with bigger, more complex spacecraft

Growing a sustainable space eco-system

- For the national space programme to grow and spur innovation and be sustainable in the long term, it is essential to have **industry**, **academia** and **government** all playing their part.

Development of Future Workforce
New ideas and concepts
International Collaboration

Academia

Employment opportunities
Providing Capability/Services to the Government
Contributes to the Economy

Industry capability and services

Government
Benefits of space use

Regulatory framework
Need for Services
Funding for initial projects/ideas

SURREY

Summary of lessons learned

A programme instead of a project

- Communicate the goals and roadmap
- Be prepared for setbacks
- Be prepared for change

Build a sustainable programme.

- Work with experienced partners for speed
- academic, industry and government stakeholders
- Make it robust to government change

Don't underestimate the importance of ground segment and delivering results

Resist the Hype

- Do your due diligence
- Realistic goals
- Realistic budgets and schedules

![Surrey logo]

SURREY

DOING SPACE DIFFERENTLY

Thank you!

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