Summary of Q2

- Annual orders for FY2020/03 is on track（over 600 MM JPY at Q2 end). Sales in Q2 was 204 MM JPY.
  - ✓ “Provide Solutions” (STEP 1,2) and “Mass Production” (STEP 3,4) grew on YoY basis. Sales for national projects declined from last year (FY19/03: 65 MM JPY, FY20/03: 18 MM JPY).
  - ✓ Ongoing large-scale PoCs and custom development projects for actual deployment and operation with current and new customers. No change in annual forecast.
- Invested 2.8 MM USD in AutoModality in US.
  - ✓ Integration of AutoModality's “Perceptive Navigation” technology into ACSL’s proprietary drone controls will enable autonomous flight in more complex and technically difficult GPS-denied environments.
  - ✓ Collaboration to strengthen marketing and sales in both Japan and the US.
- Expanded deployment and operations, mainly in “Provide Solutions” (STEP 1,2) for current and newly developed customers.

Agenda

1. FY20/03 Q2 Financial Results
2. Business Highlights
3. Appendix
4. Company Introduction

Financial Results

Achieved 204 MM JPY Sales in Q2. Total sales declined on YoY basis due to increased seasonality and decrease in national projects.

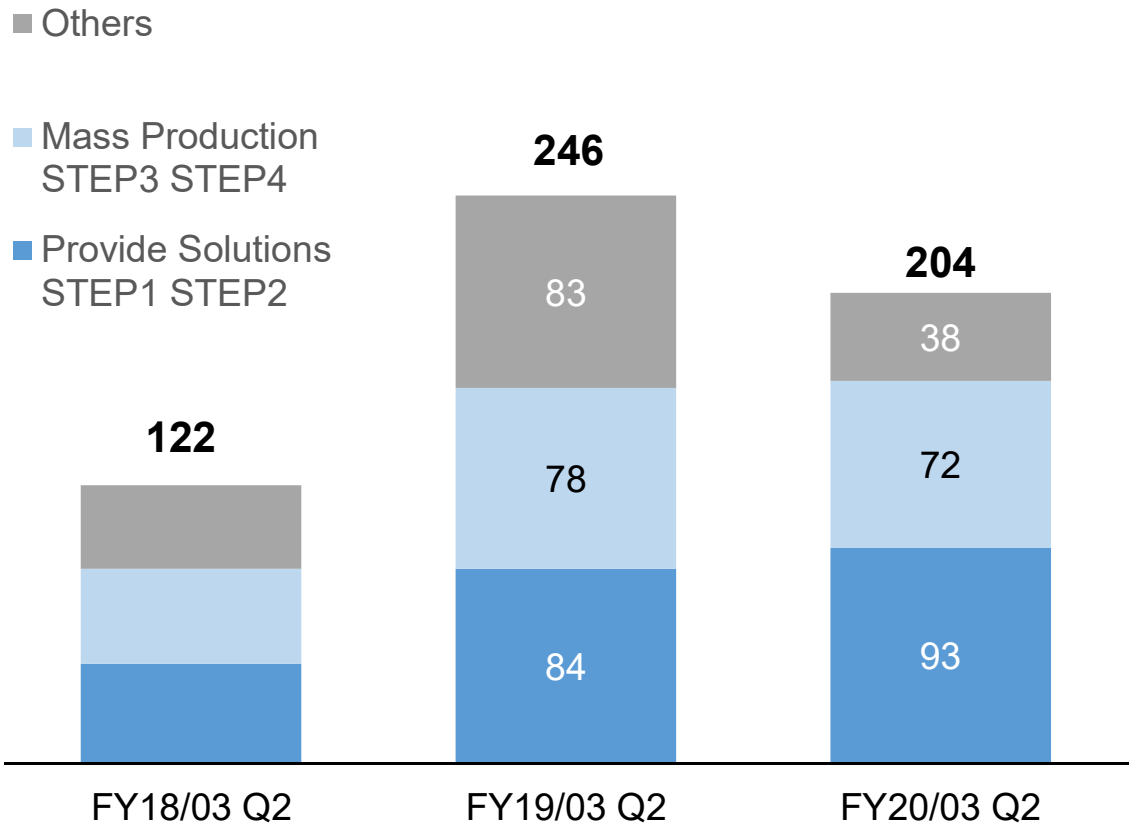
[MM JPY]

	FY20/03 Q2		FY19/03 Q2	FY19/03 Annual
	Actual	YoY	Actual	Actual
Sales	204	▲17.0%	246	807
Gross Profit	77	▲20.6%	97	403
Gross Ratio	37.9%	▲1.7pt	39.6%	50.0%
Operating Loss(▲)	▲299	-	▲232	▲330
Ordinary Loss(▲)	▲82	-	▲86	▲176
Net Loss(▲)	▲84	-	▲87	▲183

Sales

"Provide Solutions" (STEP 1,2) and "Mass Production" (STEP 3,4) grew on YoY basis. "Others" decreased due to national projects.

Sales by step
[MM JPY]

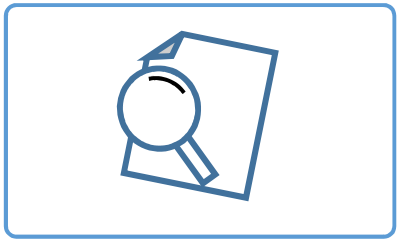


- Decreased sales for national projects (47 MM JPY) in others
- Customer projects (steps 1-4) grew slightly in Q2 while large-scale PoCs and custom development closing Q4 increased

Provide Solutions Sales

New client development and application expansion by current clients led to an increase in number of deals to 36.

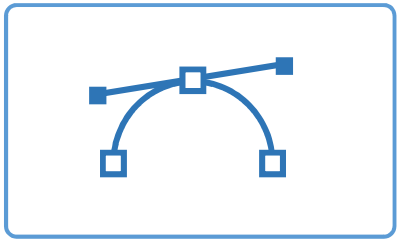
STEP 1
Proof of Concept



Proof of Concept
(Detail out drone usage)

- Verification of concept for drone usage is feasible or not
- Closed trials
- Use of ACSL platform drones

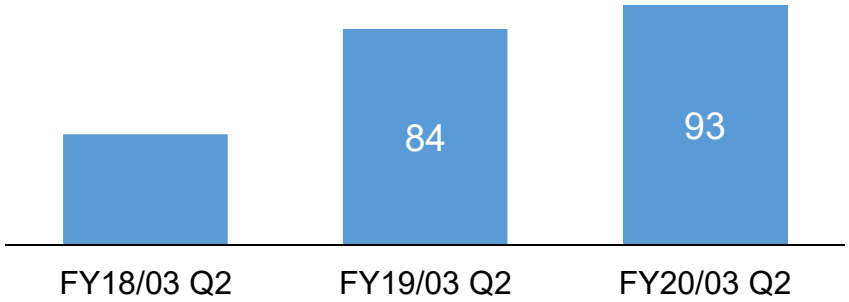
STEP 2
Custom Development



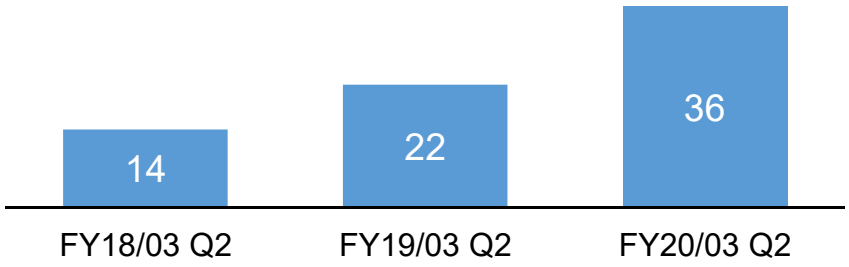
Custom development
(Design and develop entire system)

- Detail test designs
- Development of customized drones and systems
- Testing at low risk environment

"Provide Solutions" (STEP 1,2) Sales (MM JPY)



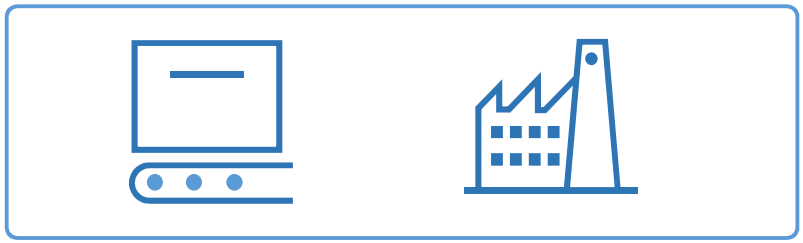
"Provide Solutions" (STEP 1,2) Number of Deals



Mass Production Sales

While number of units decreased, sales remained at the same level as last year, driven by ASP increase.

STEP 3 / STEP 4
Mass Production

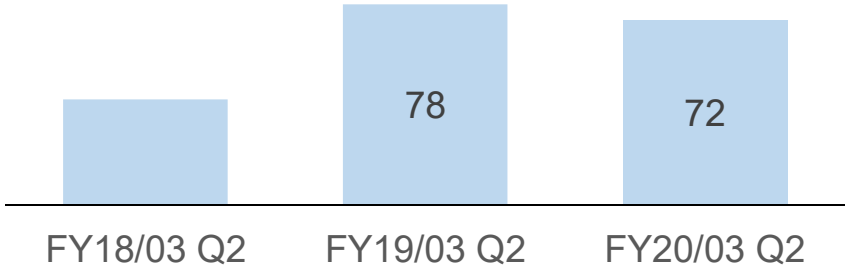


Deployment for commercial usage
(Sales of mass production model)

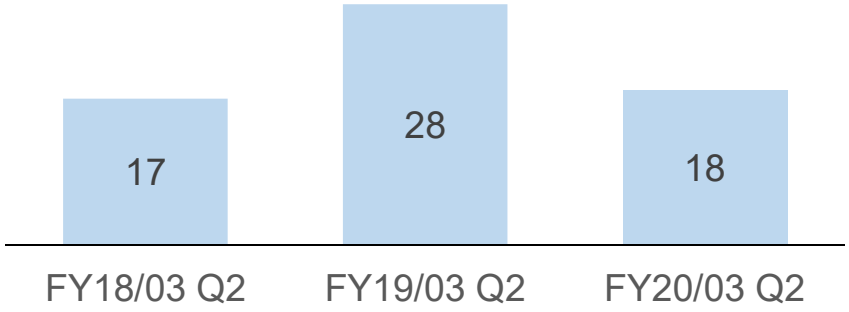
- Supply improved customized drones and systems
- Piloting or commercial use at actual sites by clients

*STEP 4 is more than 10 units sales per client in a year. Standard model sales is also included.

