PD AeroSpace, LTD.

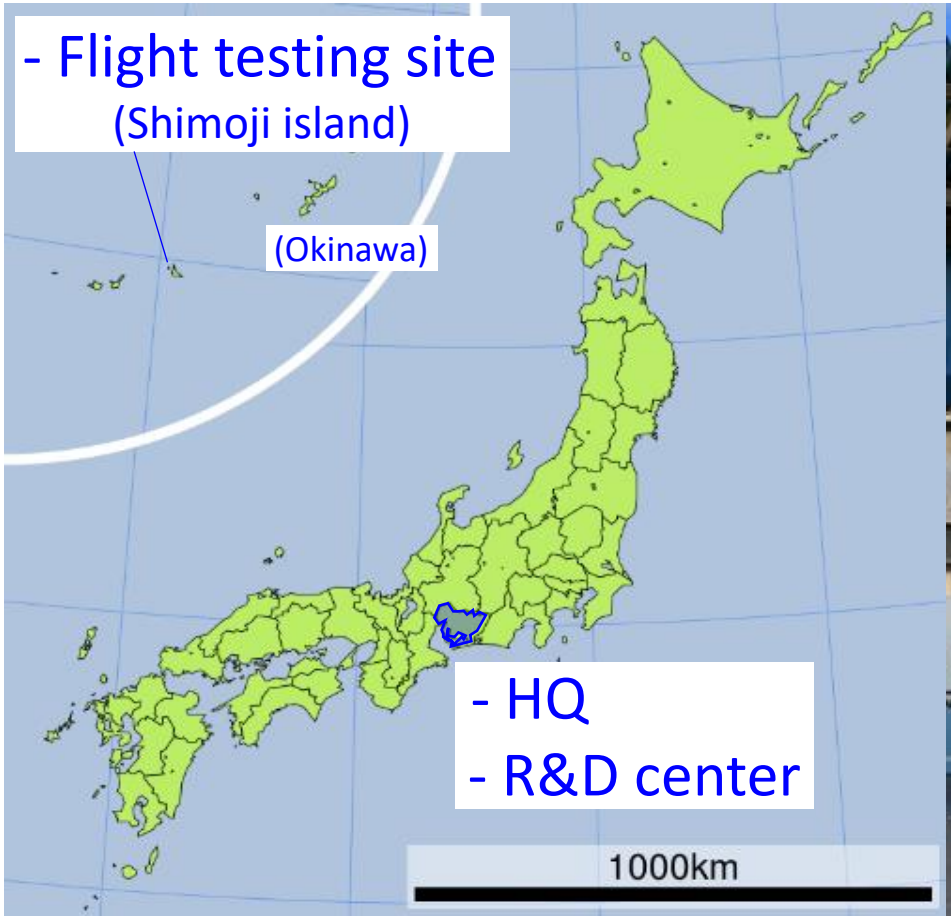
Company Profile

Nov. 2022

https://pdas.co.jp/en/

Basic Company Information

- PD AeroSpace was founded in 2007.
- 3 sites in Japan, 40 full and part time employees.
- $12M raised via CVCs, VCs and Angels.
- Fully-Reusable winged rocket (Spaceplane); Detonation based original concept engine; Jet/Rocket hybrid technology



"Be A Wing for Space"

Space is vast and mostly unknown. And soaring into outer space will give us opportunities to discover myriads of possibilities. We may even find totally new energy resources out there.

And seeing our Planet Earth from space will, without doubt, reawaken our love for nature and life.

Going out to space will also present difficulties and risks. However, taking on those challenges will benefit us humanity immensely.

At PD Aerospace, we are determined to make space more accessible, and committed to growing to **"Be A Wing for Space".**

Our Credo

1. We contribute to society with technology.
2. We maintain harmony with space, the Earth, nature, and humanity.
3. We strive to be a company that is expected to exist, and to clarify the significance of its own existence in its activities.

Our Mottos

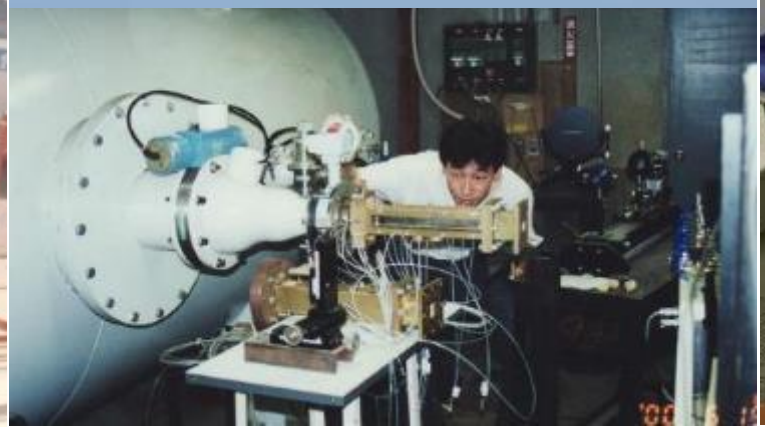
1. Never give up and keep an indomitable spirit of challenge.
2. When there is no path, make one yourself.
3. Innovation over improvement.
4. Understand that time and space are limited, so take action now.

Our Chief Executive Officer

CEO & CTO

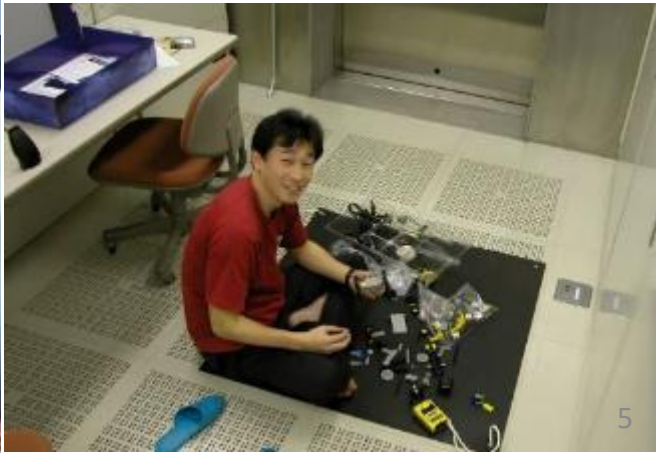
Shuji Ogawa: Born in Nagoya, Japan. Helped his father with experiments and inventions since childhood. Aspired to become a pilot and astronaut. Graduated from Division of Aerospace Engineering, Graduate School, Tohoku University. Developed aircraft and automobile parts. Member, Space Transportation Systems Subcommittee, Office of National Space Policy, Cabinet Office.

Shuji is also Founder and CTO of the company



AISIN

アイシン精機株式会社



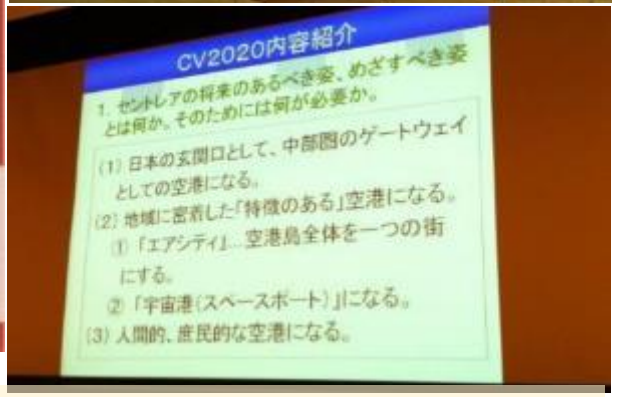
Team

Employees: 40 (including seconded staff members)

※ Stockholders are also seen in the photo.

Also +90 Pro bono and several Interns (domestic and international)

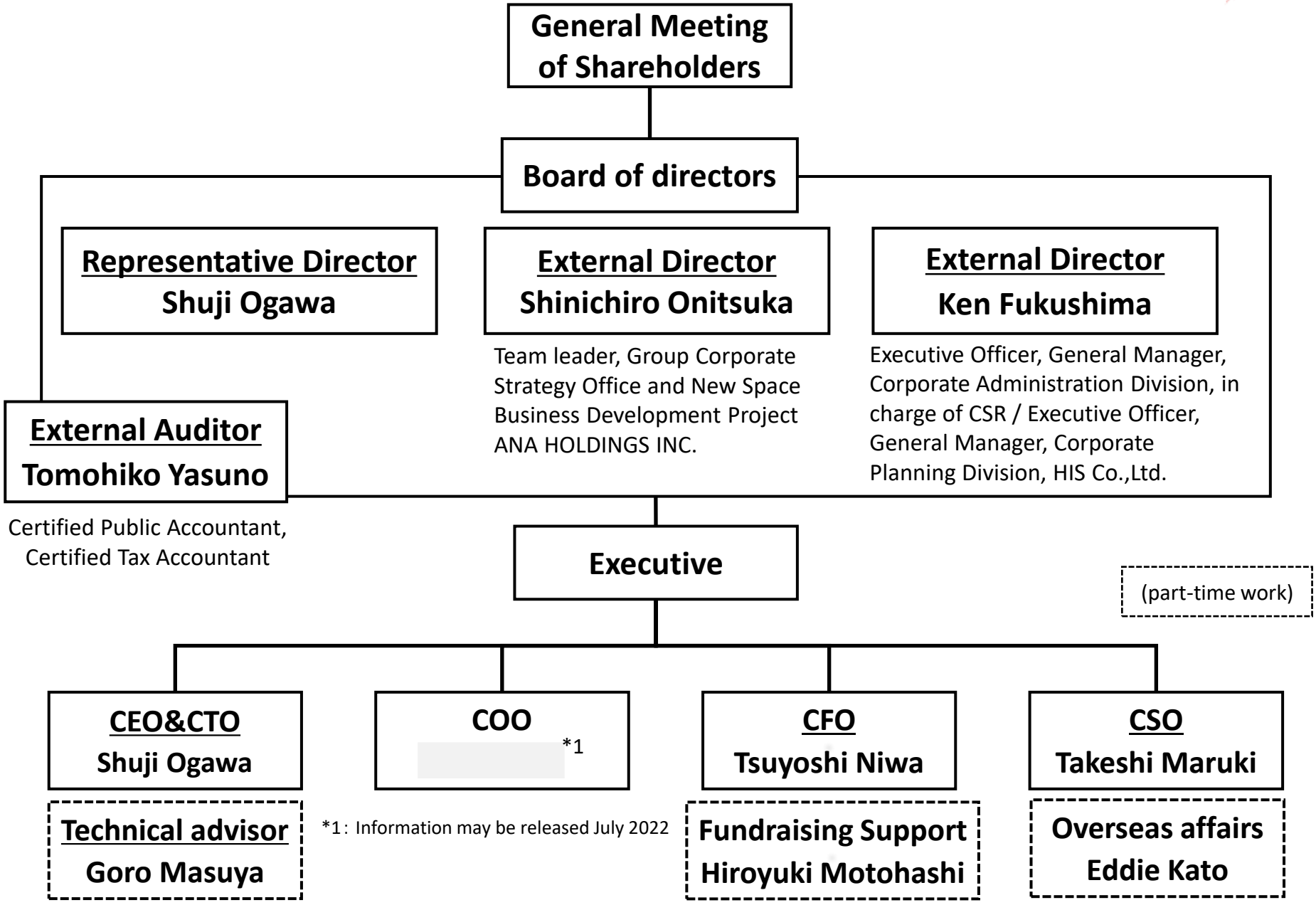
Ten years of progress since our inception



TV interviews

Shuji Ogawa, our CEO, was appointed to "Space Policy Committee" by Prime Minister↓

Management Team



Organization Chart of Development Project Partners

Board of directors

Spaceplane development Gr.
- Engine development
- Airframe development

Engineering support Gr.
- Facilities maintenance
- IT Systems support
- Experiment support

Spaceplane Operations Gr.
- Spaceport
- Manned mission
- Legislation

Corporate Planning Gr.
- Business planning
- Public relations

General Affair Gr.
- Accounting
- Human Resources
- Recruitment

Engine development

- JAXA
  Evaluation / overall development support
- Prof. Endo, Hiroshima Univ.
  Combustion theory
- Prof. Mizukaki, Tokai Univ.
  Combustion Analysis

- NETS, LTD.
  Engine system development
- Prof.Kanda, Chubu Univ.
  Combustion theory
- Prof. Sato, Waseda Univ.
  Supersonic combustion

