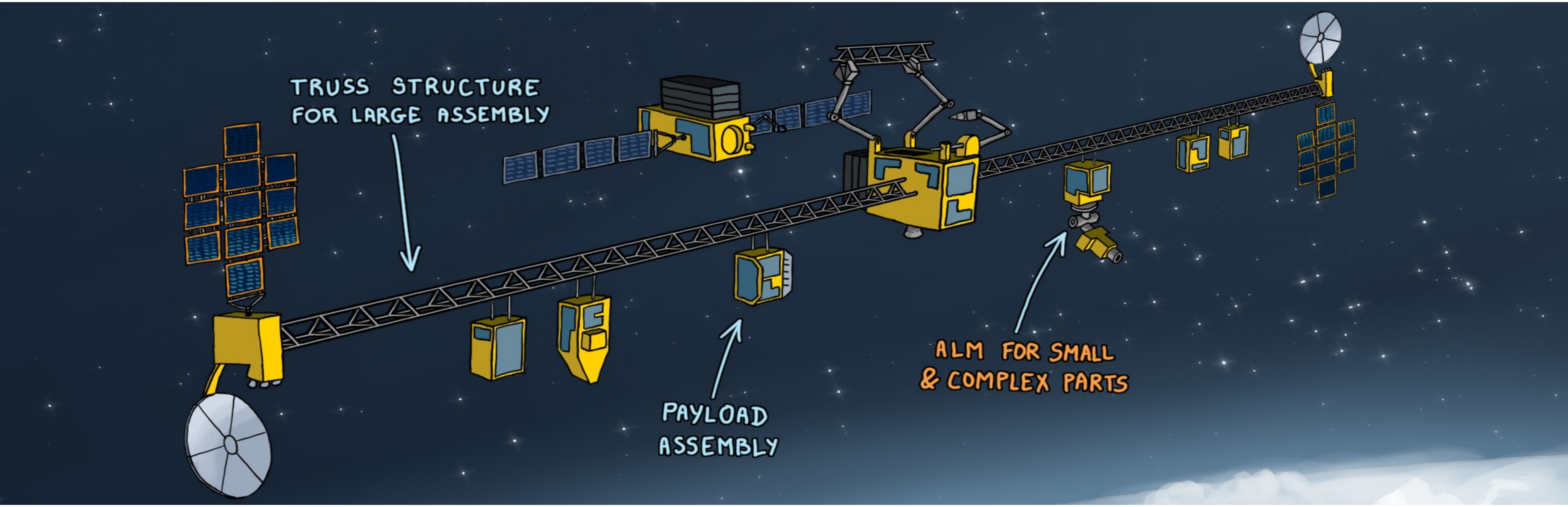

DEFENCE AND SPACE

In space manufacturing and assembly of large systems

September, 12th, 2019
Dr. Christophe Figus

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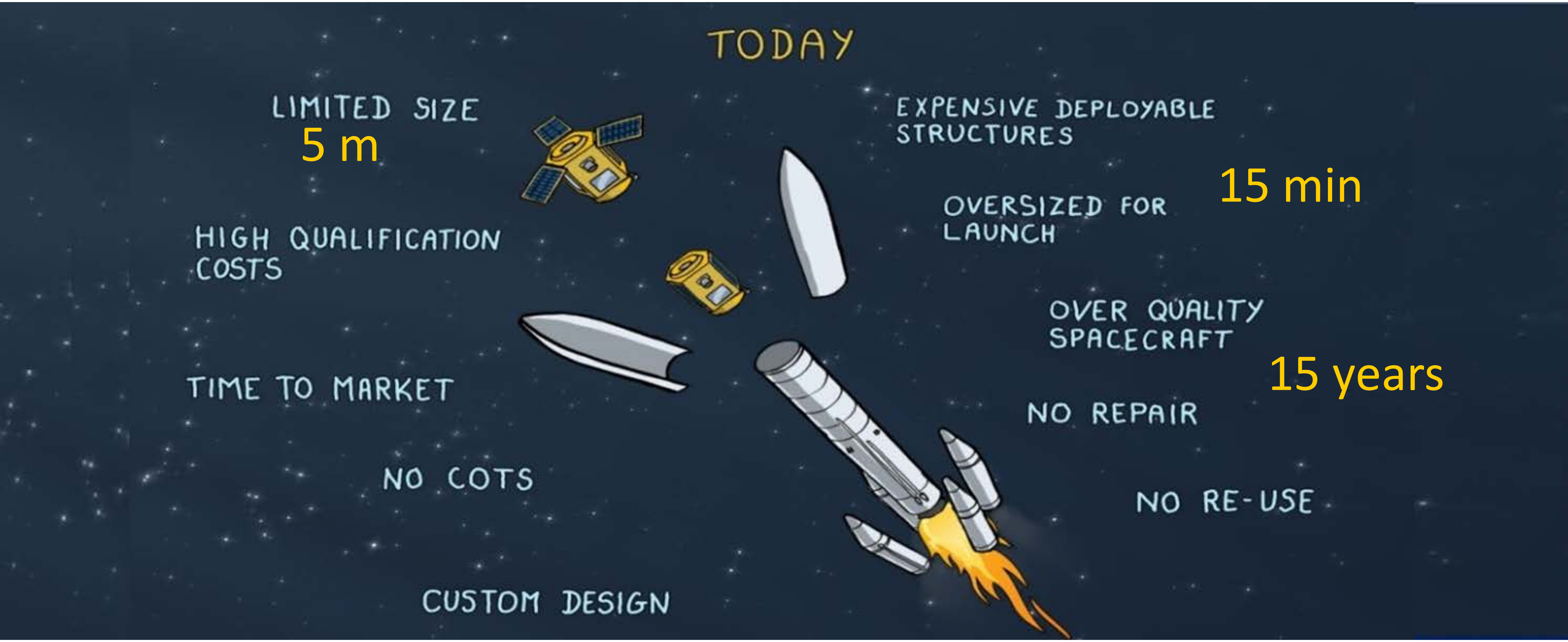
Customer pains



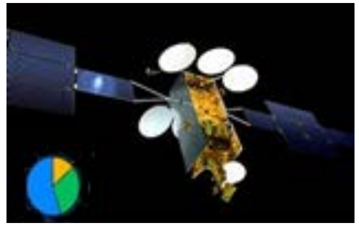
Market Opportunities

18 Business cases investigated
9 Business cases more deeply studied

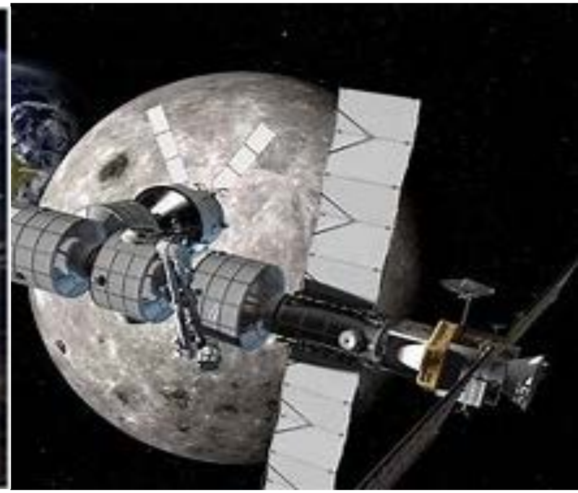
Mission	Use case Name	Application
A1	End-to-End Antennae for Telecom (Double capacity)	Telecom
A2	Assemble or Repair Structures for telecom GEO	Telecom
A3	End-to-End Trusses in Leo (Leo Hub)	Scientific
A4	Assemble Radiators for Telecom	Telecom
B1	End-to-End Antennae for Navigation	Navigation
B2	Optical or X-Rays telescope using in space assembly of various modules	Scientific
B3	End-to-End Trusses in Geo (Geo Hub)	Telecom
B4	Assemble shielding for Scientific	Scientific
C1	End-to-End Antennae for Telecom (Large antenna)	Telecom
C2	Assemble or Repair Structures for Exploration	Exploration
C3	End-to-End Trusses in Leo (Leo Hub)	Observation
C4	Assemble shielding for Exploration	Exploration
D1	End-to-End Antennae for exploration	Exploration
D2	Assemble repair satellite	Observation
D3	Assemble & Upgrade Solar Panels for telecom GEO	Telecom
E1	Astronomical science based on a 1km radio-telescope for low frequency	Scientific
E2	End-to-End Trusses (Boom)	generic
E3	Assemble and Upgrade Solar Panels for Exploration	Exploration