"Mass Production" (STEP 3,4) Sales (MM JPY)



"Mass Production" (STEP 3,4) Number of Units



Others

Maintenance remained at the same level as last year while sales for national projects decreased from 65 MM JPY to 18 MM JPY.

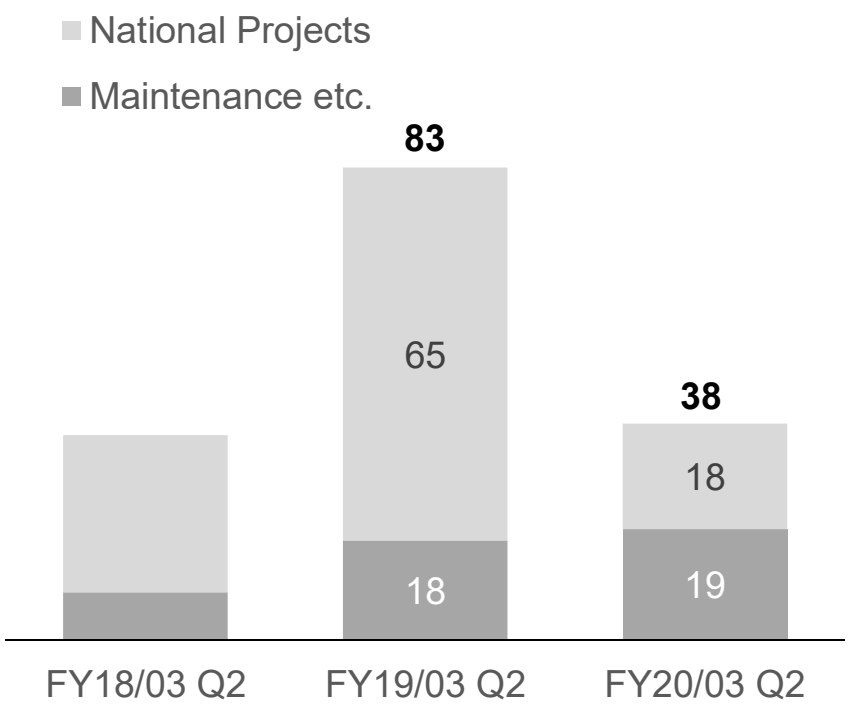
Others

Maintenance after drone installation
(Parts sales, Repair etc.)

- Sales of drone parts
- Repair service
- Some national projects

* While subsidies from national projects should in general count as a non operating income, some national projects count as a sales

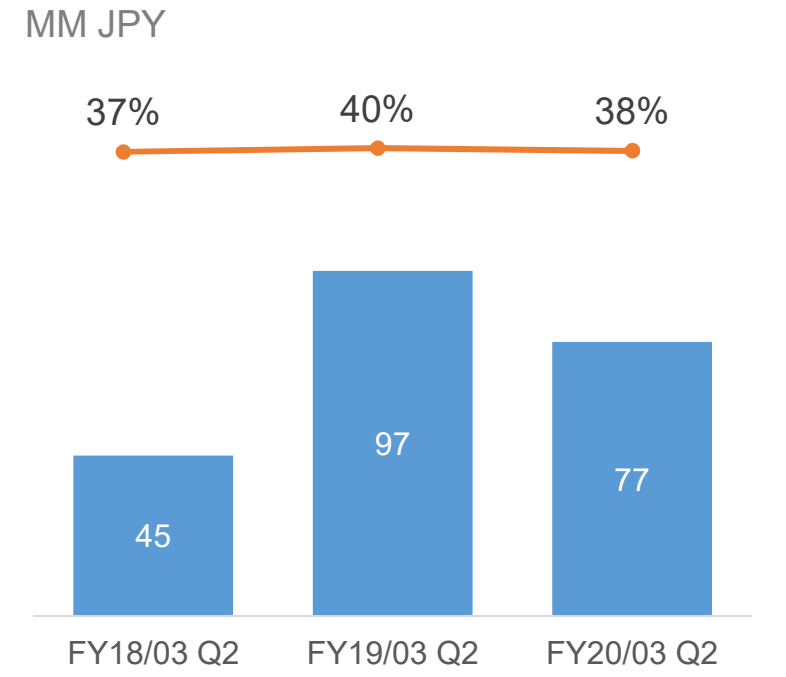
Others sales (MM JPY)



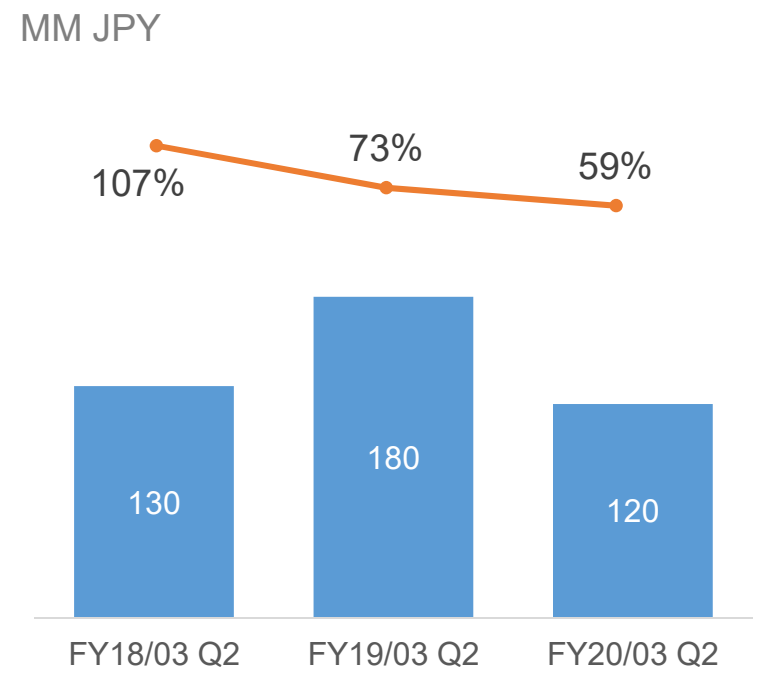
Gross Profit and R&D Expenditure

Gross ratio decreased on YoY basis. Annual R&D investment volume remained the same as last year (about 360 MM JPY).

Gross Profit and Gross margin



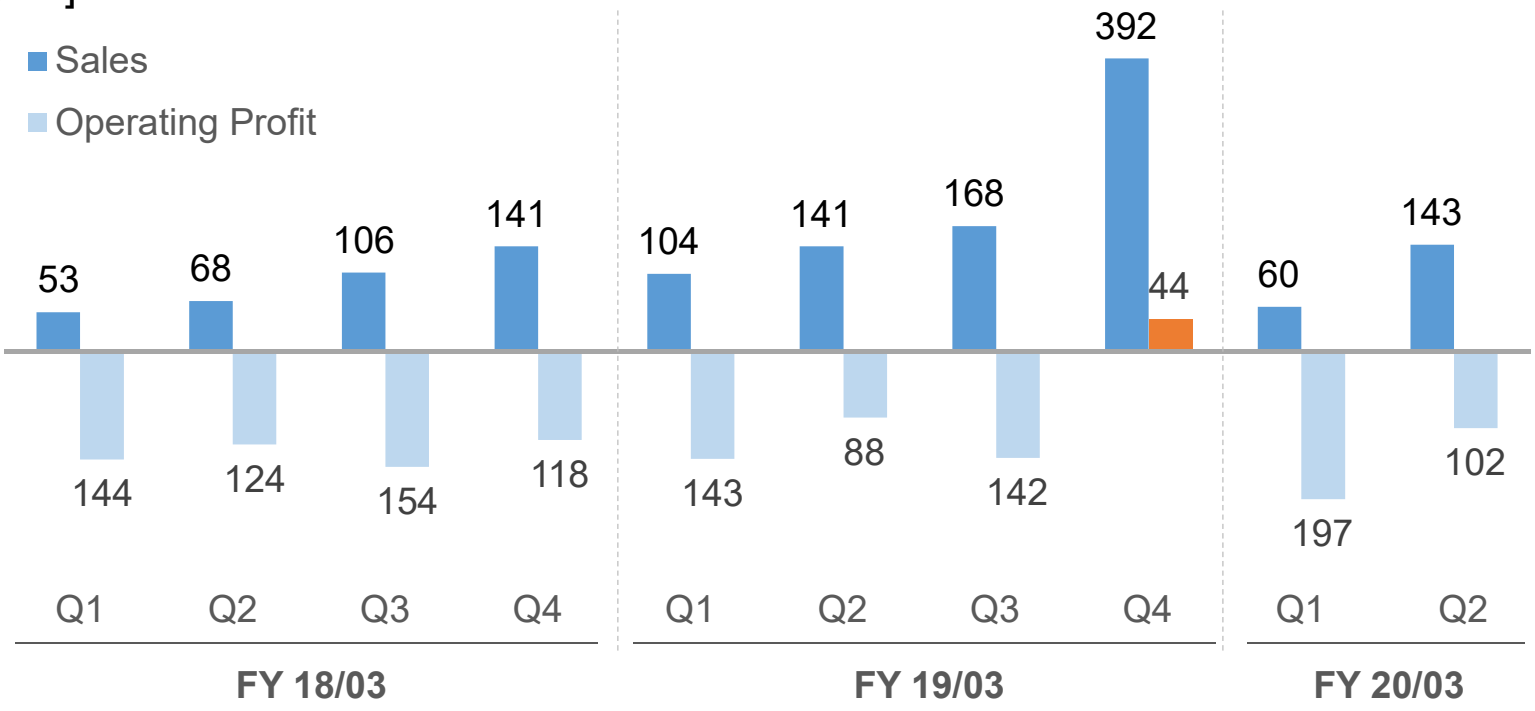
R&D Expenditure to Sales Ratio



Sales and Operating Profit by Quarter

Since the scope of most projects has become larger and sales are booked upon completion, most sales will be realized in Q4.