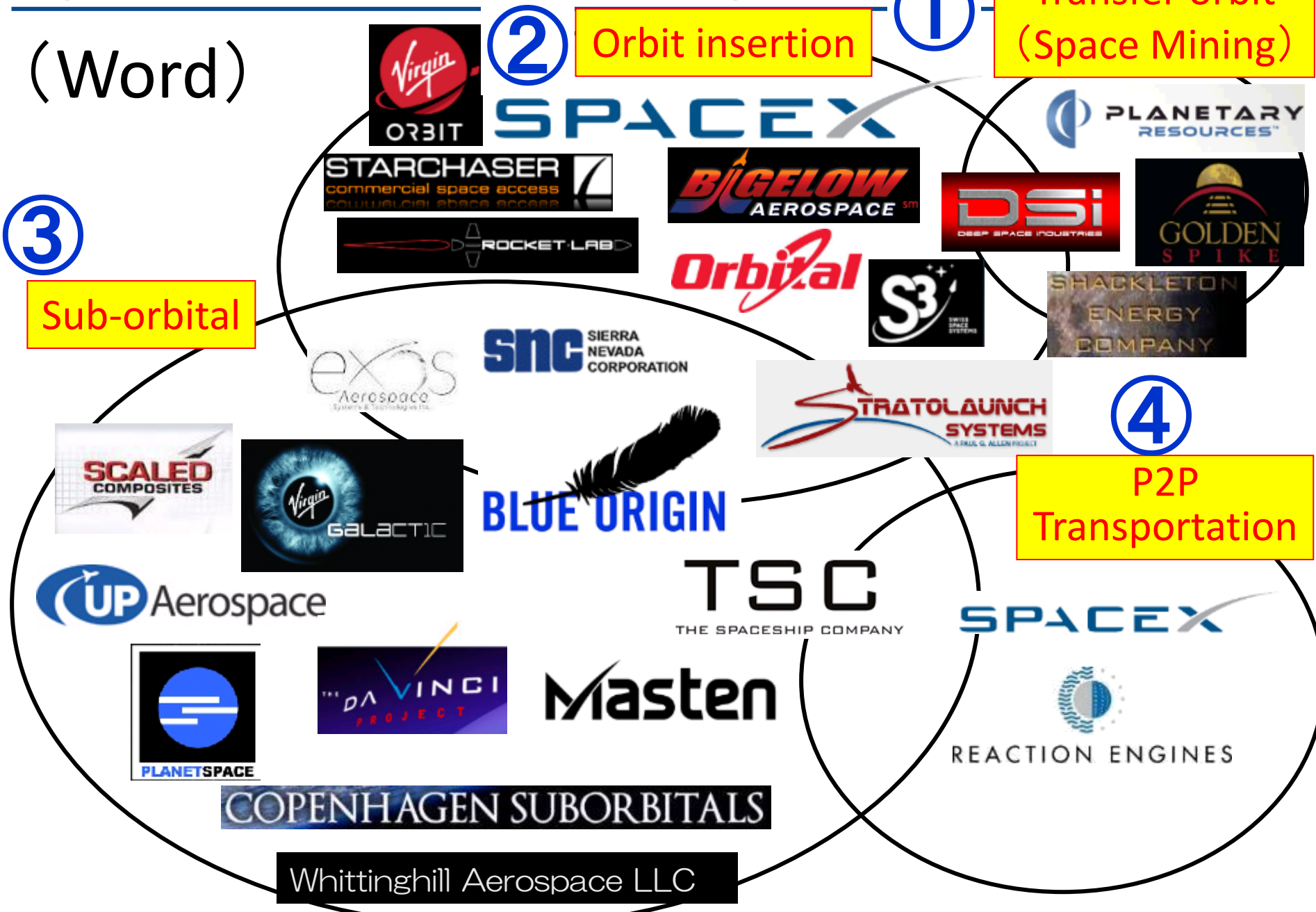
Airframe development

- JAXA
  Structural analysis/overall development support
- Prof. Tsuchiya, Univ. Tokyo
  Simultaneous optimization of orbital fuselage geometry
- Assoc.Prof. Yoshida, Nihon Univ.
  Orbital optimization
- Assoc.Prof. Nakaya, Gifu-nct
  CFD analysis
- Prof. Shimoyama, Tohoku Univ.
  CFD analysis

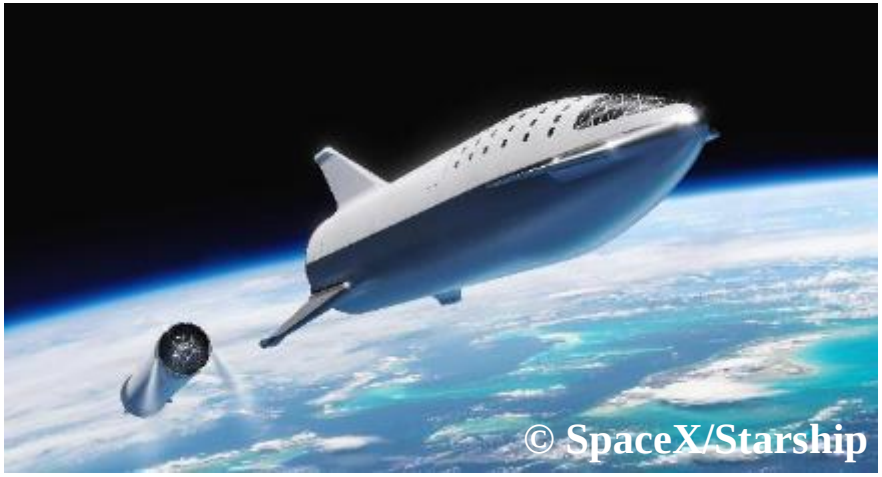
- Toray Carbon Magic Co.,Ltd.
  Airframe Structure Manufacturing
- NC Network Co., Ltd.
  Parts fabrication and metalworking
- Nakashima Special Steel/Metalnics Co.,Ltd.
  Metal materials and metal processing
- Prof. Ueba, Muroran IT.
  CFD analysis

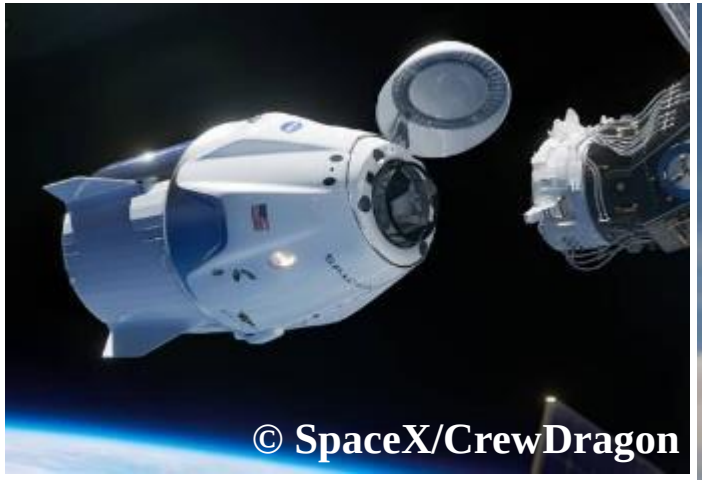
Players in the Commercial Space Industry

（Word）



Images of various Spacecrafts (Overseas companies)





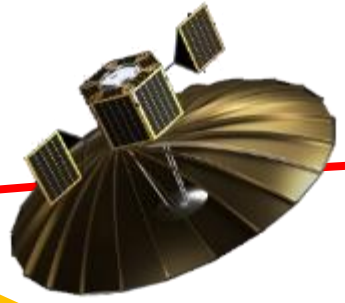
Our Target Businesses

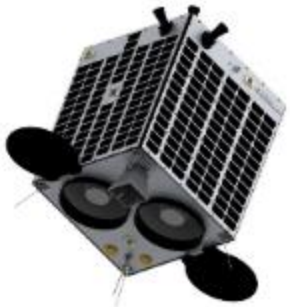
PD AEROSPACE

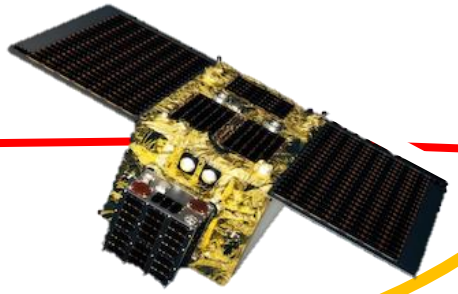
3rd Target

Orbital flight

Small satellite orbital insertion







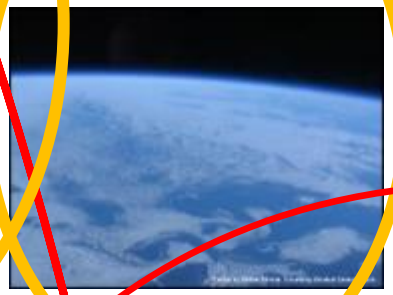
500～600km

1st Target

Sub-orbital flight

Unmanned

Manned



2nd Target

Intercontinental flight

(P2P flight)

Hypersonic transport

Earth

Business Start-up Tactics / Business Development Path

Flight Style	Unmanned	Manned
1) Sub-orbital	1. ▪Micro gravity experiment ▪High Altitude Atmosphere Observation X07-80 ▪Hight speed FTB	2. ▪Sub-orbital Space tourism X08
2) Orbital	3. ▪Small satellite orbital insertion	4. ▪Orbital Space tourism ▪Space Hotel X09
3) P2P	5. ▪Cargo shipment	6. ▪Personnel Transportation X10
Space Port	▪Testing site ▪Collaboration with businesses	▪Commercial site

Starting with the "unattended Unmanned" sub-orbitals 1.,

Focus on "manned" and proceed with green arrow 2., 4., 6.

Sub-orbital Space Flight Profile

- Apogee : 80 km/262kft
- Total Flight Time : 90 min
- Total Time in μG : 4 min
- View : The Earth

◀ Apogee
(Alt. 80km/262kft)

Engine shutdown ▶
（Alt. 50km/164kft)

◀ Re-entry
（Alt. 30km/98kft)

Ascending by Rocket ▶
thrust（Alt.15km/49kft)

- Take off ▶
- Cruise climb by Jet thrust

◀ - To spaceport
- Gliding /
powered flight

Planet Earth seen from the altitude of 100 km

Image of Our Suborbital Spaceplane

Competitors and Comparison

- In 2004, A small startup succeeded in manned space flight and won the X Prize.
- In 2021, Virgin Galactic and Blue Origin began partial commercial operations.

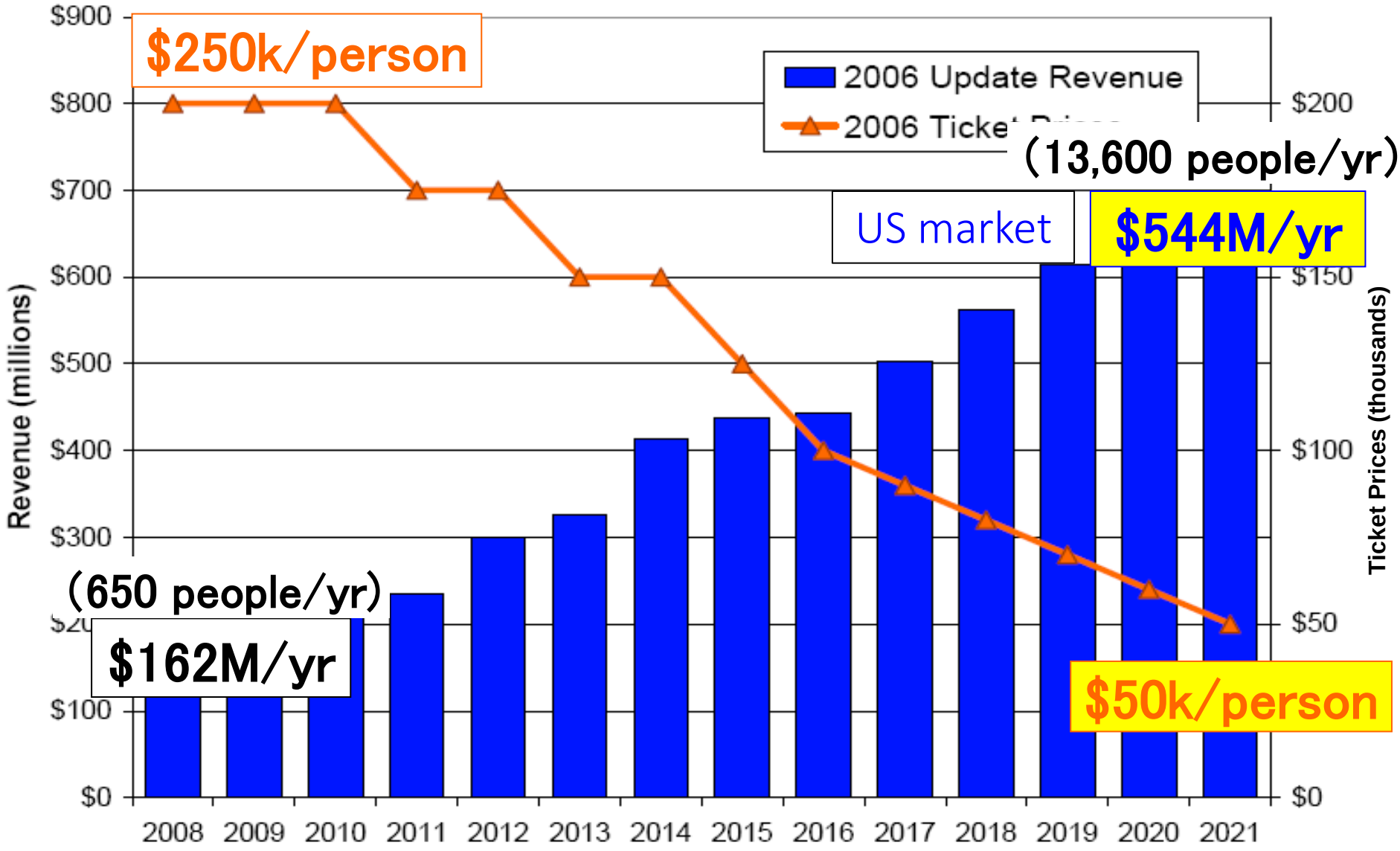
Ranking	1	3	4	7	2	8	6	5
Dev.Lv (pt)	97	55	50	5–10	95	0–10	10	25
Appearance								
Plane	New Shepard	Star chaser	Spica	CosmoCourse	SpaceShip2	SHIPinSPACE	(TBD)	PEGASUS
Country	USA	UK	Denmark	Russia	USA	UK, Other	Japan	Japan
Manufacturer	Blue Origin	STARCHASER Industries LTD	Copenhagen Suborbitals	Skolkovo foundation	TSC	SHIPinSPACE	SPACEWALKER	PD AeroSpace
Saler	Blue Origin	(TBD)	(Non Profit)	(TBD)	Virgin Galactic	Black Star Global Enterprises	(TBD)	PD AeroSpace (subsidiary)
Takeoff Landing	VTVL	VTVL	VTVL	VTVL	HTHL	HTHL	VTHL	HTHL
Engine	Liquid	Liquid	Liquid	Liquid	Hybrid	Liquid	Liquid	Mode switch
Rocket Propellant	LH2/KRS	LOx/KRS	LOx/Ethanol	(Unknown)	N2O/HTPB	LOx/KRS	LOx/LNG	LOx/KRS
Appogee	> 100km	> 100km	> 100km	220km	> 80km	260km	120km	> 80km
Passenger	3	> 1	1	6	6	44	6	6
Pilot	1	(TBD)	0	(Unknown)	2	4	(TBD)	2
Spaceport	Private (USA)	(TBD)	(Sea/Baltic Sea)	Kapustin Yar Rocket launch site	SPA (USA), Kiruna, Abu Dhabi	(TBD)	Taiki (JP)	Shimoji-island (JP)
Investor	Jeff Bezos (Amazon.com)	(Unknown)	NPO	(Unknown)	Richard Branson, Abu Dhabi	BlackStar Global Enterprises	(TBD)	HIS, ANAHD, Mizuho, Toyotsu,