Useful Mass (UM): Mass that generates customer value
Necessary Mass (NM): Mass required for In Orbit mission
Total Mass (TM): Mass at launch

	Antenna Use case	Spacecraft Use case
UM/TM	20%	11%
NM/TM	45%	60%



ISS : 420 Tons / 12 years of assembly / $50b-$100b



What about Lunar Gateway ?

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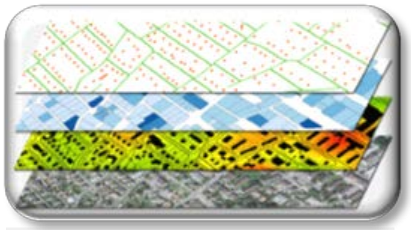
Way forward/Future applications

Geo-Information/ Earth Observation



Space Hub
80 payloads of 200 kg on a single PF
Upgradable, scalable, repairable

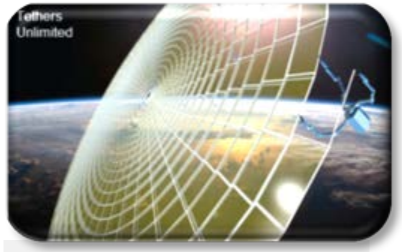
IoT Connectivity

Constellation 600 s/c
30% mass saving
9,6m² antenna dish (51kg)
5,4 T & $80M / launch

Broadband Connectivity

Double antenna capacity / Satcom
SC payload utilization rate70%
X2 antenna
increase of efficiency

Astronomy



JWST (5.6 m) 10 ExoEarth, $9B for the telescope only.
Foldable parts
Next one: 12m to detect more ExoEarth =$27B

New Frontiers

Lunar orbital PF gateway, LOP-G
30% mass saving
$130kg/m^3 \rightarrow 90kg/m^3$
$50K/kg Moon orbit
LOP-G volume = 200 m^3