Quarterly Sales and Operating Profit
[MM JPY]

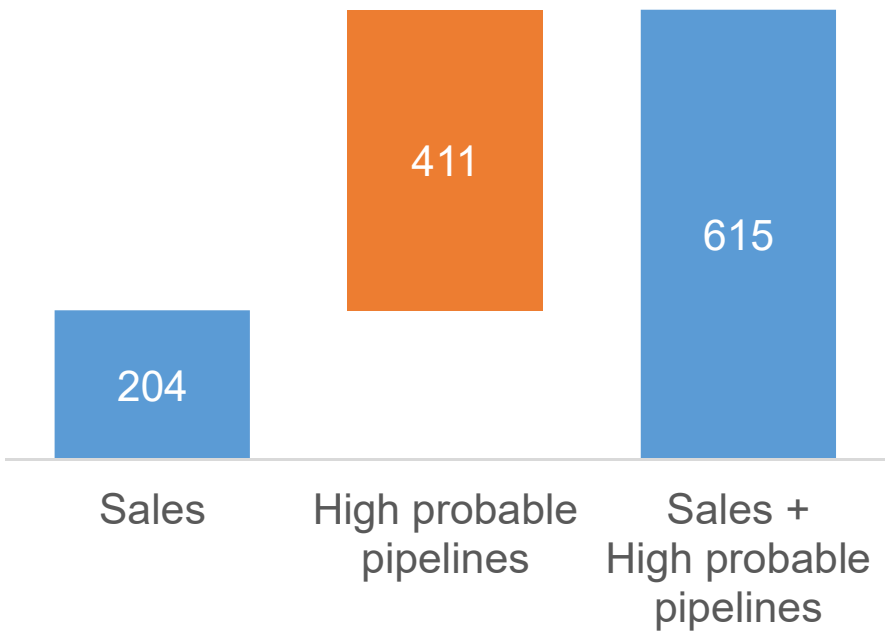


Q4 sales forecast is strong. This seasonality is expected to continue to intensify.

Order status for FY 20/03 in Q2 end

High probable pipelines[1] at Q2 is 615 MM JPY. Steadily taking orders, mainly in “Provide Solutions”, towards the annual sales target of 1.4 billion JPY.

Sales and pipelines
[MM JPY]



- Already received purchase orders of 411 MM JPY by end of Q2, mostly as large projects
- Large projects complete in 2nd half and sales are booked mainly in Q4
- Strong demand in “Provide Solutions” (STEP 1,2)” from current and new customers

1：High probable pipelines is the total amount of sales for projects with a purchase order at the end of September

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Business Highlights

In Q2, progressed in demonstration and actual use in the logistics field, and invested in US companies to accelerate technology development

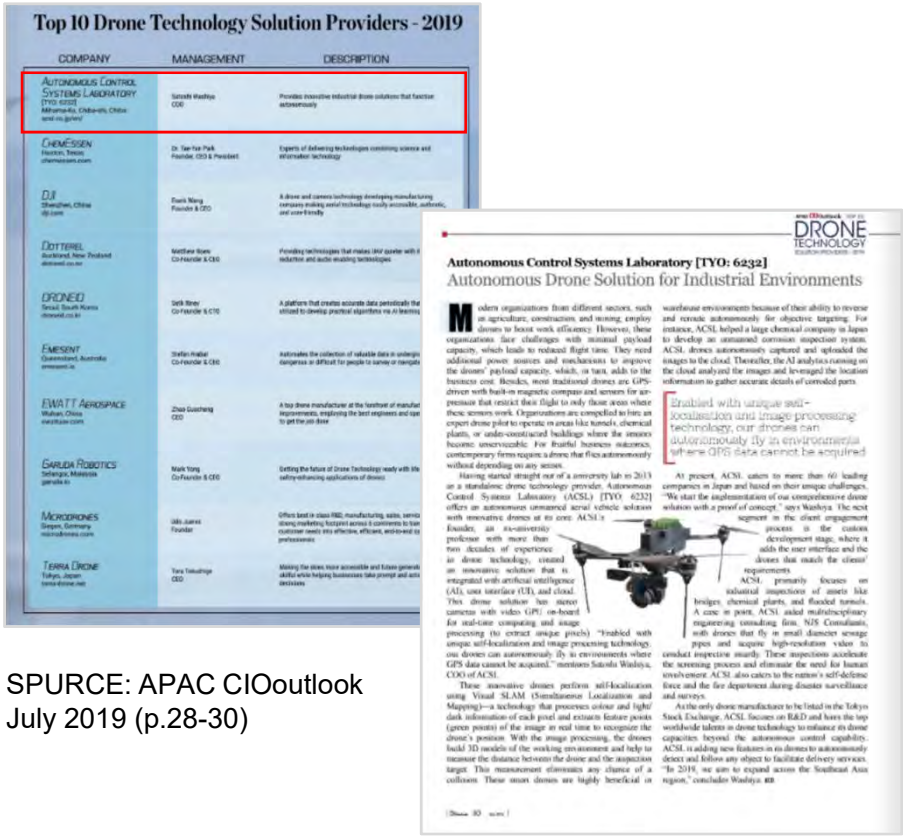
July	ACSL selected as **one of the top 10 drone technology solution provider** by APAC CIOoutlook	APAC CIOOutlook
	Demonstrated a **two-route simultaneous assistant-free flight** using drones in cooperation with **ANA Holdings, NTT DoCoMo, and Fukuoka City.**	ANA
August	**Invested US $ 2.8 million in AutoModality**. Aiming for autonomous flight in a **more advanced and complex non-GPS environment** by incorporating AutoModality's technology	AutoModality
	Established a **logistics network using drones between remote islands**, and participated in the demonstration of logistics by drones for the residents of remote islands	ANA
September	Collaborated with **JSR and Accenture** on the development of a system that automatically evaluate the corrosion level of plant equipment with **drone aerial photography and AI image recognition technology**	JSR accenture
	ACSL Ranks 9th in Japan Fast Technology Fast50	50 Technology Fast 50 2019 Japan WINNER Deloitte.
October	Transported daily necessities and health supplements **with drone in isolated area after typhoon**	

Selected in Drone Ranking by APAC CIOoutlook

Selected as a top 10 drone technology solution provider in 2019 by foreign technical media APAC CIOoutlook

Evaluated innovative autonomous drone

- APAC CIOoutlook is a magazine that provides a platform for sharing information, knowledge, and experiences to CIOs, CTOs, IT management, and corporate decision makers in APAC countries.
- Along with China DJI and nine other companies, ACSL was selected as a top 10 drone technology solution provider
- The reason is that drones that can fly autonomously in a non-GPS environment using Visual SLAM technology are considered innovative



Top 10 Drone Technology Solution Providers - 2019

COMPANY	MANAGEMENT	DESCRIPTION
Autonomous Control Systems Laboratory [TYO: 6232]	Satoshi Washiya, COO	Provides innovative industrial drone solutions that function autonomously
ChemEssen	Dr. Tae-Yun Park, Founder, CEO & President	Experts of delivering technologies combining science and information technology
DJI	Frank Wang, Founder & CEO	A drone and camera technology developing manufacturing company making aerial technology easily accessible, authentic, and user-friendly
Dotterel	Matthew Roos, Co-Founder & CEO	Providing technologies that makes UAV quicker with reduction and auto-enabling technologies
Droneo	Seth Shin, Co-Founder & CTO	A platform that creates accurate data periodically that utilized to develop practical algorithms via AI learning
Emesent	Stefan Hrabar, Co-Founder & CEO	Automates the collection of valuable data in underground dangerous or difficult for people to survey or navigate
EWATT Aerospace	Zhao Guocheng, CEO	A top drone manufacturer at the forefront of manufacturing improvements, employing the best engineers and capabilities to get the job done
Garuda Robotics	Mark Yong, Co-Founder & CEO	Setting the future of Drone Technology ready with life safety-enhancing applications of drones
Microdrones	Udo Juenet, Founder	Offers best in class R&D, manufacturing, sales, service, strong marketing, footprint across 5 continents to train customer needs into effective, efficient, end-to-end solutions professionals
Terra Drone	Yuta Tokushige, CEO	Making the skies more accessible and future generation skilled while helping businesses take prompt and accurate decisions

SPURCE: APAC CIOoutlook July 2019 (p.28-30)

DRONE TECHNOLOGY

Autonomous Control Systems Laboratory [TYO: 6232]

Autonomous Drone Solution for Industrial Environments

Modern organizations from different sectors, such as agriculture, construction, and mining employ drones to boost work efficiency. However, these organizations face challenges with minimal payload capacity, which leads to reduced flight time. They need additional power sources and mechanisms to improve the drones' payload capacity, which, in turn, adds to the business cost. Besides, most traditional drones are GPS-driven with built-in magnetic compass and sensors for air-pressure that restrict their flight to only those areas where these sensors work. Organizations are compelled to hire an expert drone pilot to operate in areas like tunnels, chemical plants, or under-constructed buildings where the sensors become unserviceable. For fruitful business outcomes, contemporary firms require a drone that flies autonomously without depending on any sensor.

Having started straight out of a university lab in 2013 as a standalone drone technology provider, Autonomous Control Systems Laboratory (ACSL) [TYO: 6232] offers an autonomous unmanned aerial vehicle solution with innovative drones at its core. ACSL's founder, an ex-university professor with more than two decades of experience in drone technology, created an innovative solution that is integrated with artificial intelligence (AI), user interface (UI), and cloud. This drone solution has stereo cameras with video GPU on-board for real-time computing and image processing (to extract unique pixels). "Enabled with unique self-localization and image processing technology, our drones can autonomously fly in environments where GPS data cannot be acquired," mentions Satoshi Washiya, COO of ACSL.

These innovative drones perform self-localization using Visual SLAM (Simultaneous Localization and Mapping)—a technology that processes colour and light/dark information of each pixel and extracts feature points (green points) of the image in real time to recognize the drone's position. With the image processing, the drones build 3D models of the working environment and help to measure the distance between the drone and the inspection target. This measurement eliminates any chance of a collision. These smart drones are highly beneficial in warehouse environments because of their ability to reverse and execute autonomously for objective targeting. For instance, ACSL helped a large chemical company in Japan to develop an unmanned corrosion inspection system. ACSL drones autonomously captured and uploaded the images to the cloud. Thereafter, the AI analytics running on the cloud analyzed the images and leveraged the location information to gather accurate details of corroded parts.