Assumed Exchange Rate:
1 USD = 100 JPY

Rocket type

Winged type

Global market：$1.0B to 2.5B (estimated)



Assumed Exchange Rate 100 JPY = 1 USD

Research by Futron Corporation in 2006

Space Tourism & Travel - Revenues

- NSR forecasts the revenue opportunity from space tourism ticket sales to grow to **over $3.4 billion annually, by 2028.**
- **Suborbital tourism**, due to significantly higher demand and lower prices, controls **82% of the market** by end of forecast.
- Orbital revenues driven by few, expensive flights to ISS (or similar), aiming to expand commercial foothold in orbit.

Primary area: Profit-making mechanism

Net sales ＝

Price ・・・ $300k/person

× Passengers ・・・ 5 persons/flight

× Flights ・・・ 218 flights/year

(4 spacecrafts in operation)

× Flight occupancy rate ・・・ 92%

First year of operation: 30 passengers; Sales $9.0M

Fifth year : 1,000 passengers; Sales $300M

We aim for 10% of the global market, focusing on customers in Asia

※ Market trends will be taken into consideration for pricing.

Technical and Business Alliance for Space Transport

Multiple individual investors

- Bringing space closer to us, moving forward to realize **peaceful and prosperous society**.

- **Be a wing** that bridges Space and Earth.

Business Scope

PD AEROSPACE

【R&D】⇨【Manufacturing, Maintenance】

- Design
- Manufacture
- Periodical maintenance

(Collaborative research)

Universities, Research institutes

(Development partners)

OEMs
Parts suppliers, Manufacturers
Software developers

* To purchase existing products for electronic devices and parts

ANA (Planned)

【Operation】

- Flight operation
- Daily maintenance
- Ground service

HIS (Planned)

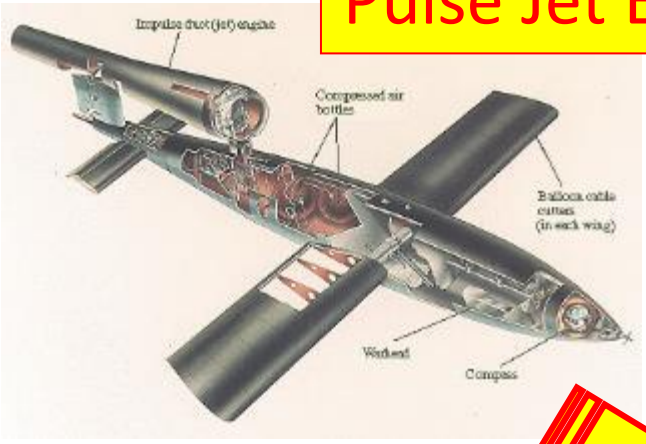
【Service】

Customers

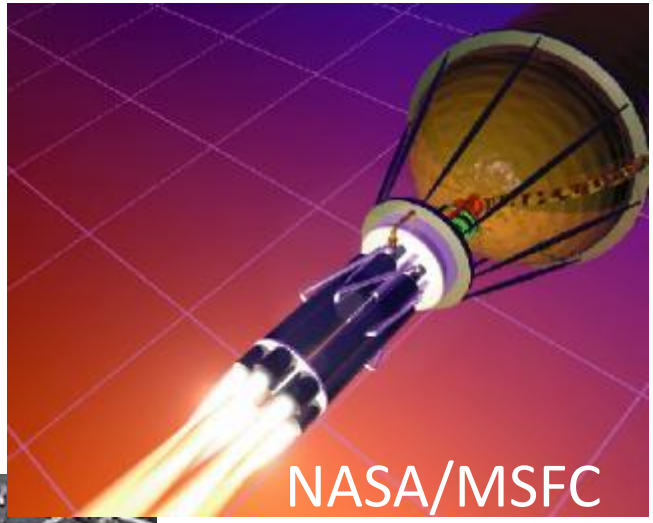
- Japan Meteorological Agency
- Universities, research institutions
- Aerospace manufacturer
- Planning companies, travel agencies

Detonation Technology

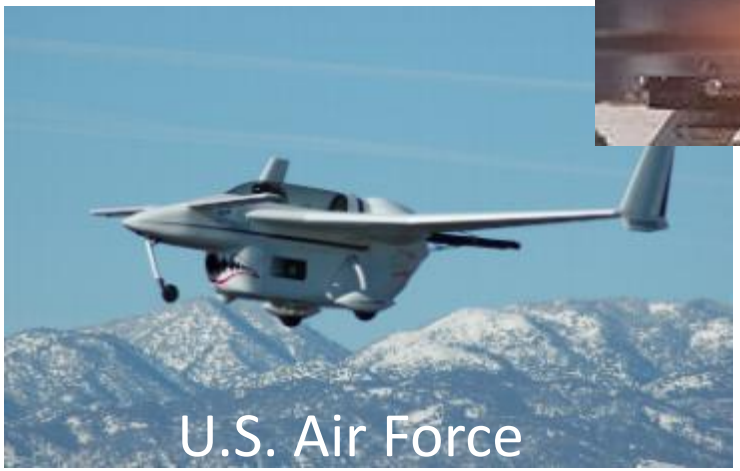
Pulse Jet Engine



V-1(Germany)



Detonation Engine



Original concept
“Jet/Rocket combustion mode Switchable Engine”

【Reference】Engine Classification

PD AEROSPACE

Aerospace Engines

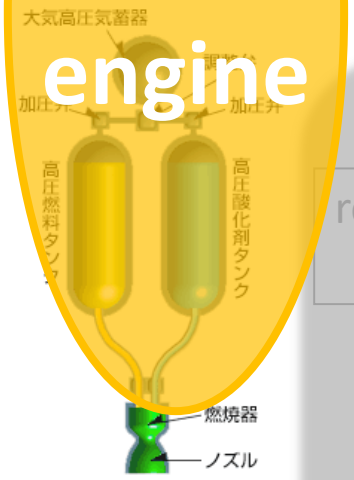
Oxidizer

Onboard

Liquid
Solid
Hybrid

Rocket Engine

Rocket engine



出展：宇宙情報センターHP

【 Continuous combustion】

Air intake

compression method

Forced compression

Natural compression

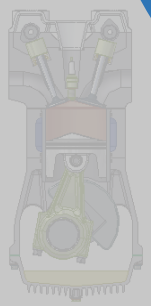
Reaction Compression (Combustion wave compression)

Jet engine

Compressor

Piston

reciprocating engine

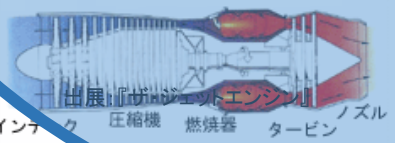


出展：車FAN HP

【 intermittent combustion 】

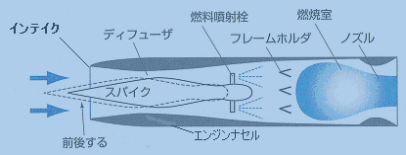
Compressor

Gas turbine engine



【 Continuous combustion】

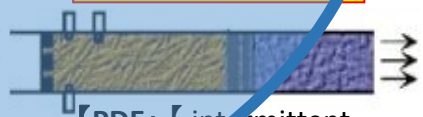
Ramjet engine



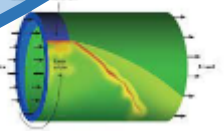
出展：『よくわかる航空工学の基本』

【 Continuous combustion 】

Detonation engine



【PDE：【 intermittent combustion 】



【**RDE**： Continuous combustion 】

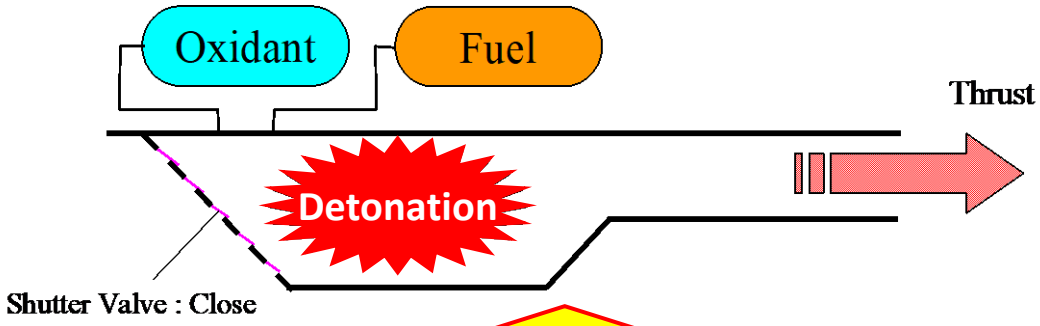
PDE：Pulse Detonation Engine
RDE：Rotating Detonation Engine

Jet/Rocket combustion mode switchable engine

Detonation engine features: Uses detonation combustion and can switch from jet to rocket combustion and vie versa, depending on atmospheric conditions.