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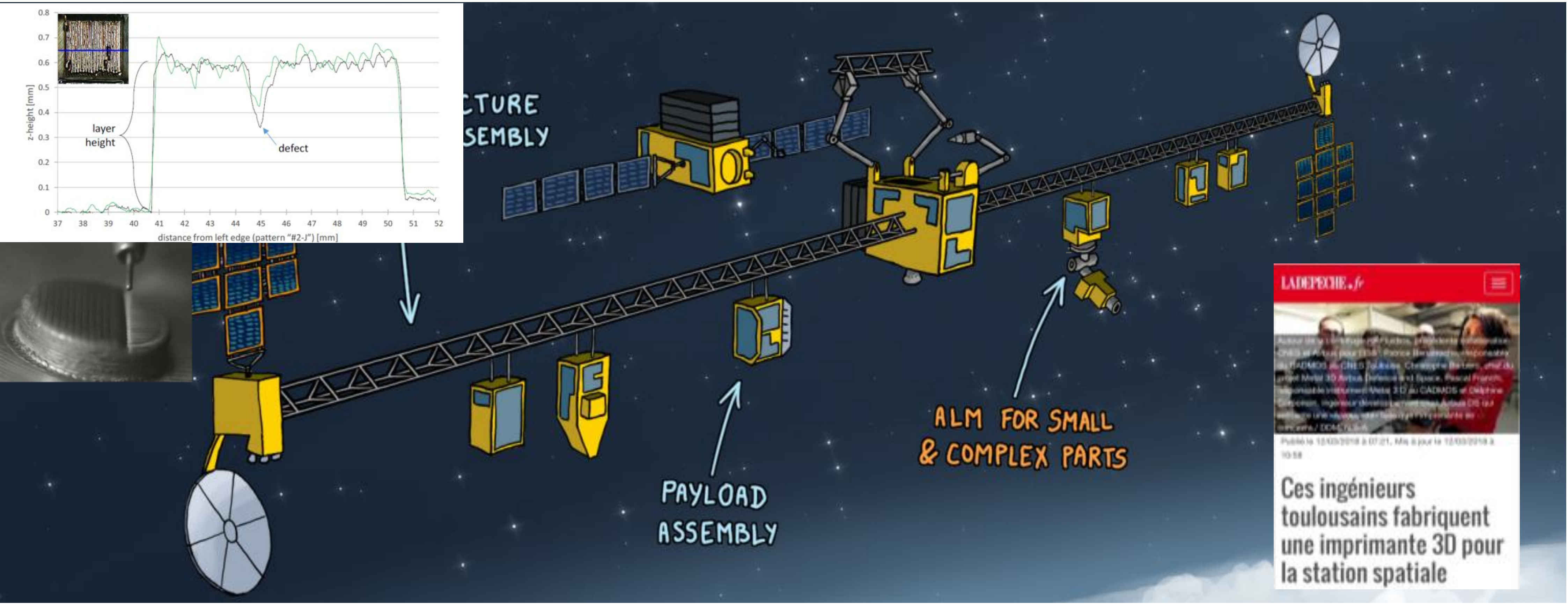
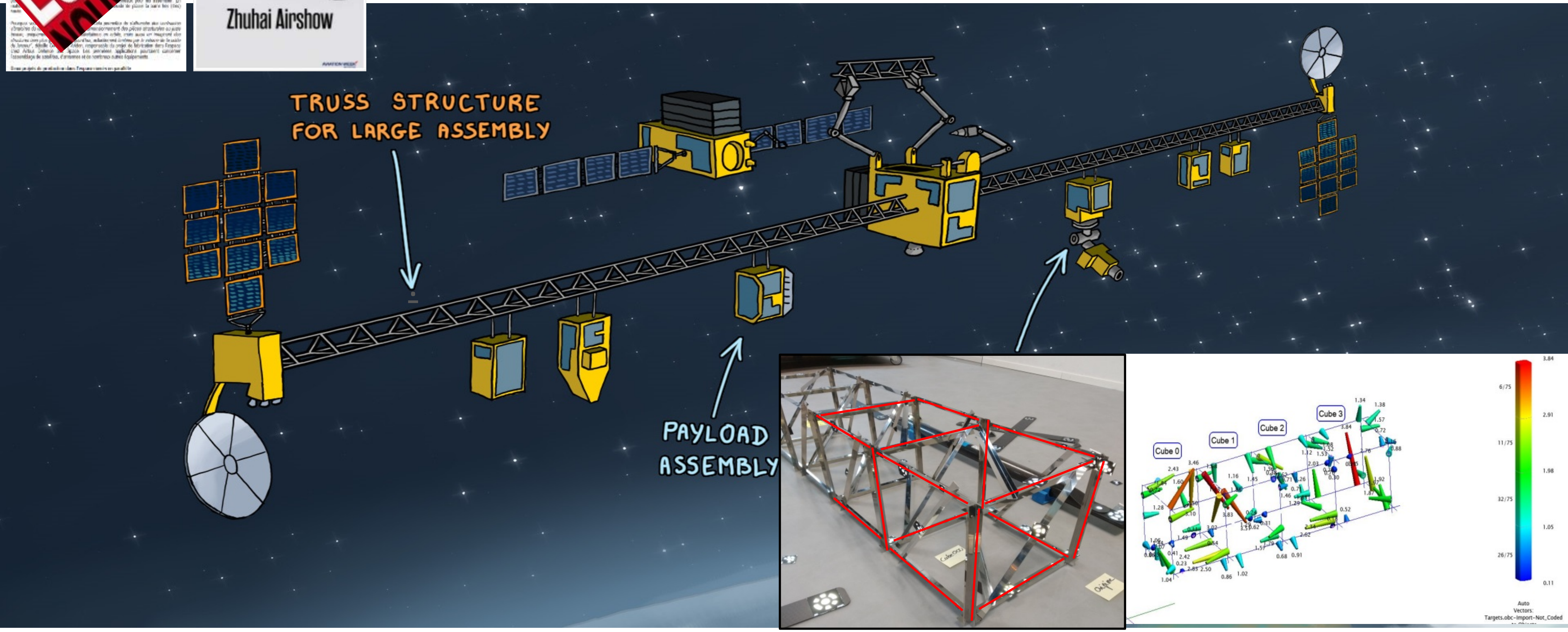
METAL3D