> Enabled with unique self-localization and image processing technology, our drones can autonomously fly in environments where GPS data cannot be acquired

At present, ACSL caters to more than 60 leading companies in Japan and based on their unique challenges. "We start the implementation of our comprehensive drone solution with a proof of concept," says Washiya. The next segment in the client engagement process is the custom development stage, where it adds the user interface and the drones that match the clients' requirements.

ACSL primarily focuses on industrial inspections of assets like bridges, chemical plants, and flooded tunnels. A case in point, ACSL aided multidisciplinary engineering consulting firm, NJS Consultants, with drones that fly in small diameter sewage pipes and acquire high-resolution video to conduct inspection smartly. These inspections accelerate the screening process and eliminate the need for human involvement. ACSL also caters to the nation's self-defense force and the fire department during disaster surveillance and surveys.

As the only drone manufacturer to be listed in the Tokyo Stock Exchange, ACSL focuses on R&D and hires the top worldwide talents in drone technology to enhance its drone capacities beyond the autonomous control capabilities. ACSL is adding new features in its drones to autonomously detect and follow any object to facilitate delivery services. "In 2019, we aim to expand across the Southeast Asia region," concludes Washiya.

Invested in AutoModality in US

Aiming for autonomous flight in a more advanced and complex non-GPS environments by incorporating AutoModality's technology

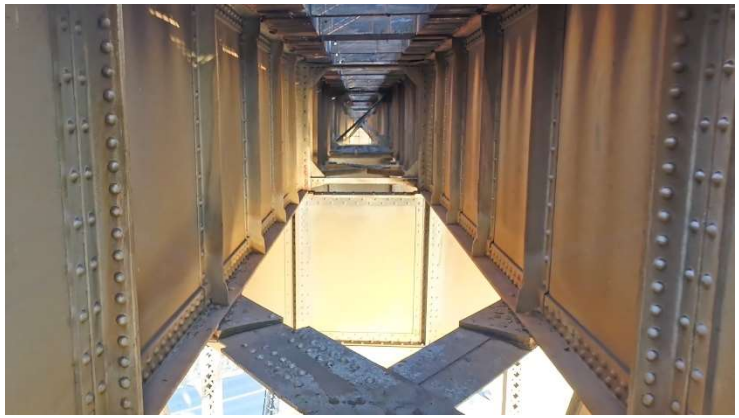
About Perceptive Navigation

- Self-localization technology focusing on object recognition using remote sensing technology (LiDAR)
- Able to operate in open spaces such as bridge inspections and increasing the accuracy of drone self-position estimation by recognizing the relative position to the object.

About AutoModality

- Conducts R&D and sales of flight software for drone with headquarters in New York and a development base in California
- In the past, won various awards in US and won business competitions

Carry out inspections of steel bridges
(Provided by AutoModality)



Accurate flight with Perceptive Navigation
(Provided by AutoModality)

Potential Synergies with AutoModality

Incorporating “Perceptive Navigation” into ACSL control technology to realize technology synergies and possible future entry into US market

	ACSL	AutoModality	Synergy
Technology	■ Self-localization technology for relative coordinate system in the entire flight environment using image processing (Visual SLAM) ■ Autonomous flight technology (cerebellum) with proprietary control algorithms ■ Peripheral technologies such as inspection camera, cloud, analysis AI	■ Self-localization technology of relative coordinate system centering on the approaching object using LiDAR (Perceptive Navigation) ■ Off-the-shelf Chinese flight controller (cerebellum) ■ Off-the shelf Chinese products	
System	■ NVIDIA TX2 (cerebrum) ■ Proprietary flight controller (cerebellum) ■ Proprietary drone body	■ NVIDIA TX2 (cerebrum) ■ Off-the-shelf Chinese flight controller (cerebellum) ■ Off-the-shelf Chinese drone body	

Demonstration of Unmanned Logistics for Remote Islands

Provided aircraft and operational support in demonstration of unmanned logistics between remote islands, conducted by ANA and Goto City

ANA　五島市 GOTO CITY

共同リリース

2019年8月29日
五島市
ANA ホールディングス株式会社

ドローンによる長崎県五島市の離島間無人物流の実証を行います

～五島市ドローン i-Land プロジェクト離島間無人物流実証事業に ANA ホールディングスを採択～

ANA ホールディングス株式会社（本社：東京都港区、代表取締役社長：片野坂 真哉、以下「ANAHD」）と五島市（市長：野口 市太郎）は、株式会社自律制御システム研究所（本社：千葉県千葉市、代表取締役社長：太田 裕朗、以下「ACSL」）、株式会社 NTT ドコモ（本社：東京都千代田区、代表取締役社長：吉澤 和弘、以下「ドコモ」）、株式会社プロダクションナップ（本社：長崎県長崎市、代表取締役社長：仁田 豊文、以下「NAP」）と協力し、長崎県五島市における有人島間にドローンを用いた物流網を構築し、二次離島地域住民の生活利便性を向上することを目指したドローンによる物流の実証を行います。今後、五島市無人物流協議会（仮称）を設立し、地域住民、域内の小売業者、医療事業者等と連携体制を構築し、今年度内に合計 20 日間の実証実験を行います。

なお、五島市は、内閣府地方創生推進交付金事業 令和元年度ドローン i-Land プロジェクト 離島間無人物流実証事業の委託事業者として、ANAHD を採択しました。

◆各社の主な役割

ANAHD:	ドローンの運航管理 （本事業の受託事業者）、協議会事務局
ACSL:	機体の提供および運航サポート
ドコモ:	ドローンの上空飛行に係る LTE ネットワークの提供、および docomo sky™(ドコモ スカイ)の運航支援基盤による上空の電波状況を考慮した運航計画の策定支援 ※「docomo sky」は、株式会社 NTT ドコモの商標です。
NAP:	運航サポート
五島市:	本事業の発注者。検証対象となる地域及び関係者との調整等

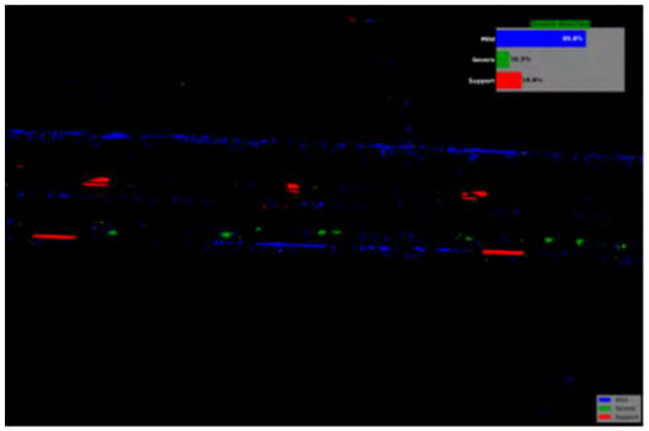
SOURCE: ANAHD

Corrosion Evaluation System with JSR and Accenture

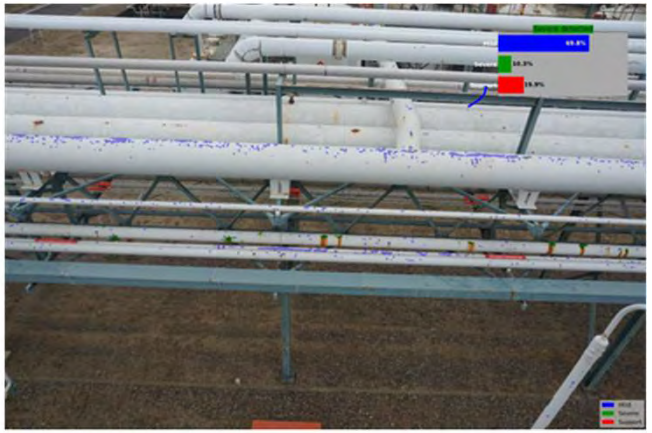
Developed a system that automatically evaluates severity of corrosion of plant equipment using drones and image recognition AI

Corrosion level determination system

- Collaboration with JSR: “AI System Joint Development & Support Project”
- Based on the results of demonstrations and experiments at the JSR Kashima Factory, ACSL developed an autonomous drone that can fly even in non-GPS environments, and a mechanism that links aerial image data and the actual component
- In addition, with Accenture, ACSL developed an integrated AI application platform that enables analysis of images and data to determine the precise location of corrosion.



Corrosion evaluation image



Overlay of photographed image and corrosion evaluation image

ACSL Ranks 9th in Japan Fast Technology Fast50

Recorded a sales growth rate of 415% and won 9th place at Deloitte Touche Tohmatsu Limited 2019 Japan Technology Fast 50

Won 9th place with high growth rate

- Japan Technology FAST50 is a ranking of growth based on revenue from the technology, media, and telecommunications industry conducted by Deloitte Tohmatsu Group
- ACSL recorded a growth rate of 415% based on sales for the past 3 fiscal years and won the 9th place out of 50
- Awarded as the only company in the hardware domain among companies ranked in the top 10

ACSL

50 Technology Fast 50 2019 Japan WINNER Deloitte.

2019 年 10 月 21 日

各位

ACSL テクノロジー企業成長率ランキング
「2019 年 日本テクノロジー Fast 50」で 9 位を受賞
－415%の収益(売上高)成長を記録 －

株式会社自律制御システム研究所(千葉県千葉市、代表取締役社長：太田 裕朗、以下 ACSL)は、デロイト トーマツ グループが発表したテクノロジー・メディア・テレコミュニケーション(以下、TMT)業界の収益(売上高)に基づく成長率のランキング、「デロイト トウシュ トーマツ リミテッド 2019 年 日本テクノロジー Fast 50」において、過去 3 決算期の収益(売上高)に基づく成長率 415%を記録し、50 位中 9 位を受賞いたしました(http://www.deloitte.com/jp/fast50/2019)。

日本テクノロジー Fast 50 は、デロイト トウシュ トーマツ リミテッドが世界約 40 カ国および北米・欧州・アジア太平洋地域の 3 地域ごとに実施しているランキングプログラムの日本版です。TMT 業界での成長性や成功のベンチマークであり、今回で 17 回目の開催です。上場・未上場企業を問わず TMT 業界に含まれる企業からの応募をもとに、過去 3 決算期の収益(売上高)成長率の上位 50 社がランキングされます。
プログラムの詳細は、http://www.deloitte.com/jp/fast50 をご覧ください。