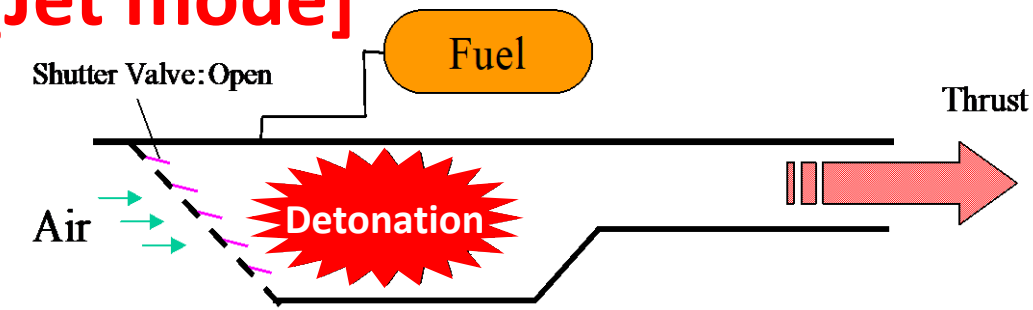
(Pulse Detonation Engine : Patented in 2012)
(Rotating Detonation Engine : Patent application in 2022)

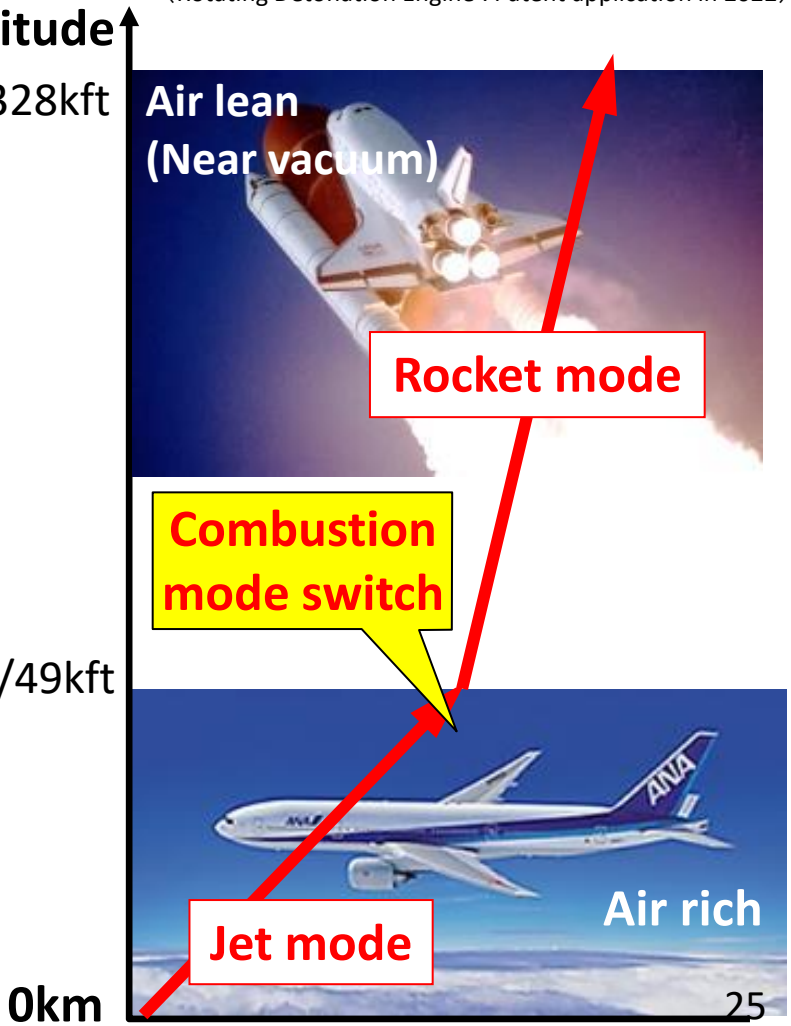
[Rocket mode]



Combustion mode switch

[Jet mode]





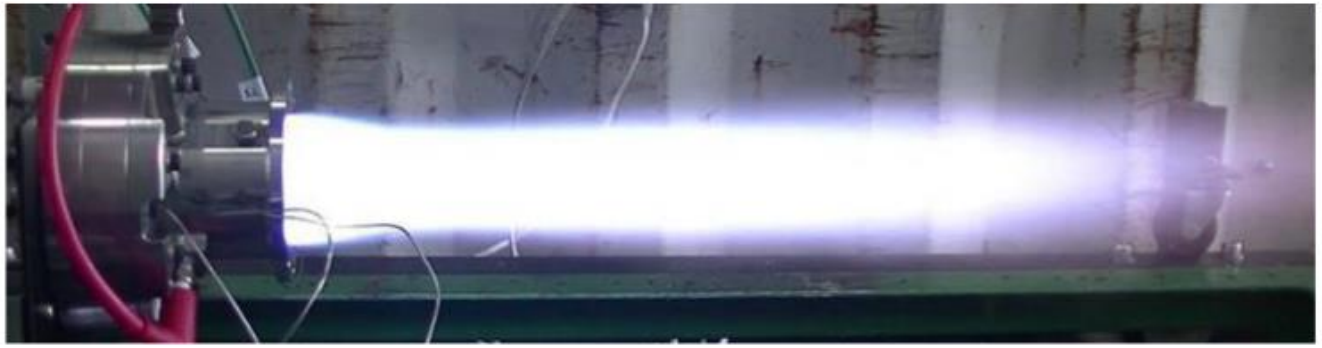
Key Concept : Jet/Rocket switchable technology

PRESS RELEASE

April 5, 2022

PD AeroSpace, LTD.

Demonstrates the World's First RDE-based Jet/Rocket Mode Switching Technology



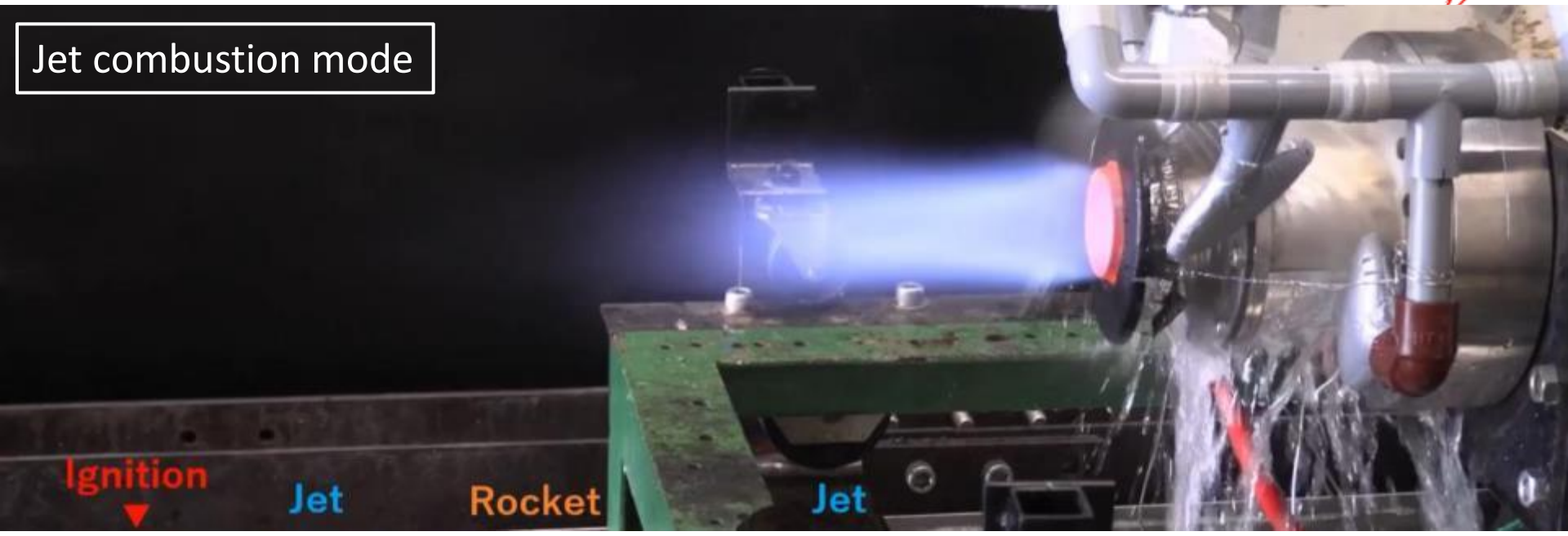
NAGOYA, JAPAN, April 5, 2022 – PD AeroSpace, LTD. ("PDAS") has successfully demonstrated the world's first Jet/Rocket combustion mode switching in a rotating detonation engine ("RDE").

Conventional jet engine cannot be used in the space where air is not available. Thus, rocket engine with oxidizer is required for the space flight. In order to efficiently fly within both the atmosphere and the space, both jet and rocket engines need to be on board, or aircraft and spacecraft needed to be operated individually as two systems. PDAS's jet/rocket combustion mode switching engine aims to solve this issue.

PDAS started developing the jet/rocket switching concept in a Pulse Detonation Engine (PDE), and successfully validated the concept in 2017. After the validation, PDAS started developing and successfully validated the same concept in RDE. PDAS has already submitted the patent application for the RDE-based Jet/Rocket combustion mode switching technology on March 8 2022, and presented the results in the academic conference on March 10 2022.

The successful demonstration of the Jet/Rocket mode switching is a major milestone for PDAS's goal of providing safe and efficient space transportation systems. PDAS will continue to develop the engine to be used as the main engine for its unmanned suborbital spaceplane ("PDAS-X07") in 2024.

Key Technology : Demonstration of Testing



Competitive power

↓Benchmark

Exchange rate assumption
1 USD = 100 JPY

PD AEROSPACE

Dev. Level	97	95	30
Appearance			
Plane name	New Shepard	SpaceShipTwo	PEGASUS
Country	USA	USA	Japan
Manufaturer	Blue Origin	The Spaceship Company	PD AeroSapce
Type	Rocket type (VTVL)	Winged type (HTHL)	Winged type (HTHL)
Cost	△ Acceptable unknown	--- $500K/person	○ Competitive $350K/person
Safety (Re-entry)	○ Good by Reverse thrust, Parachute	--- by ONLY Gliding	◎ Very good by Powered flight (Retryable landing, waiting)
Versatility	--- Even Needed launch site, Landing place	--- Dedicated spaceport	◎ Very good Avalable regular airport
Develop. difficulty	○ Good Possible by current tech.	--- Experiment success	△ Weak Needed new technology

VTVL : Vertical Launch and Vertical Landing, HTHL : Horizontal Takeoff and Horizontal Landing

1) Safety improvement

- Able to abort at any phase of flight
- Able to hold and perform go-around
- Able to keep flight permitted area, divert to another airport

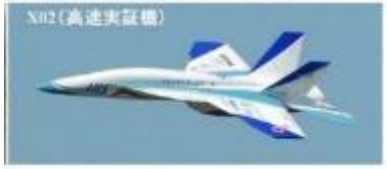
2) Lower production and operational costs

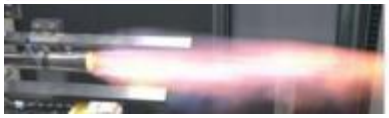
- Simple system = Lower production and maintenance costs
- Able to reduce numbers of pilots, maintenance staff, tools and spare parts = Reduced maintenance costs
- Specialized airport not required = Lower operation costs
- High efficiency engine = Reduced fuel costs

3) Expandable

- For multiple purposes

Design study of suborbital spacecraft applying hypersonic engine technology





JAXA
Operates at Mach 5 from takeoff
Hypersonic engine technology

PD AeroSpace LTD.
Jet/Rocket Hybrid Engine Technology, Unmanned Aerial Vehicle Experimental Technology

Joint research results
Presented the feasibility of a suborbital spacecraft reaching an altitude of 100 km with a jet/rocket hybrid engine.

Aerospace Development Applications

Reusable Space Transportation

Private Business

Suborbital spaceplane

Collaborative Research Implementation System

Research Representative：PD AeroSpace LTD
（CEO Shuji Ogawa）

Researcher in JAXA：Aviation Technology Division
（Propulsion Technology Research Unit ／ Hideyuki Taguchi *et al.*）

Background and Outline of Joint Research

Suborbital spacecrafts, which are being developed by various companies for applications such as space travel and nano-satellite launches, are typically equipped with separate jet engines and rocket engines, or with the same vehicle. However, the use of two different engines or two different airframes results in a complex and expensive system.

PD AeroSpace has the technology and knowledge to develop a new concept engine that switches between jet and rocket combustion.

This joint research will utilize the hypersonic engine technology developed by JAXA, which can operate at Mach 5 from takeoff, to complement the design of the jet/rocket switchable hybrid engine and present the feasibility of a suborbital spacecraft with improved reliability and safety while reducing operational costs.

The jet/rocket switchable hybrid engine and suborbital spacecraft technologies are expected to be applied to future reusable space transportation vehicles.

Business development after completion of joint research

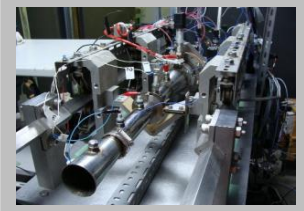
By utilizing the spaceplane system to be created, we aim to develop services such as suborbital space travel, provision of observation and experiment environments, manned/unmanned microgravity experiments, and nano-satellite launches.