z-height [mm]
layer height
defect
distance from left edge (pattern "#2-J") [mm]
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
…CTURE
…SEMBLY
PAYLOAD ASSEMBLY
ALM FOR SMALL & COMPLEX PARTS
LADEPECHE.fr
Ces ingénieurs toulousains fabriquent une imprimante 3D pour la station spatiale


USINE NOUVELLE

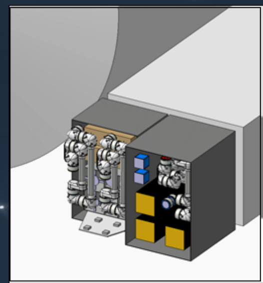

AVIATIONWEEK
& SPACE TECHNOLOGY
Zhuhai Airshow

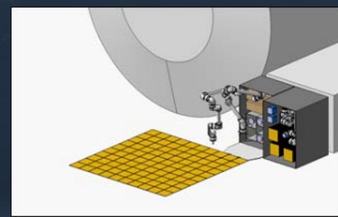
DEMETRA


TRUSS STRUCTURE
FOR LARGE ASSEMBLY
PAYLOAD
ASSEMBLY
Cube 0
Cube 1
Cube 2
Cube 3

Roadmap

- 2017-2018 : Develop facilities:
  - Simulator : Manufacturing space lab (DEMETRA)
  - ✓ Engineering Model Metal3D (3D printer)
  - Develop robotic
- 2018-2019 : Develop demonstrator :
  - Process definition & validation
  - ✓ Antenna reflector Assembly
- 2020-2022: Qualification
  - Metal3D PFM delivery
  - Robotic Factory Qualification
- 2022-2023: In Orbit demonstration
  - SpaceSat experiment delivery