【受賞要因】
当社の収益(売上高)成長率 415%を達成した要因として、以下の点が挙げられます。
- 世界的にも稀有な非 GPS 自律制御技術、システム開発能力、機体カスタム力等を武器として、PoC(概念検証)からソフトウェア/ハードウェアの設計、開発、製造(ファブレス)、保守・メンテナンスまで、ドローンを用いた業務効率化ソリューションをワンストップで提供
- 点検、物流・郵便、防災・災害支援分野を中心に、現状のオペレーションの維持及び効率化を目的とした業務の効率化・無人化は各産業において喫緊の課題。ACSL は大手企業を中心として、これまで多くの特注ドローンの開発実績があり、既存・新規顧客においてドローンの試用及び実運用への導入が加速

【ACSL について】
産業分野における既存業務の省人化・無人化を実現すべく、ドローンを中心に AI やクラウド、エッジコンピューティングを含めた無人化システムの開発を進めています。特に、画像処理・AI のエッジコンピューティング技術を搭載した最先端の自律制御技術を提供しており、既にインフラ点検や郵便・物流、防災などの分野で採用されています。

Transportation of Goods by Drone to Isolated Area

Used drones to transport daily necessities and medical supplies to an area that was isolated by typhoon damage to surrounding infrastructure

Governor Koike receiving explanation in front of drone

Emergency supplies transport

- Used drones to transport daily necessities and medical supplies to 70 people in 40 isolated households
- ACSL provided drone aircraft, and ANA Holdings and NTT DoCoMo assisted flight operations flight
- The drone flew beyond visual line-of-sight (Level 3) for 2.5 km and 5 minutes using LTE communication.
- While a normal flight requires prior application to the government, this flight was performed under special permission, as granted under Japanese regulations for disaster response

Featured on CNN as an Innovative Company

ACSL was featured on “Innovate Japan” as a innovative company aiming to tackle disaster recovery missions

SOURCE: CNN
URL:
https://app.frame.io/presentations/0d5a9244-ba06-4f47-8a34-bcc3aaaec6a3?fbclid=IwAR2uaC4Q6DgKL8jhRar43YWIpewwo_n7AshCWb8ccMwdzfHg1ZdtNOxlFwc

Agenda

1. FY20/03 Q2 Financial Results
2. Business Highlights
3. Appendix
4. Company Introduction

Balance sheet

[MM JPY]

	FY20/03 Q2		FY19/03 Q2	FY19/03 Q4
	Actual	YoY	Actual	Actual
Current Assets	4,375	+118%	2,010	4,858
Cash	4,063	+127%	1,792	4,465
Fixed Assets	377	+569%	56	68
Total Assets	4,752	+130%	2,066	4,926
Current Liability	85	▲35%	131	225
Fixed Liability	0	-	0	0
Total Liability	85	▲35%	131	225
Net Asset	4,666	+141%	1,935	4,701
Total Asset	4,752	+130%	2,066	4,926

Forecast FY2020/03

Continued high sales growth ratio. FY20/03 sales is expected to be 1,418 MM JPY. Operating profit is expected to be 9 MM JPY.

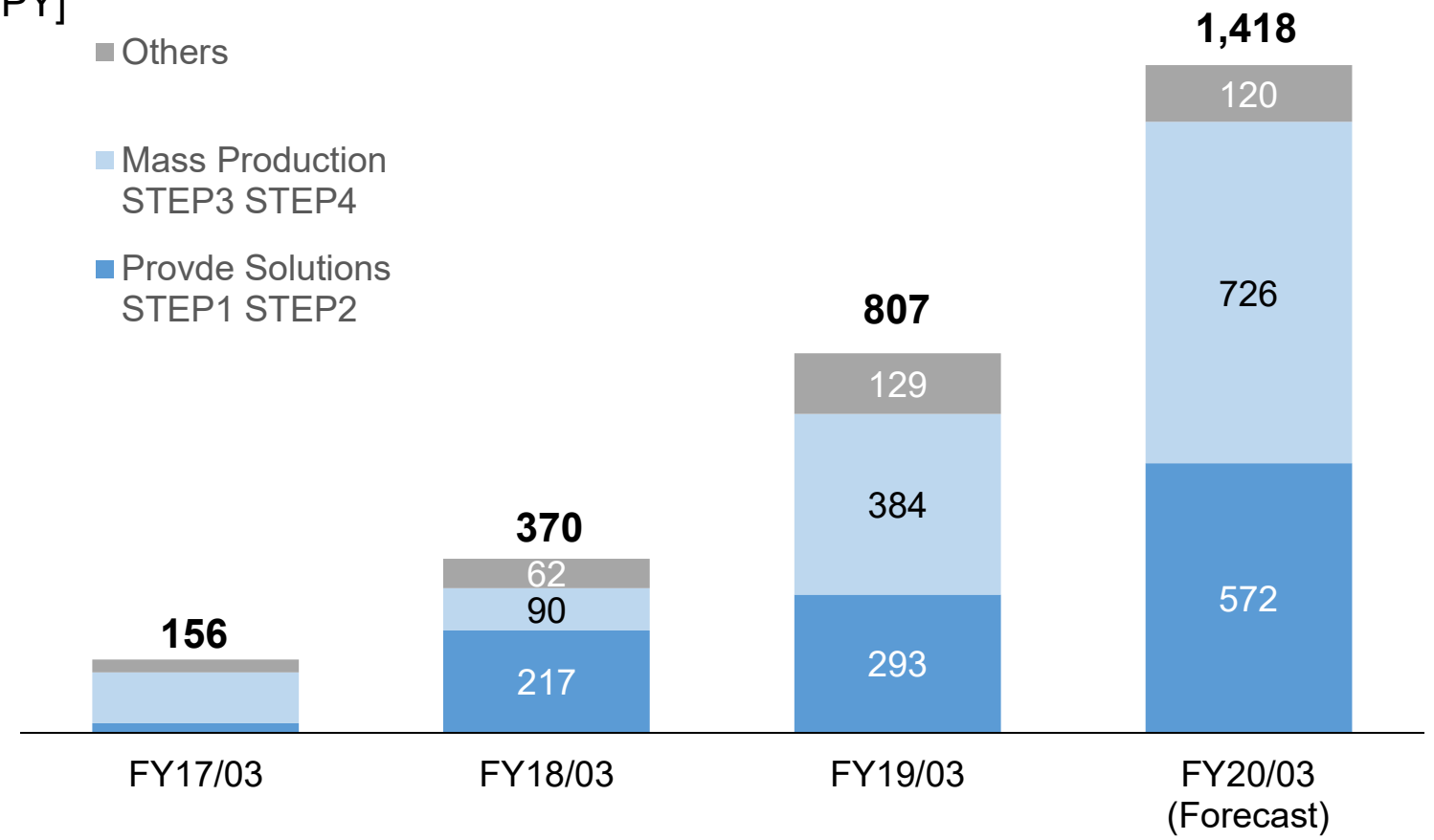
[MM JPY]

	FY 2020/03 Annual		FY2019/03 Annual
	Forecast	YoY	Actual
Sales	1,418	76%	807
Gross Profit	850	111%	403
Gross Ratio	60.0%	+10.0 pt	50.0%
Operating Profit	9	Turn Positive	▲330
Ordinal Profit	187	Turn Positive	▲176
Net Profit	119	Turn Positive	▲183

Sales Forecast

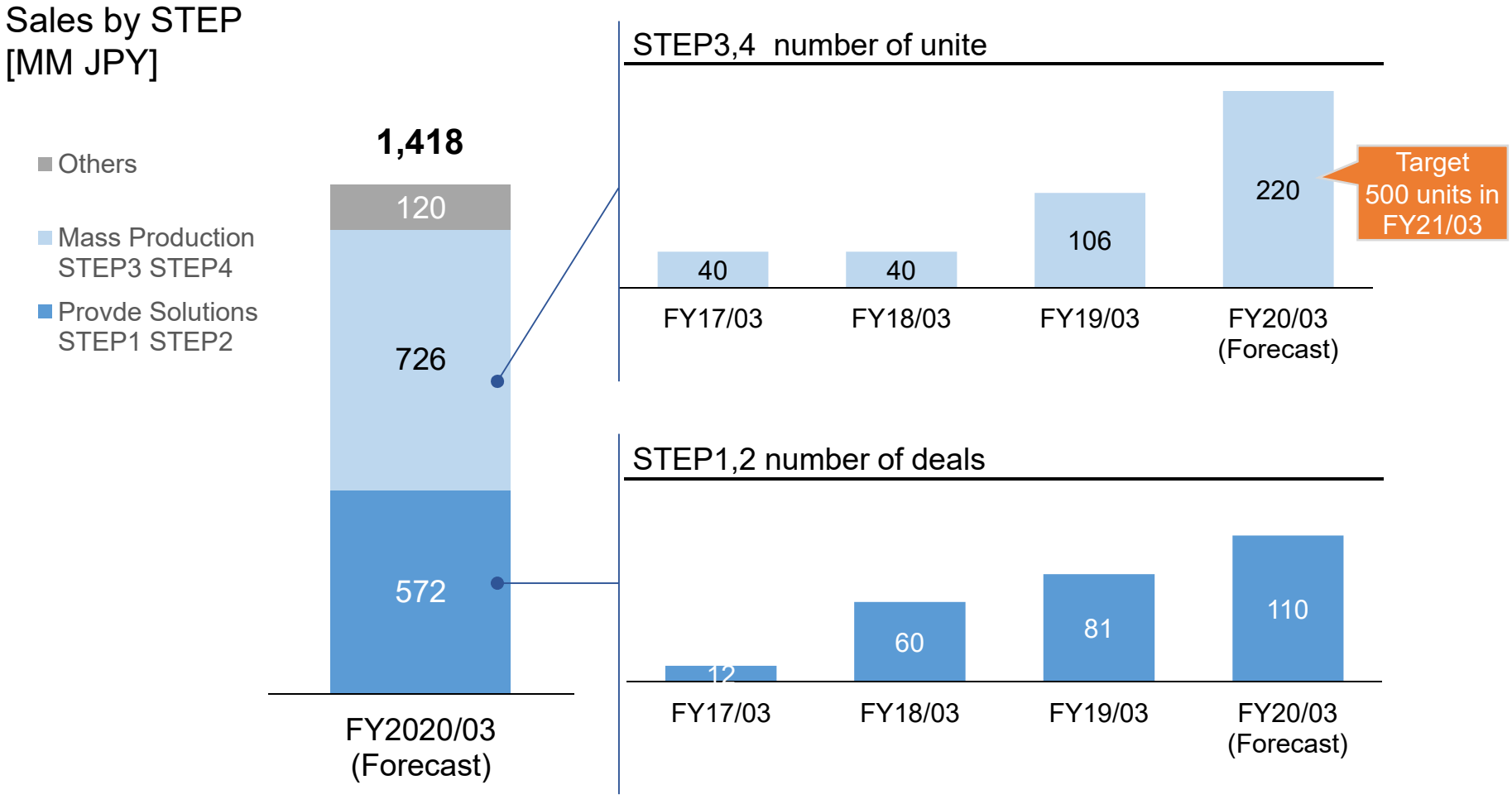
Expected to grow through customer based expansion and transitioning current customers to the mass production phase