Development Roadmap

PD AEROSPACE

Up to 2017 | '18 | '19 | '20 | '21 | '22 | '23 | '24 | '25 | '30

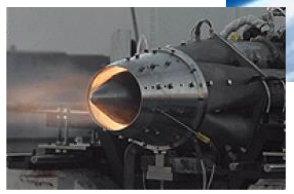
【Engine】



PDE
(Rocket mode)

PDE
(Jet/Rocket
mode switch)

【RDE】
FTE2n Series (X06)
FTE3n Series (X07)



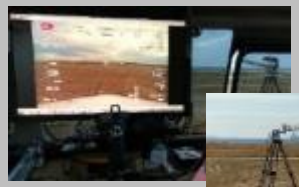
FTE5n (X08)

[Manned system]
X08, PEGASUS

X08 Jun. '27
(1st suborbital Flight)

Based on Unmanned technology
To upsize and to advanced

【 Plane 】



FPV,
Tracking device

Radio com. 200km

Spaceport development

X03A
Auto Pilot

X02A, X04
FPV, Long rage

【Suborbital UAS】
X06, X07

X07 Apr. '24 (1st sub-obi Flight)

FTE4n (X09)

[Next
Generation model]
X09 PEGASUS-X

X-Planes and New-type Rocket Engine

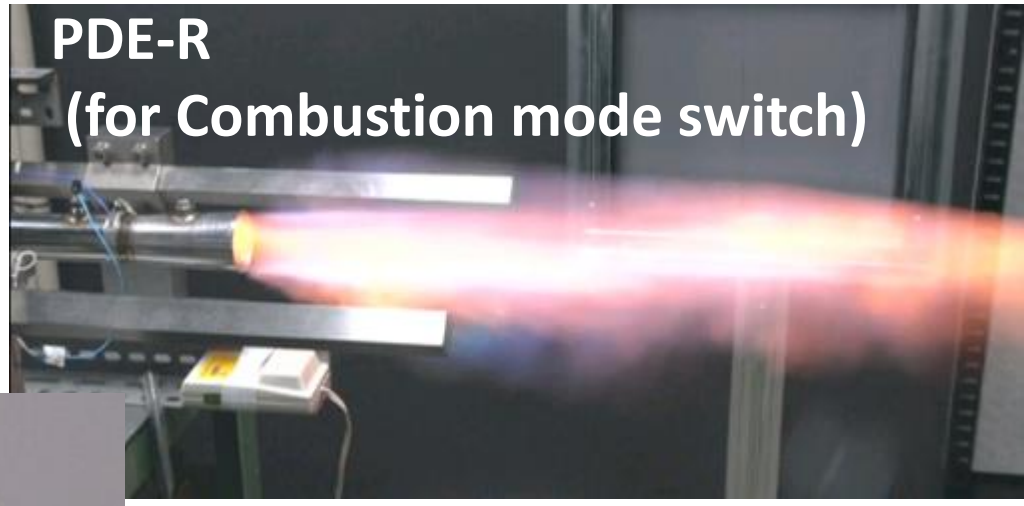
PD AEROSPACE

X01（for Demonstration）

X02A（for High-speed flight）

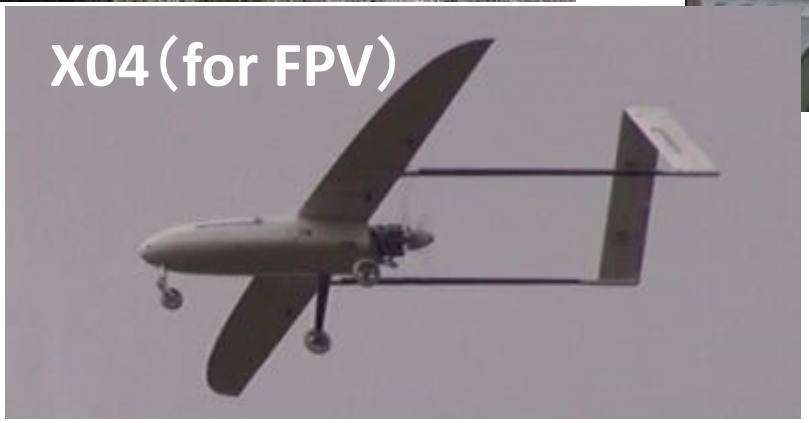
X03A（for Autopilot）

PDE-R (for Combustion mode switch)



PDE : Pulse Detonation Engine

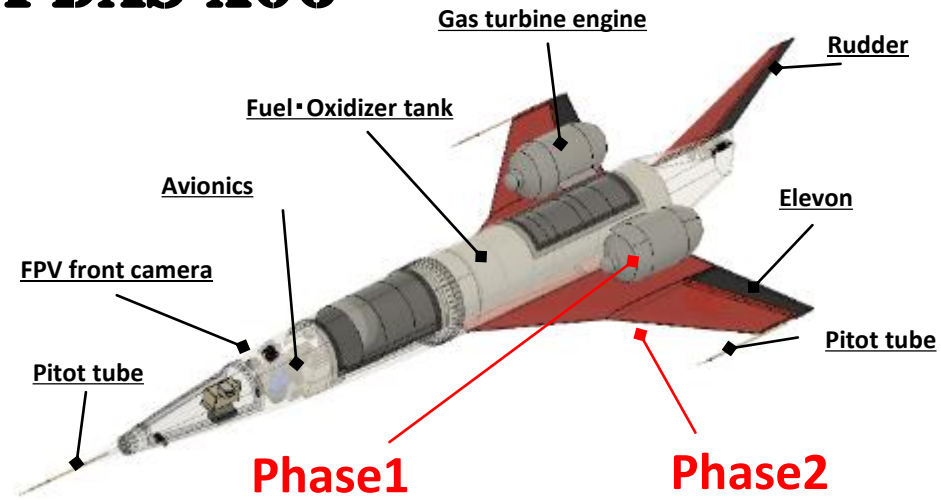
X04（for FPV）



FPV : First Person View

Technology Demonstrators

PDAS-X06



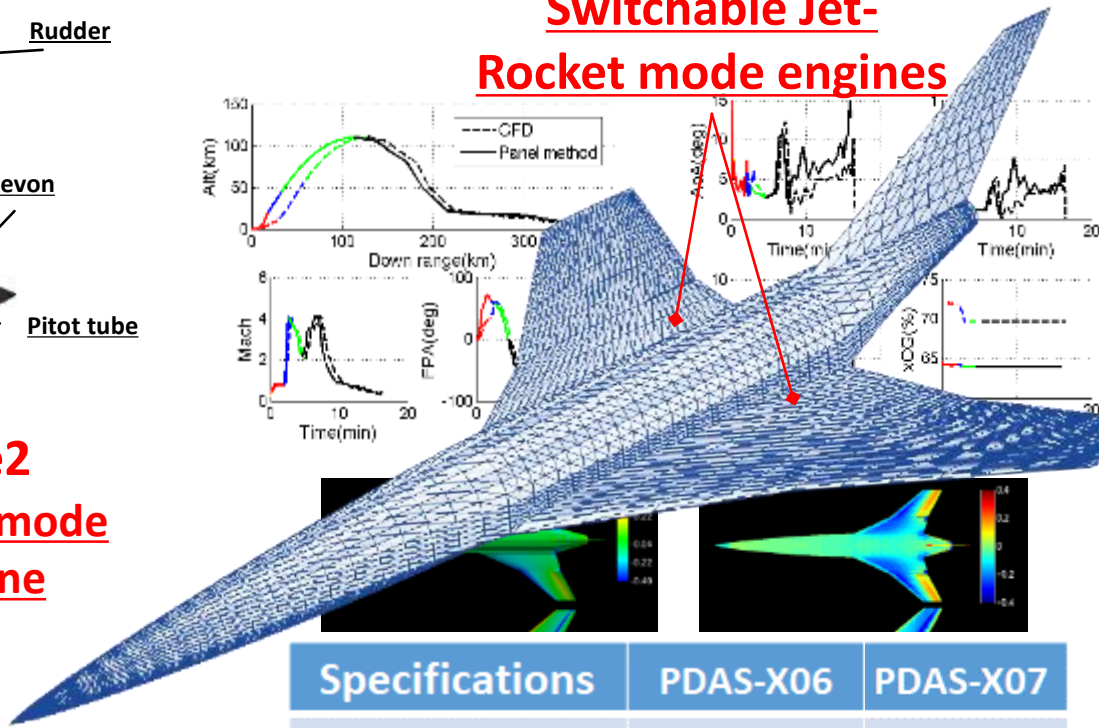
Phase1
Gas turbine engines

Phase2
Rocket mode engine

※Rocket engine to be added

PDAS-X07

Switchable Jet-Rocket mode engines



Specifications	PDAS-X06	PDAS-X07
Length	4.9 m	8.3 m
Width	2.4 m	4.4 m
MTOW	400 kg	2.1 t
Service Ceiling	10 km	> 80 km
Max Mach Num	M0.35	M3.2
Max Thrust (Total)	3 kN	20 kN
Engine	P1:GTE x2 P2:GTE, PDE	RDE-S x2

Flight Testing

Maintenance in Hangar


Entry to Commercial airport

Ground Control Station
（Radio Communication System）


Inside of GCS（Cockpit System）

Spaceport Business

- Development site
- Operation site

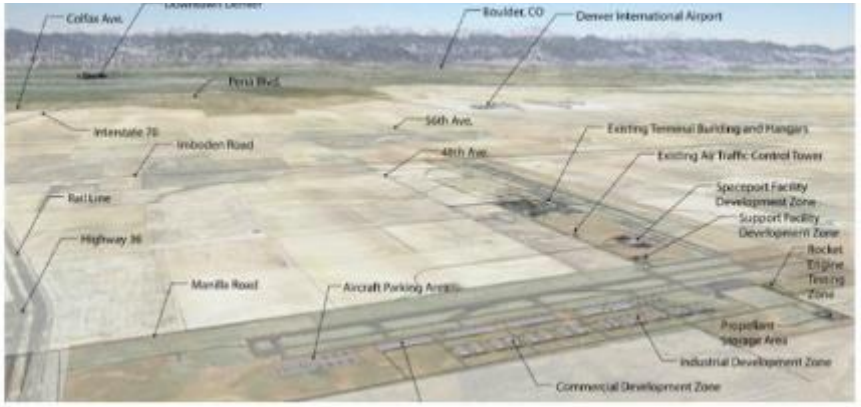
※ Japan and Overseas

Spaceport Business/ International Cooperation: CASP (Colorado, USA)

Press release

Dec. 2, 2020

Adams County News and Information
PD AeroSpace and Colorado Air and Space Port Sign Memorandum of Understanding (MOU)



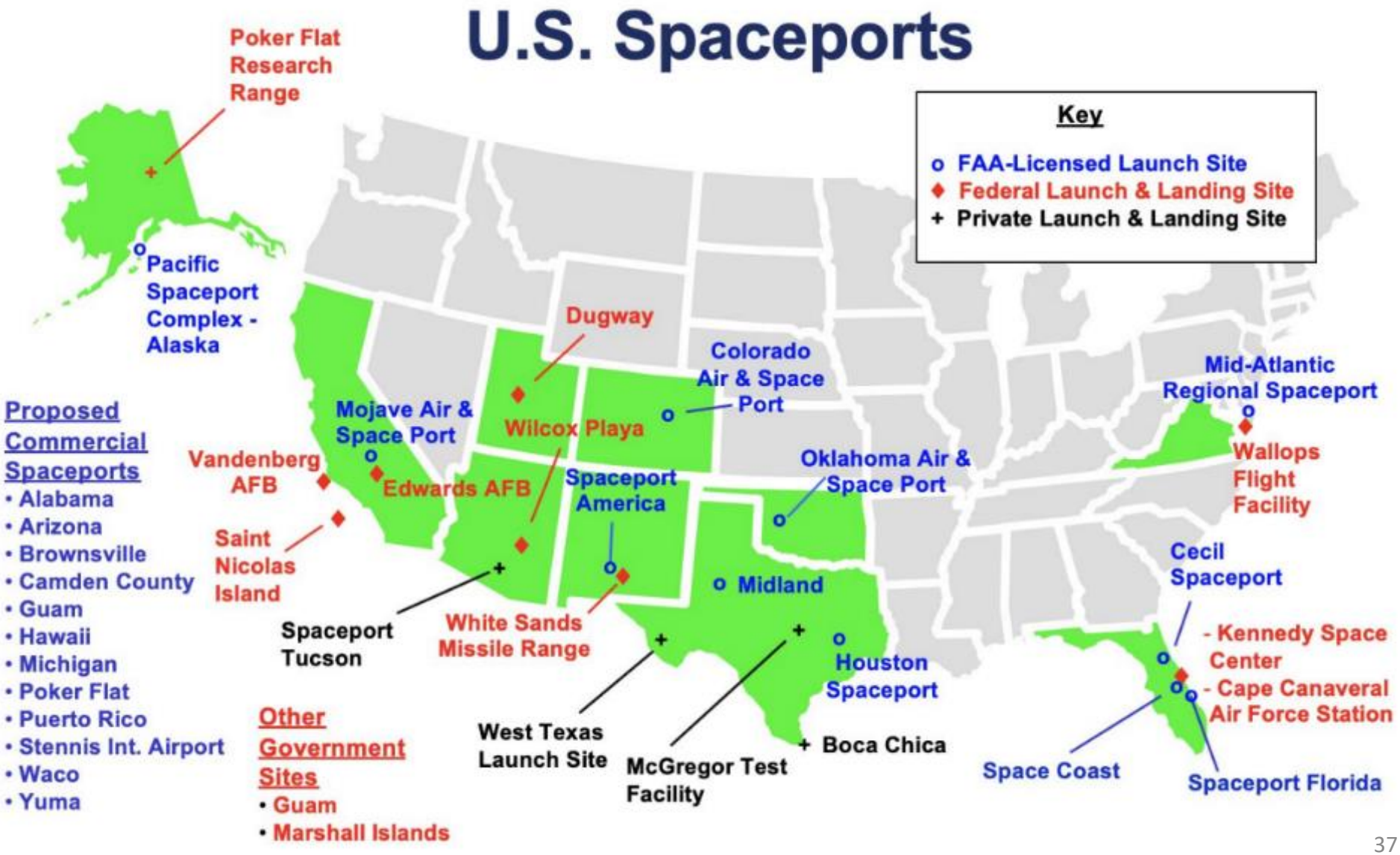
PD AeroSpace, LTD. (PDAS) and Colorado Air and Space Port (CASP) have entered into an MOU, which lays out a series of future interactions that are mutually expected to occur between the two entities, but are not legally binding. Future actions include PDAS establishing a United States (U.S.) presence at CASP, working with CASP to create a relationship with the Federal Aviation Administration (FAA), and eventually conducting test flights and evaluations.