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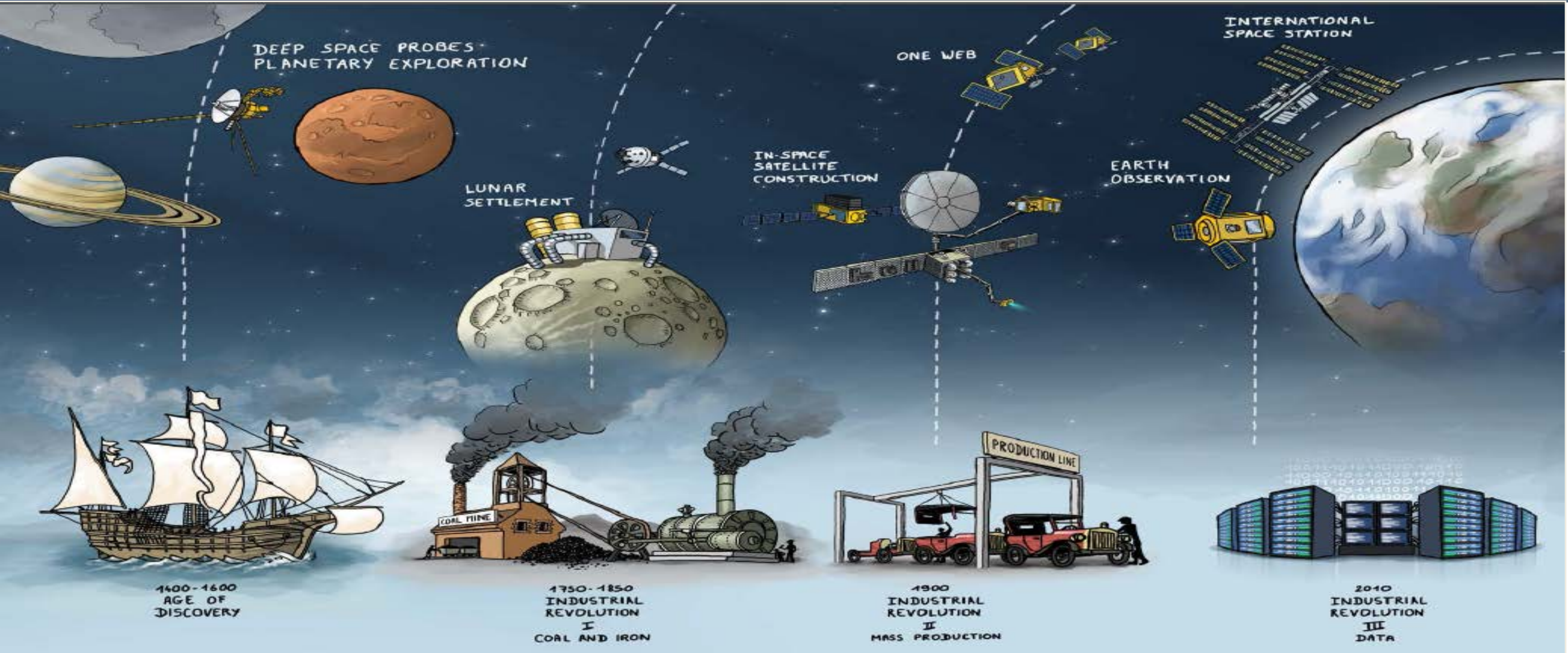
Understand where we Come from to prepare where we Go!



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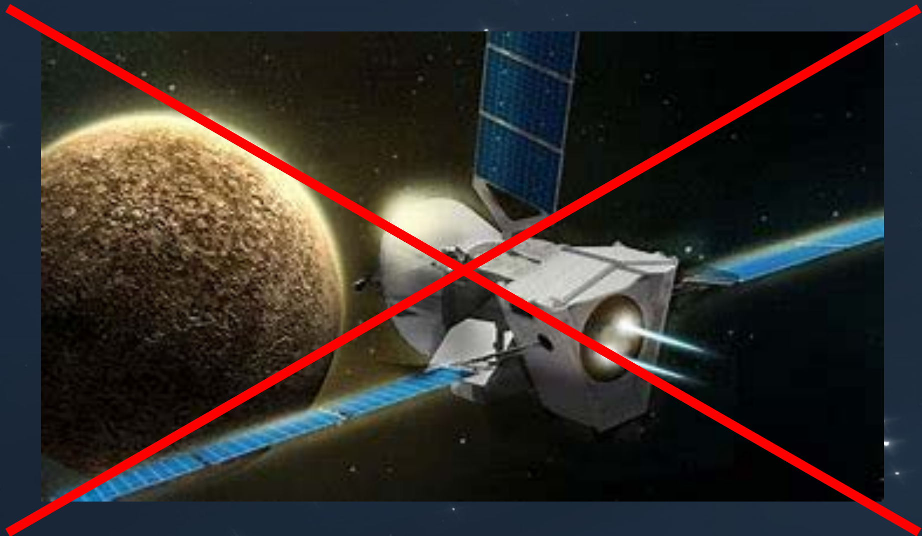
2061 ?



Join us

To Make future a reality

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