Sales by STEP
[MM JPY]



KPI by STEP

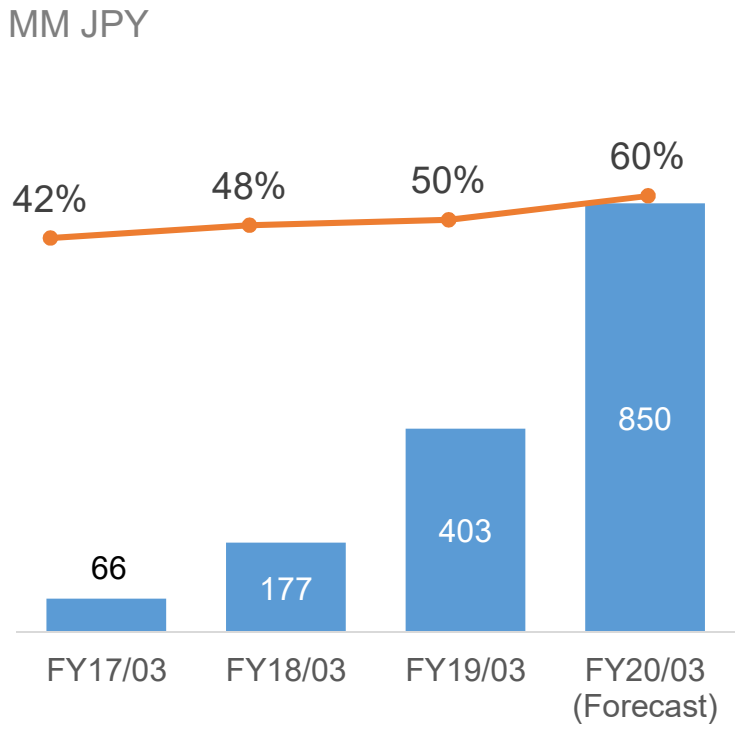
In FY 20/03, the KPI targets 110 solution deals, and 220 unit sales



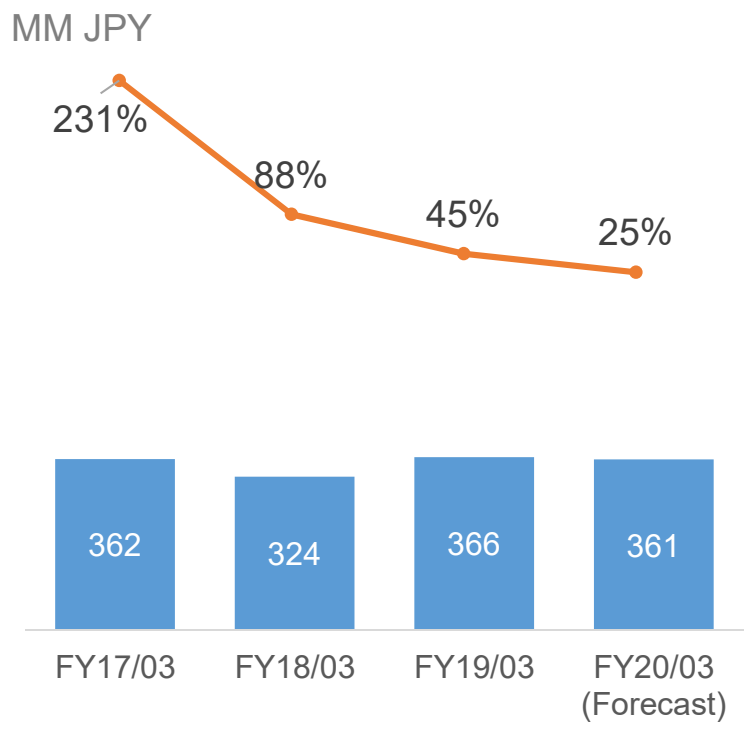
Gross Profit and R&D Expenditure

Gross profit is expected to improve due to sales expansion. R&D investment is expected to be kept in the same volume

Gross Profit and Gross Margin

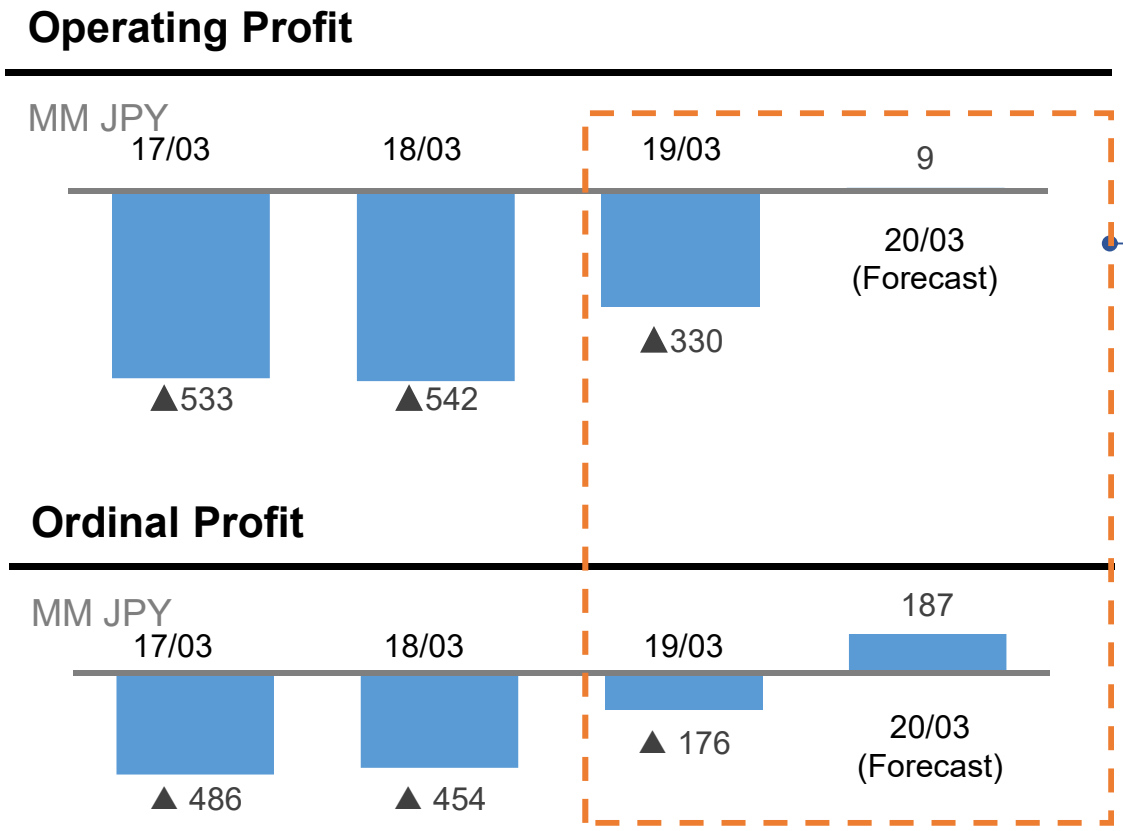


R&D Expenditure to Sales Ratio



Profit forecast

An operating profit is expected to be posted in FY2020/03. Ordinary profit is expected to be 187 with subsidies from national projects



- Expenditure for national projects is counted under R&D
- Subsidies for projects is count as non-operating income in the following fiscal year
- About 150MM JPY is counted in FY19/03 as subsidy for projects completed in FY18/03
- About 180MM JPY is expected in FY20/03 as subsidy for projects completed in FY19/03

Agenda

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About ACSL

- **Name** Autonomous Control Systems Laboratory Ltd.
- **Office** WBG Marive West 32F, 2-6-1 Nakase, Mihama-ku, Chiba-city, Chiba
- **Established** 2013 November
- **Capital** 2,963 MM JPY
- **#of Employee** 47（As of 2019 September）
- **Business** Manufacturing and providing industrial drone and providing solution service for automation with autonomous technology

Management team

President **Dr. Hiroaki Ohta**

Ph.D. from Kyoto University. Assistant professor at Department of Aeronautics and Astronautics, Kyoto University, followed by research scientists at University of California, Santa Barbara. Also served as Technical Advisor for a start-up in Silicon Valley. McKinsey & Company from 2010. Joined ACSL as COO from July 2016 and became President from March 2018.

COO **Satoshi Washiya**

M.S. of Architecture from Waseda University. Served both domestic and multinational companies in corporate wide transformation projects at Tokyo and Stockholm office of McKinsey & Company. Joined ACSL in July 2016.

CFO/CAO **Kensuke Hayakawa**

M.S. of Management of Technology from Tokyo institute of technology. Implemented operational improvement/transformation of Portfolio companies at KKR Capstone. Joined ACSL as CFO in March 2017.

CTO **Dr. Chris Raabe**

Ph.D. from University of Tokyo. Embedded software engineer at Boeing from 2006. Assistant professor at Department of Aeronautics and Astronautics, University of Tokyo from 2014. Joined ACSL as CTO in April 2017.