Branches to be set up in the US, working in coordination with entities such as CASP, Colorado state government and industrial associations.

■Main points of the Memorandum of Understanding (MOU)

1. To begin application process to fly its experimental plane through the FAA of Commercial Space.
2. To establish a US business entity and engage in a development plan that identifies a physical presence in Colorado.
3. Promotion with cooperation and support.
4. To develop and establish policies and procedures that will promote and sustain a market for commercial space operations, including facilities, services, and operations.

Currently 14 Authorized Spaceports



Currently 4 Active Spaceports

Taiki, Hokkaido

Oita

Shimoji-island, Okinawa

Kushimoto, Wakayama

Testing Sites / Locations

GT : Ground Testing, FT : Flight Testing

Aichi Pref.
(Hekinan)

R&D center

Wakayama Pref.
(Old Airport)

1,300m

Ground testing site
(Planned)

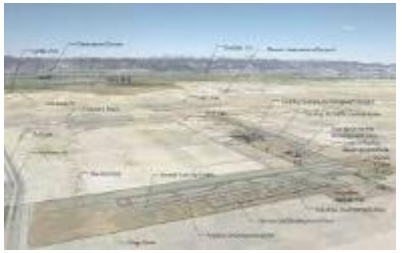
Okinawa Pref.
Shimojishima airport

3,000m

Ground/Flight testing site

US site→
(MOU contracted)

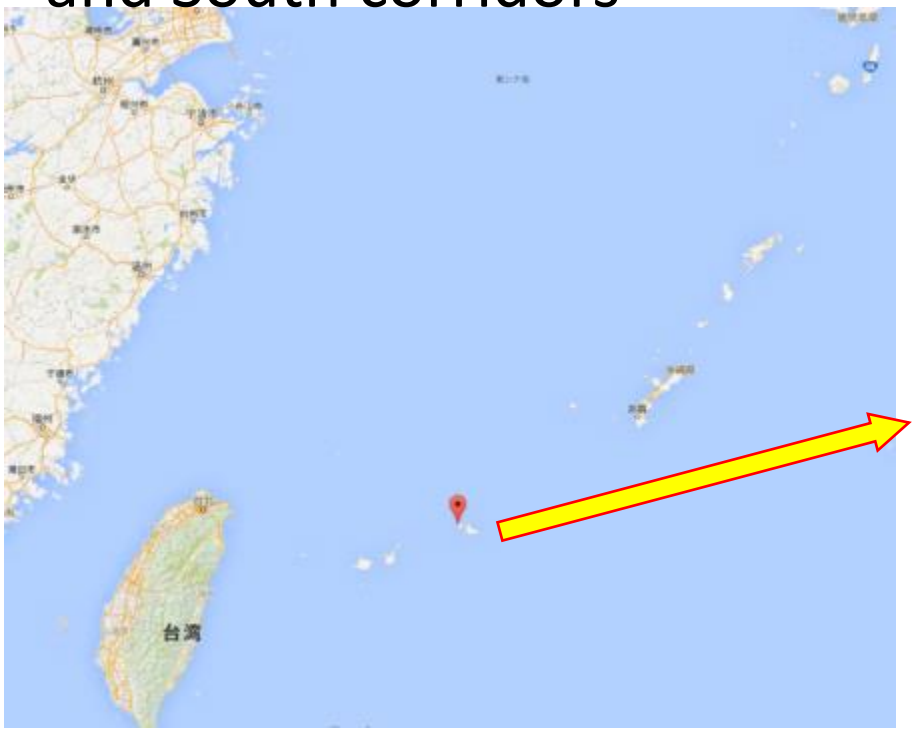
USA / Colorado
CASP

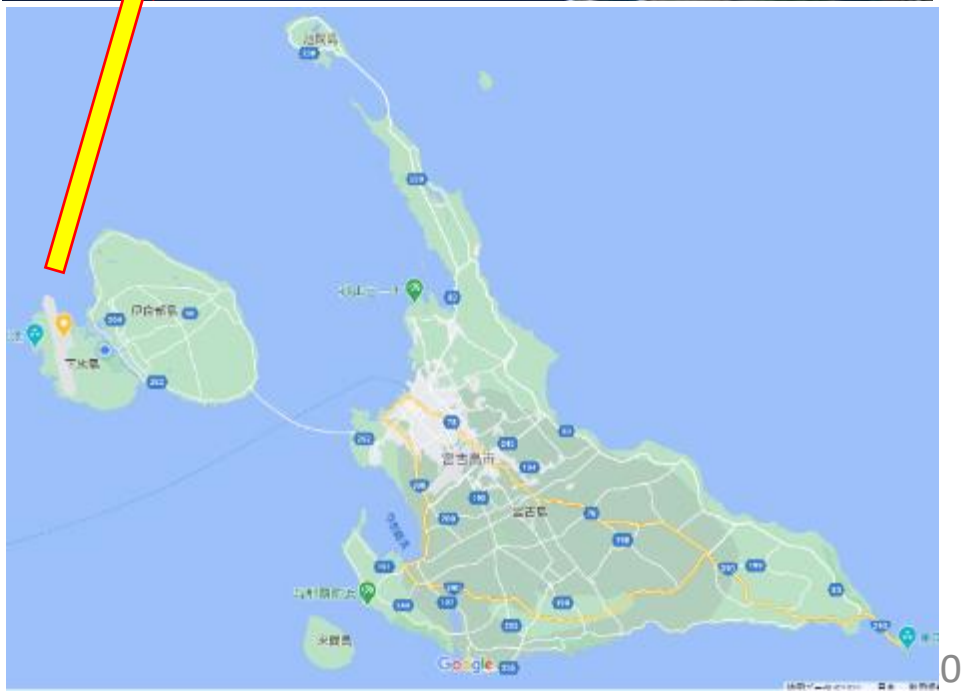


2,400m x2

[Shimoji-island(Shojishima) airport]

- 320km from Okinawa island
- 3,000m x 60m runway
- Fully equipped air traffic management facility
- Wide civil airspaces on North and South corridors





Spaceport Development (Spaceport Asia in Okinawa)

[Shimoji-island: a Gateway to Space]

Aerial images courtesy of Mitsubishi Estate Co.

1. ”Spaceport”

To utilize Shimoji-island(Shimojishima) Airport as a takeoff and landing site for winged space craft (spaceplane): a Spaceport.

2. Two phases

1) The project will be developed in two major phases.

Initial phase: Flight testing of our experimental aircraft

2) Operation phase: Attracting companies from Japan and overseas

3. Four kinds of Services

1) Flight testing

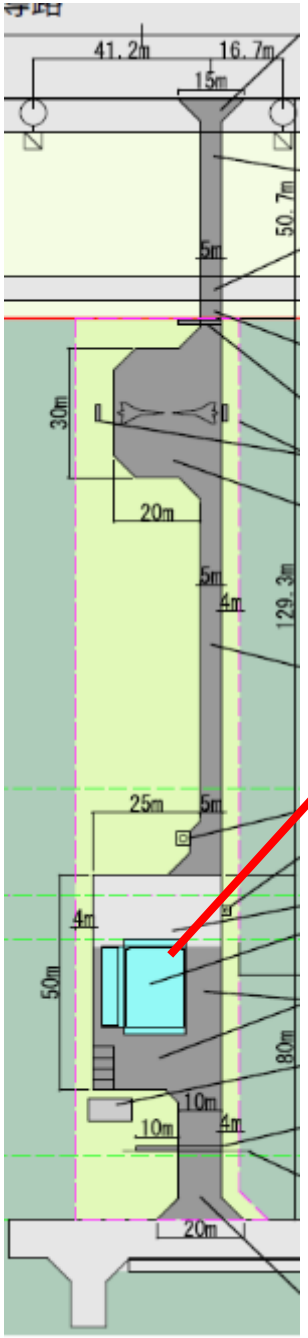
2) Tenant

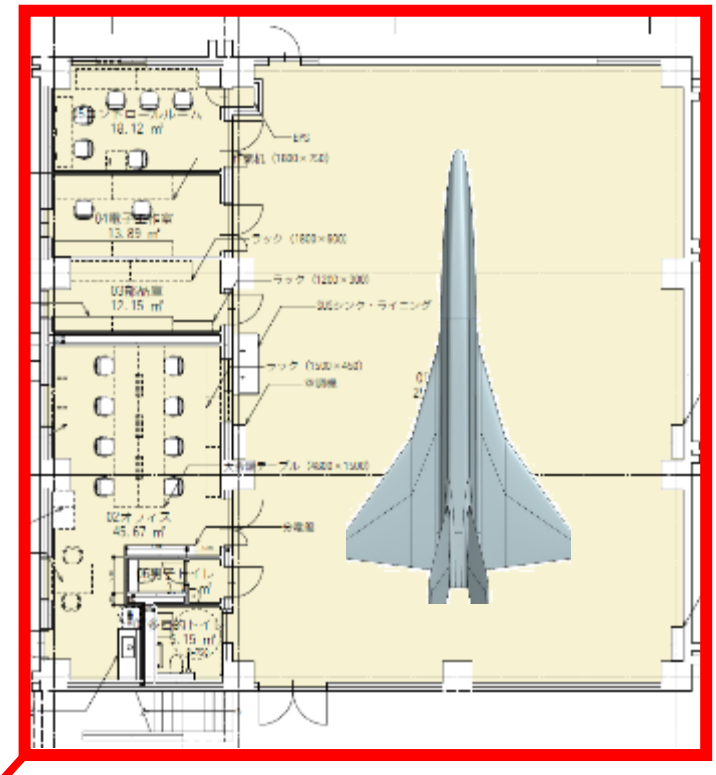
3) Training program

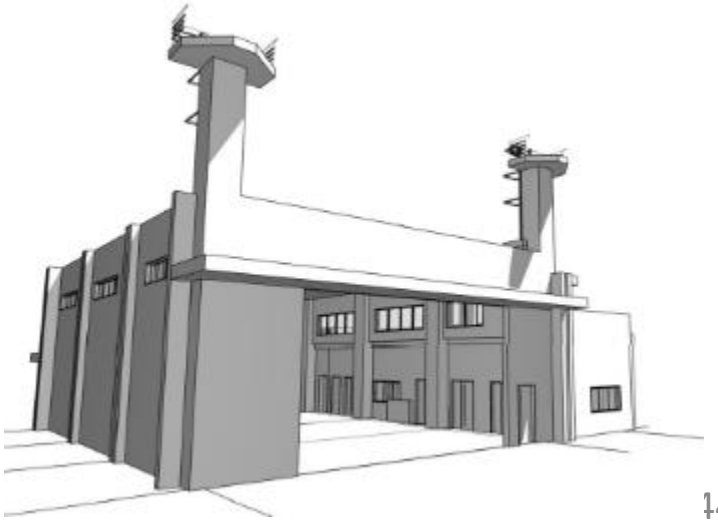
4) Tourism

Spaceport Asia / Hangar1（for X07)

Spaceport Asia / Initial phase Hangar1 (for X07)







Spaceport Business Consortium

https://www.spc.pdas.co.jp/

Spaceport Asia Business Promotion Consortium

CONCEPT

設立の趣旨

「宇宙に行ける島、下地島」をキーコンセプトに下地島宇宙港事業並びに宇宙港事業を基点とした産業振興に資する活動を行うことを目的とします。
多種多様な事業者の皆様と連携し宇宙港事業を推進します。

Spaceport Asia / Business Promotion Consortium: Members

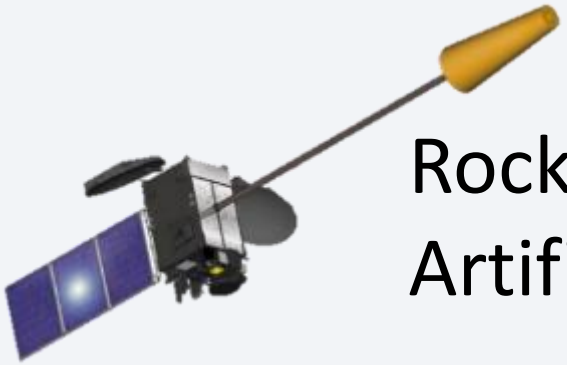
PD AEROSPACE

※抜粋

Non-development services: Training programs

宇宙旅行へ行ってみたいけど・・・
自分の体で大丈夫だろうか？
宇宙へ行ったら、どうなってしまうのだろう？
そもそも、宇宙旅行って、どんなもの？

Regulatory issues : Current situations



Rocket &
Artificial satellite

【Space Activities Act】

Sub-orbital flight

※ Space Activities Act is not applicable

→ New laws and regulations are needed for sub-orbital

Aircraft

【Aviation law】

Regulatory issues： Public-Private Council decisions

Domestic legal treatment of unmanned suborbital flights was officially decided (May 28, 2020)

内閣府
Cabinet Office

内閣府ホーム ＞ 宇宙政策 ＞ 政府関連施策

政府関連施策

サブオービタル飛行に関する官民協議会

（“Public-Private Council on Suborbital Flights” has been established）

令和元年6月26日、「サブオービタル飛行に関する官民協議会」（共同事務局：内閣府宇宙開発戦略推進事務局及び国土交通省航空局）が設立されました。
本協議会では、サブオービタル機の往還飛行について、安全性を確保するとともに、民間事業者の計画的な技術開発に資するよう、必要な環境整備について検討を進めています。

- 開催状況
- PDエアロスペース（株）の無人実験機 PDAS-X07の実証実験に向けて整理した考え方について（PDF形式：183KB）

(A way of thinking organized for the demonstration of an unmanned experimental aircraft developed by PD AeroSpace, LTD.)