External Director	Masanori Sugiyama
External Director	Shinichi Suzukawa

Audit & Supervisory member	Akira Ninomiya
Audit & Supervisory member	Hideki Shimada
Audit & Supervisory member	Takeshi Ohnogi

Mission, Corporate value

Mission

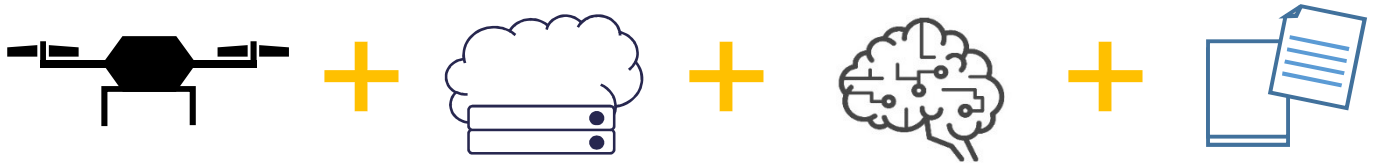
Liberate Humanity through Technology

Corporate value

Pursue world-class autonomous technology and accomplish social implementation, to automate and unman human tasks and promote evolution of humanity

Business overview

Unmanned IoT platform for industrial applications using drones



Why autonomy – ACSL realizes unmanned IoT systems

ACSL provides an integrated, autonomous, unmanned IoT drone systems to supplement human labor in inspection, delivery, disaster and surveys

Today

Chemical plants

Inspection workflow

Taking photos → Filing → Analysis → Reporting

Current Drones (Others)

"Consumer drones"

Limited impact as **standalone drones** only compensate part of current workflow

\+ **Same as today**

ACSL

ACSL

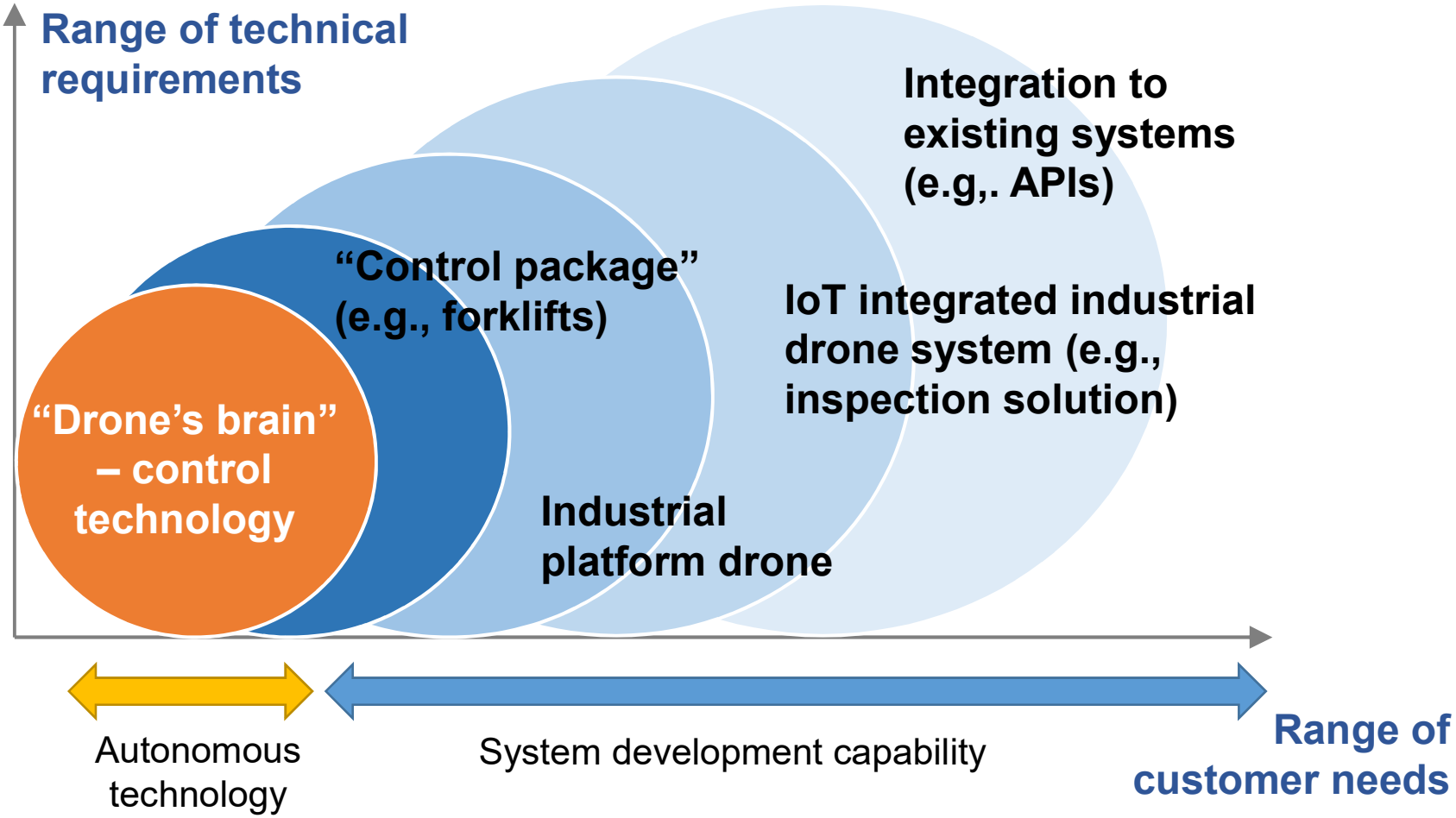
Industrial drone systems

Provide an end-to-end integrated drone systems to fully automate current workflow

Drones +  Cloud +  AI +  UI

Core technology – Drone's brain and system development

Propriety "drone's brain" – environmental recognition and controls – enables ACSL to meet a wide range of customer demands



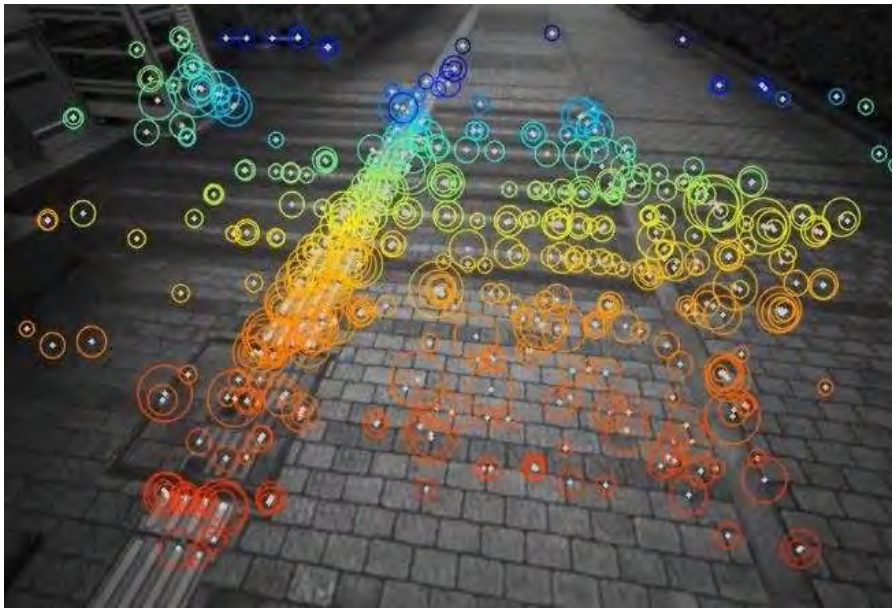
Core technology – Cutting edge non-GPS based controls

Image processing based localization and mapping (i.e., Visual SLAM) enables drones to fly in GPS-denied environment

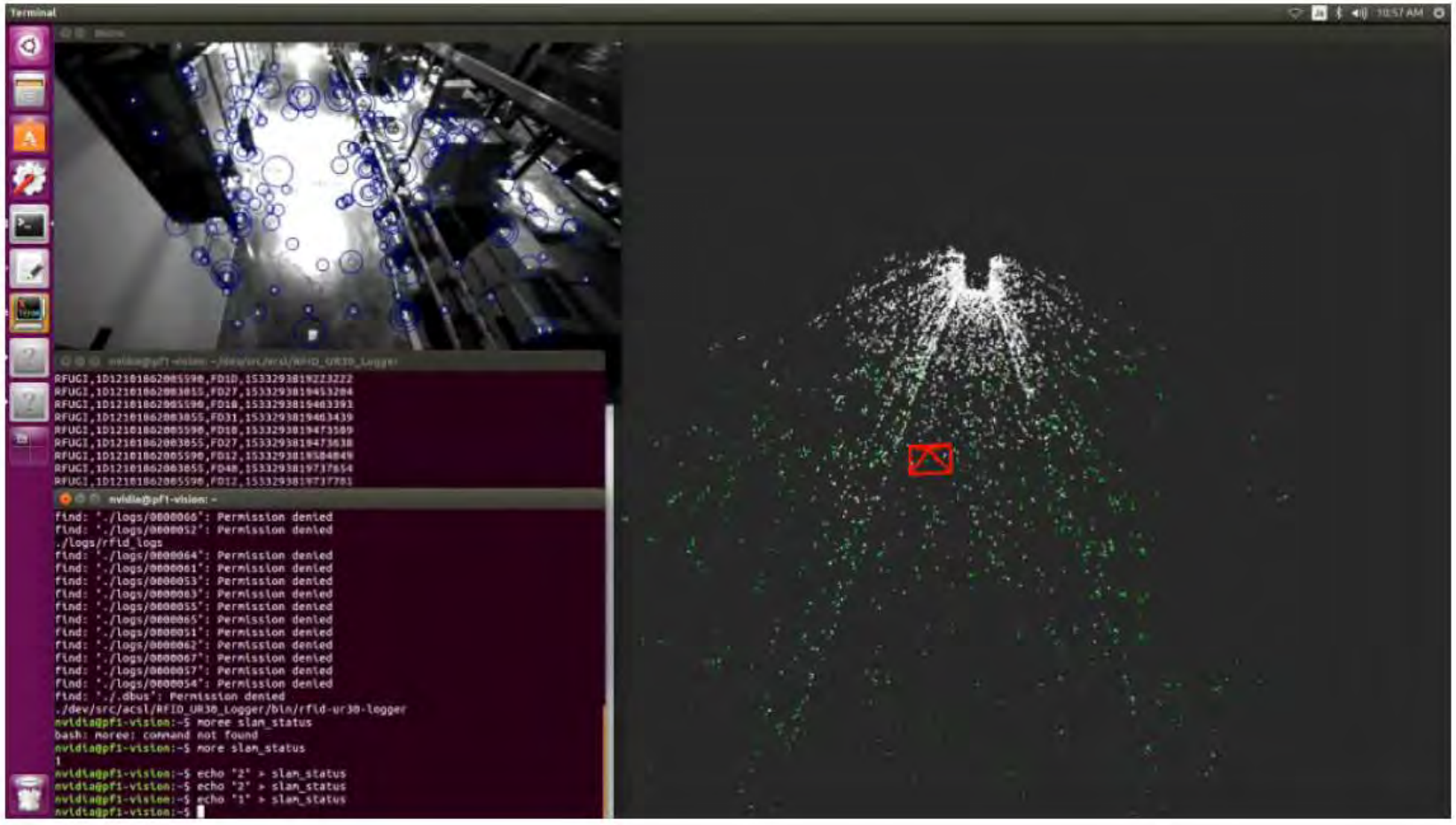
Visual SLAM does not use air pressure sensor, magnetic compass or GPS/GNSS for autonomous flight