平成30年3月20日、安倍総理は、宇宙ベンチャー育成のため、新たな支援パッケージを発表しました。
日本政策投資銀行（DBJ）、産業革新機構（INCJ）をはじめとし、官民合わせて、宇宙ビジネス向けに、今後５年間に約1,000億円のリスクマネー供給を可能とするとともに、JAXA・民間企業の専門人材を集約したプラットフォームを創設し、宇宙ベンチャーとJAXA・民間企業との人材の流動性を高めることなどを通じて、人材・技術面からも支援を行います。この他にも、ビジネス環境整備など、政府一丸となって、宇宙ベンチャーの育成を支援します。

・宇宙ベンチャー育成のための新たな支援パッケージ（PDF形式：66KB）

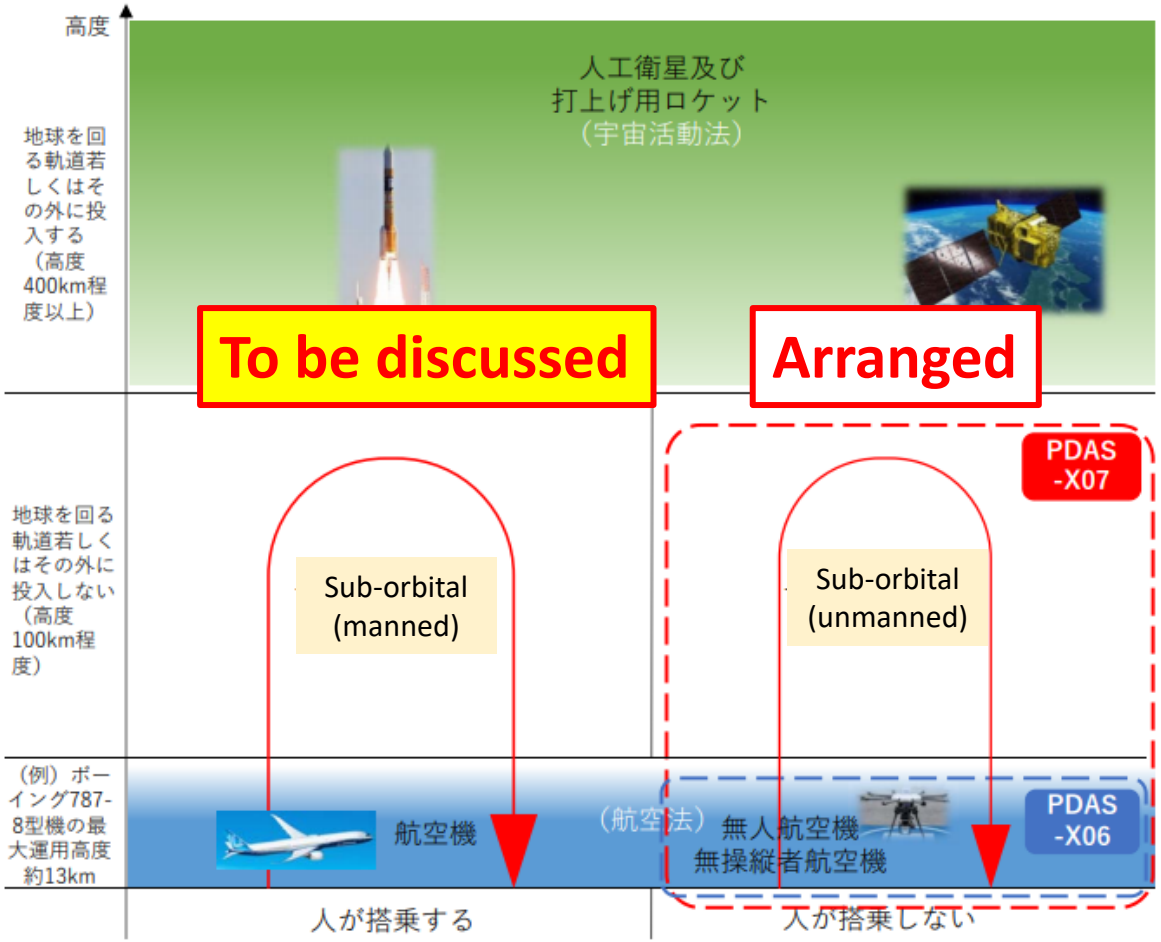
このページの先頭へ

https://www8.cao.go.jp/space/policy/policy.html (in Japanese)

Regulatory issues：Legal Approach to Suborbital Flights

PDエアロスペース（株）の無人実験機 PDAS-X07の実証実験に向けた考え方について

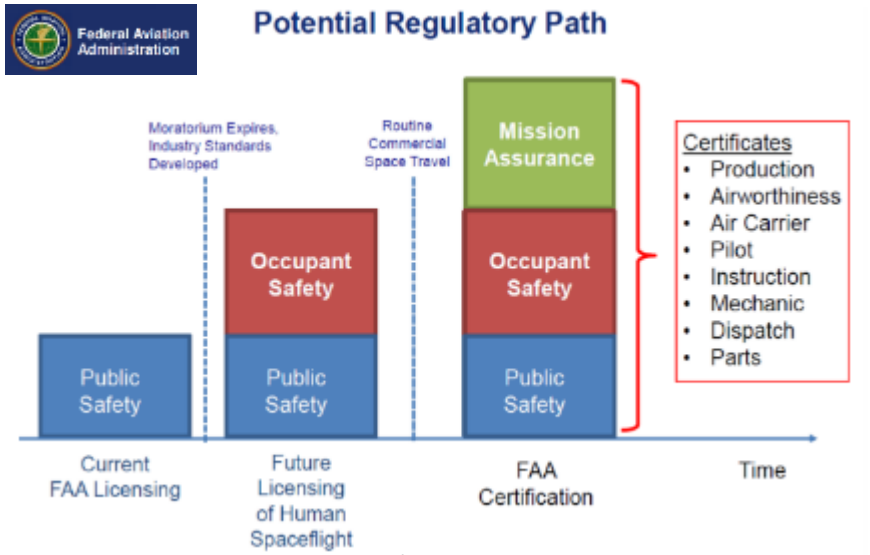
- 無操縦者航空機の範囲を超えるPDAS-X07の国内実証を速やかに実現するため、関係機関が適切な役割分担の下連携し、安全確認を行うことが必要。
- ジェット推進部分については知見を有する国交省中心に対応し（航空機等と同様の規制を適用）、ロケット推進部分については観測ロケット等と同様の規制を適用することが、考えられる。
- 実証で用いる設備や推進薬等によって規制を受ける可能性があるため、計画（やリスク）について事前に必要な情報開示をしてもらう必要がある。



内閣府 宇宙政策 政府関連施策 ページ内より https://www8.cao.go.jp/space/policy/policy.html 2020年5月28日決定

Regulatory issues : Strategies for Human Space Flights

1. Roadmap



Commercial Space Transportation / FAA (COMSTAC-STANDARD WORKING GROUP (SWG) April 27-28, 2016 OBSERVATIONS, FINDINGS AND RECOMMENDATIONS (OFR'S)

2. Consideration of target group and IC

IC: Informed Consent

- 1) Operator
- 2) Participants in experiment
  - General IC
  - Special IC
- 3) Consumer

Participants in experiment: A person who accepts risk at their own risk (Neither a business nor a consumer).

Special IC: The participants in the experiment waive all claims for damages against the government and the operator

3. Organizing Correspondents

1) Public-private council
 / Two working groups

2) Local government
 / Special national strategy zone

3) Cabinet Secretariat
 / Regulatory sandbox

4. Consideration of response policy

Different policies from 1. through 3.

e.g.)
Introduce government compensation programs up to the level of certification

List of points-to-be-considered for “Space Tourism”

10 themes	20 items
A) Plan	1. Business plan
B) Promotion	2. Promotion
C) Services	3. Service contents
	4. Customer Service
D) Ticket Sales	5. Sales method
	6. Sales
E) Flight Operation	7. Flight management
	8. Crew
	9. Cabin equipment
	10. Craft maintenance
F) Medical	11. Medical

10 themes	20 items
G) Insurance	12. Insurance
H) Law	13. Law issues
I) Spaceport	14. Construction
	15. Facilities
	16. Operation
	17. Other sites
J) Spaceplane	18. Development
	19. Docking
	20. Mass production

Future Schedule

- Elemental technical demo. of UAV — by Oct '17
- Jet/Rocket mode switch demo. — by Oct '17

- Long-distance remote-control flight — by Jan '23 NOW

- Unmanned Sub-orbital space flight — by Apr '24

- Manned Sub-orbital space flight — by Jun '27

- Service in of space tourism — by Mar '29

- Mass commercial production — by Sep '29

Milestones going forward

X07-80

X08

PEGASUS

X06

Altitude

80km

8km

UAV

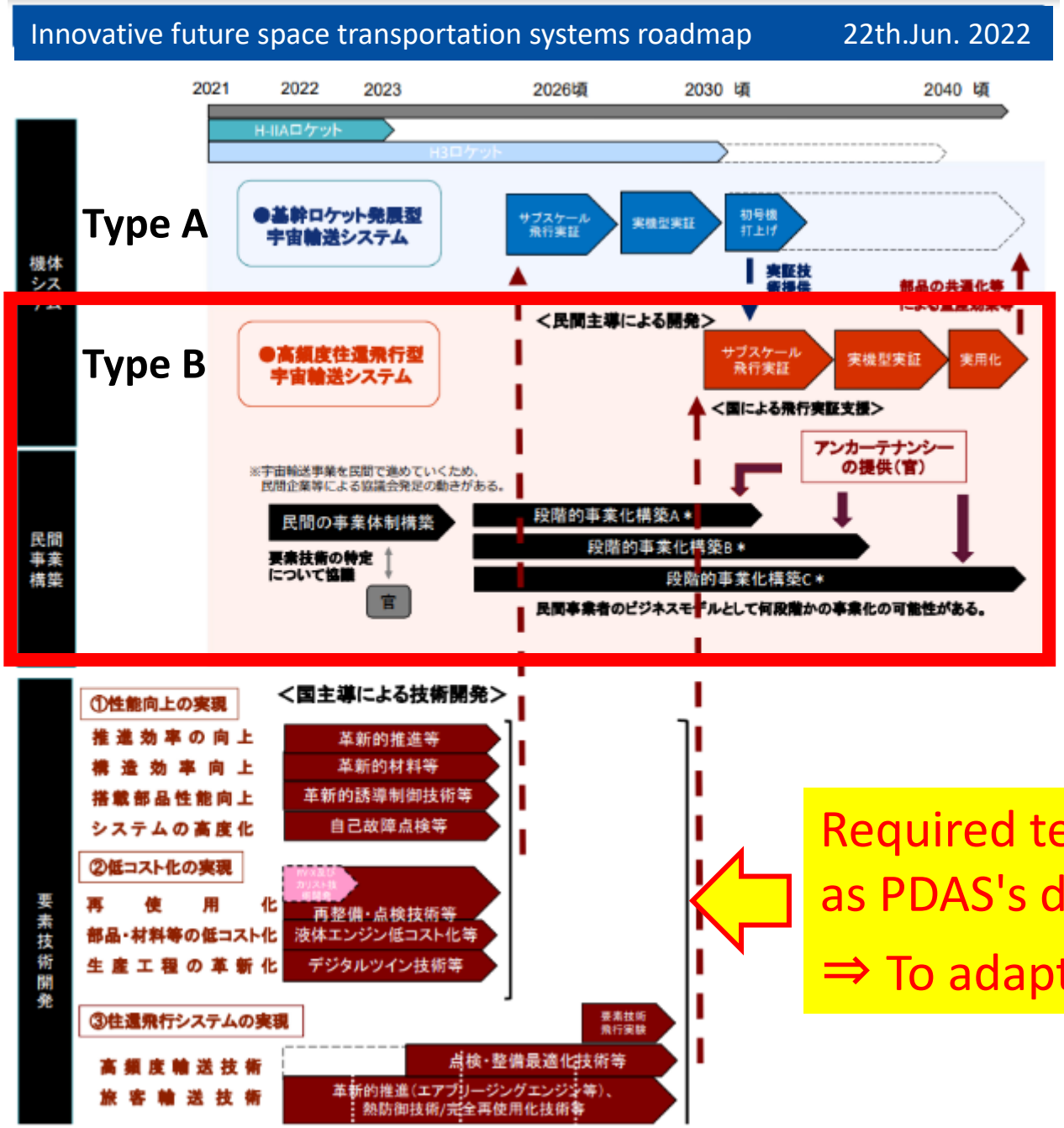
Manned Space Flights

Body length	4.9m	8.3m	32m	32m
Scheduled First launch	May 2022	Feb. 2024	Dec. 2026	Oct. 2028
				Start of commercial flights : Mar. 2029
Engine types	Jet engine			
	PDE	RDE（Jet/Rocket switchable hybrid）		
Development objective	Technical demonstration	Suborbital demonstration	Manned flight demonstration	Commercial flight

Japan Government (JGO)
the Next generation space program

Development of a high-frequency shuttle
space flight system

Government of Japan's New Roadmap



Previous Government plan (Vertical launch type)

New Government plan (High frequency shuttle type)

https://www.mext.go.jp/content/20210622-mxt_uchukai01-000016127_2.pdf

Required technologies are same as PDAS's development targets

⇒ To adapt national project

PD AEROSPACE

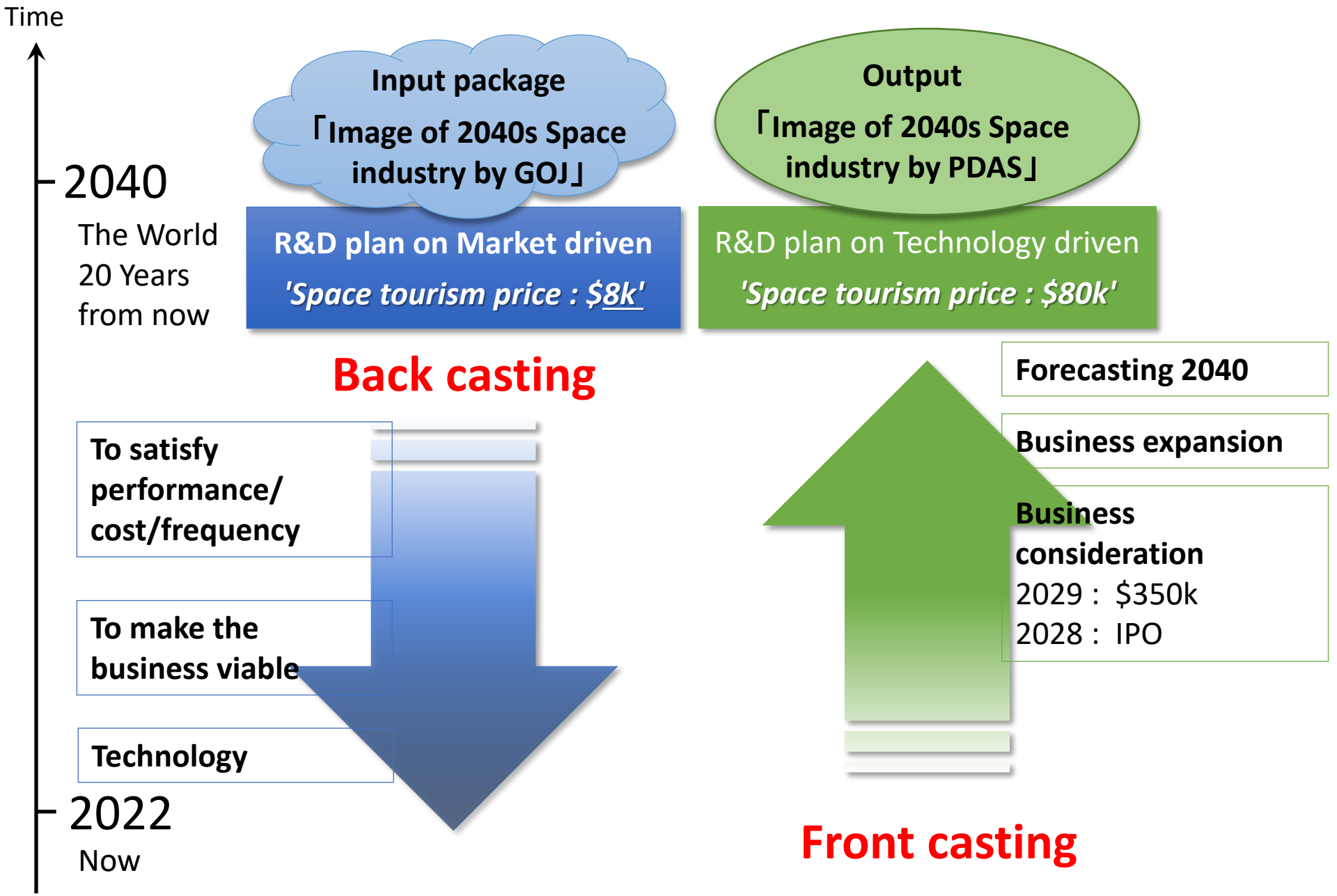
宇宙輸送マーケットの87%を占める輸送モードに **Total market size will be $140 B**
総利用者は770万人、総輸送重量は16万トンとなり利用が大幅に拡大した未来が到来

Transfer mode	2022 Percentage of total market	2045	ヒト/モノ	市場規模*1	客数/重量	Market unit price	機体キャパ*3	往訪回数*4
1. 地上~ Ground to Space Station	$100 M, 26.5%	$42 B	ヒト	21,000 (億円)	57 (万人)	$37 K /person	~60 (人/機)	9,500 (回/年)
			モノ	21,000 (億円)	8.4 (万トン)	2,500 (万円/トン)	~10 (トン/機)	834 (回/年)
2. Orbital	$50 M, 13.0%	$20 B	ヒト	20,000 (億円)	100 (万人)	$20 K /person	~70 (人/機)	15,000 (回/年)
			モノ	NA (ユースケースなしと仮定)				
3. Sub-Orbital	$500 K, 12.0%	$19 B	ヒト	19,000 (億円)	230 (万人)	$8 K /person	~100 (人/機)	23,000 (回/年)
			モノ	NA (ユースケースなしと仮定)				
4. P2P	$15 K, 35.8%	$57 B	ヒト	41,000 (億円)	380 (万人)	$10 K /person	~100 (人/機)	38,000 (回/年)
			モノ	16,000 (億円)	8.1 (万トン)	2,000 (万円/トン)	~5 (トン/機)	1,600 (回/年)

*1：市場を構成する主要ユースケースの市場規模を基に推算、*2：マーケットドリブンで推算した1回あたり利用単価を想定、*3：ユースケースのペルソナを基に同時に利用する客数/重量を推計、
*4：客数/重量÷機体キャパで年間の往訪需要を推計

GOJ's New Roadmap vs PDAS's Roadmap

[2 approaches]



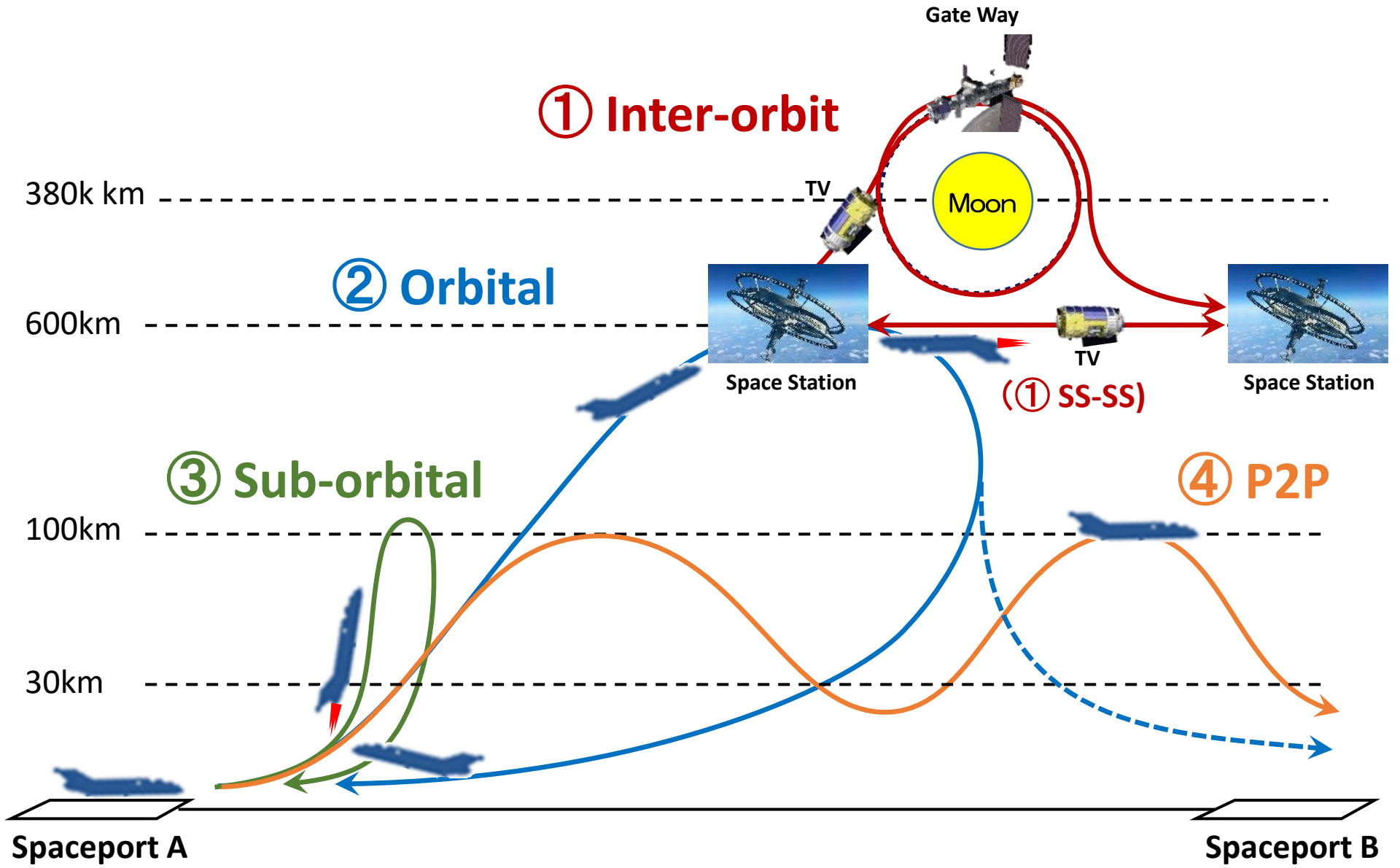
- The level of technology from the current status (technological issues)
- Maximization of effect *Consideration of targets around 2040
- Consideration for existing technology/industry

Judging from these viewpoints, it is appropriate to aim for System D first.

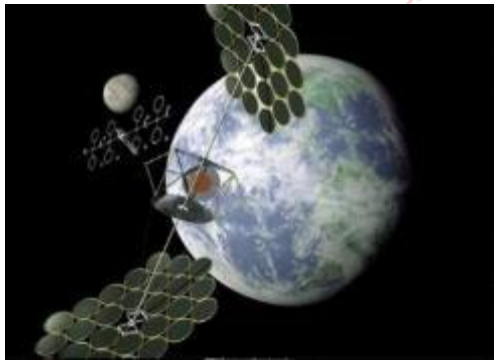
System D
= SSTO
+ Transfer Vehicle

Our proposal :
Prioritize SSTO development in JPN.

Our proposal to Gov.



Long-term Objectives



Space mining

Space Transportation

Constructions

Space tourism

Air launch

Orbital launch

Altitude 100km

μG flight
(Flying test bed)

High alt. observation

Hypersonic transportation

Point to Point flight

Spaceport