Visual SLAM cameras

Extraction of feature points



Core technology – GPS-denied flight for inventory management



Core technology – Customization capability

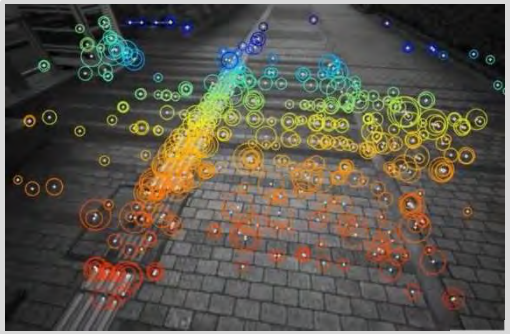
Realize custom response by adding options based on drone for various needs such as delivery, inspection, surveying, etc.

4-eye high-speed camera for measurement surveying

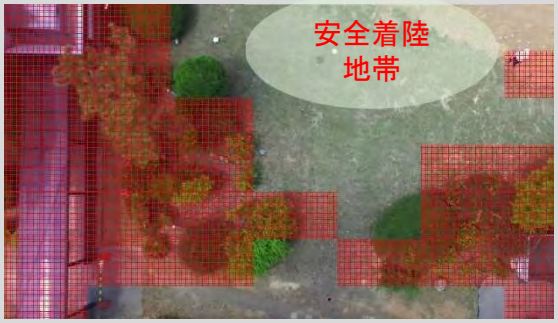
Catcher that automatically opens and closes for delivery

Core technology – Edge computing

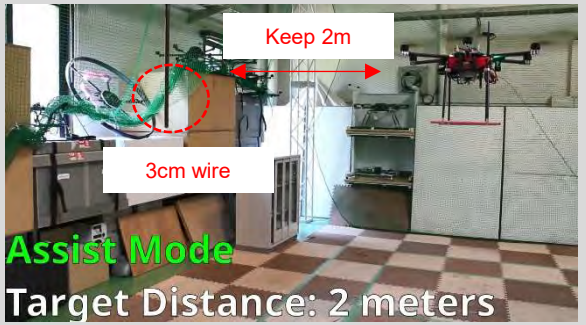
NVIDIA’s embedded PC module Jetson TX2 is installed. Realizing highly reliable processing in real time with software that meets various needs



Visual SLAM

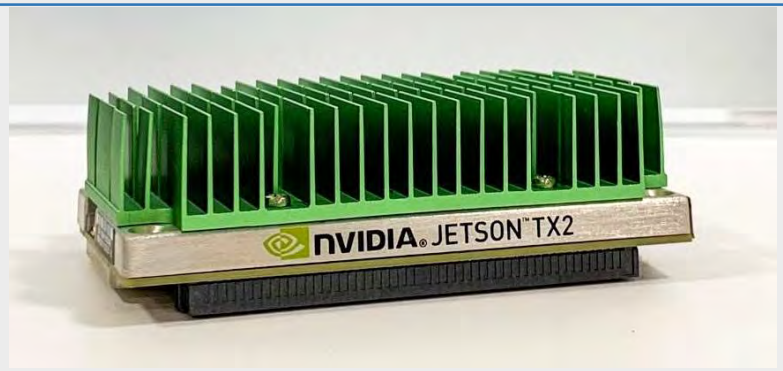


AI detecting safe landing spot



Distance control

Software is installed in embedded PC module mounted on drone

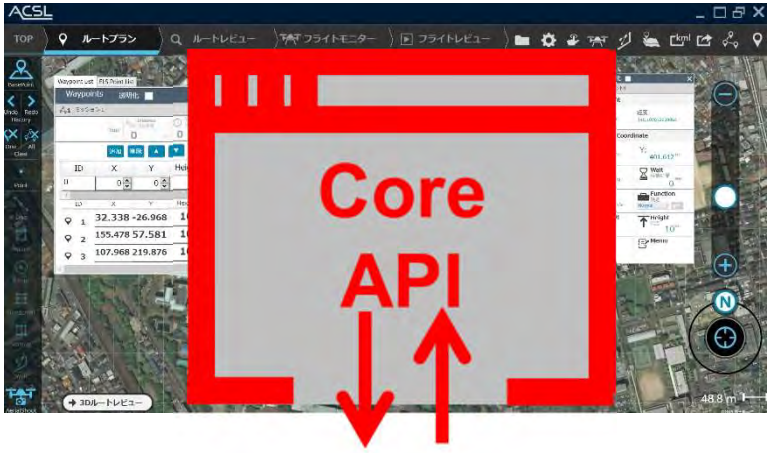


- ✓ Real-time and reliable data processing by edge computing
- ✓ Differentiate flight performance with image processing and AI
- ✓ Add safety features such as collision avoidance in combination with stereo cameras and LiDAR

Core technology – Embed system (Core API)

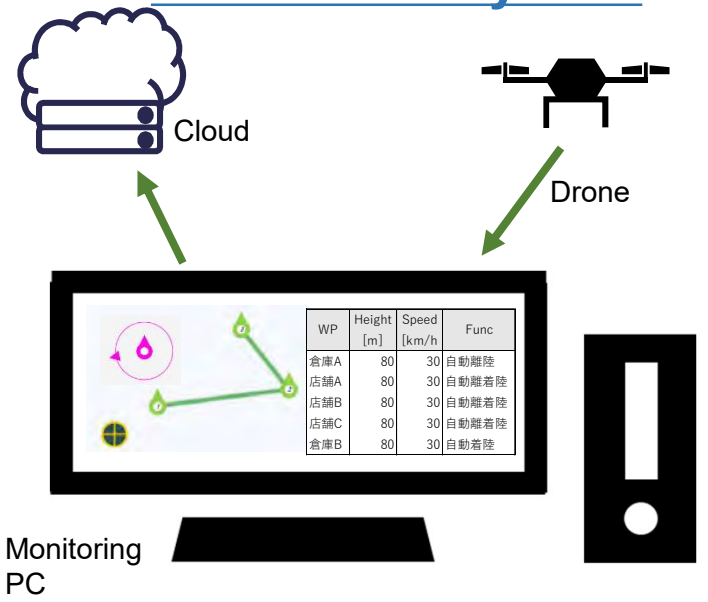
By opening APIs of in-house ground control stations, drone operation functions can be installed and extended to customer's systems

Core API



- ✓ API to communicate with ACSL drone
- ✓ Ground control station functions required for flight operations such as route plan creation and flight monitoring

Customer's system



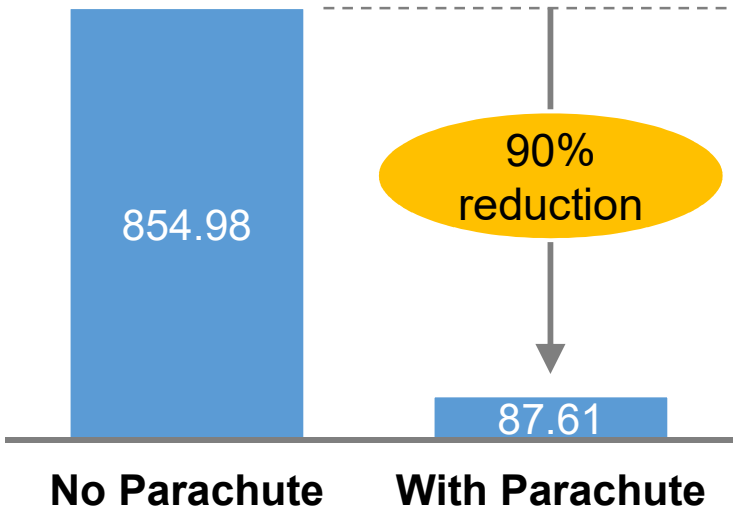
- ✓ Optimize integration with customer's operations in system
- ✓ For example, integration into dedicated systems such as equipment inspection, logistics, and disasters

Core technology – Customized parachute for safety

ACSL provides customized parachutes to reduce 90% of falling energy, closely integrated to controls for autonomous performance

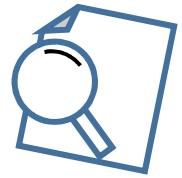
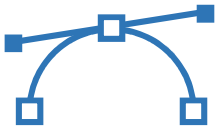
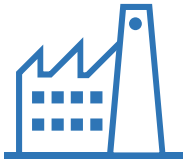
Parachute

Falling energy [J](*1)



*1: Physical energy of 8kg drone dropped from 150m height

Growth model – Step-wise Proof-of-Concept approach

STEP 1 Proof of Concept	STEP 2 Custom development	STEP 3 / STEP 4 Mass production
		 
Proof of Concept (Detail out drone usage) • Verification of concept for drone usage is feasible or not • Closed trials • Use of ACSL platform drones	**Custom development** (Design and develop entire system) • Detail test designs • Development of customized drones and systems • Testing at low risk environment	**Deployment for commercial usage** (Sales of mass production model) • Supply improved customized drones and systems • Piloting or commercial use at actual sites by clients

✓ **Lower entry barrier for clients and verify economic impact through PoCs**

✓ **Enhance relationship and continuity with clients supported by customized systems**

Growth model – Example of end-to-end drone systems

Rakuten Drone

Rakuten drone “Tenku”

Rakuten promotes delivery drone systems to tackle last-one-mile issues across Japan

- Customized drone
- CoreAPI for software development

エアスライダ
Air Slider

NJS “Air Slider”

NJS rationalizes inspection of closed-loop environment (e.g, sewages) through this drone system

- Custom small drone
- Custom software designed for user-experience

MORITA

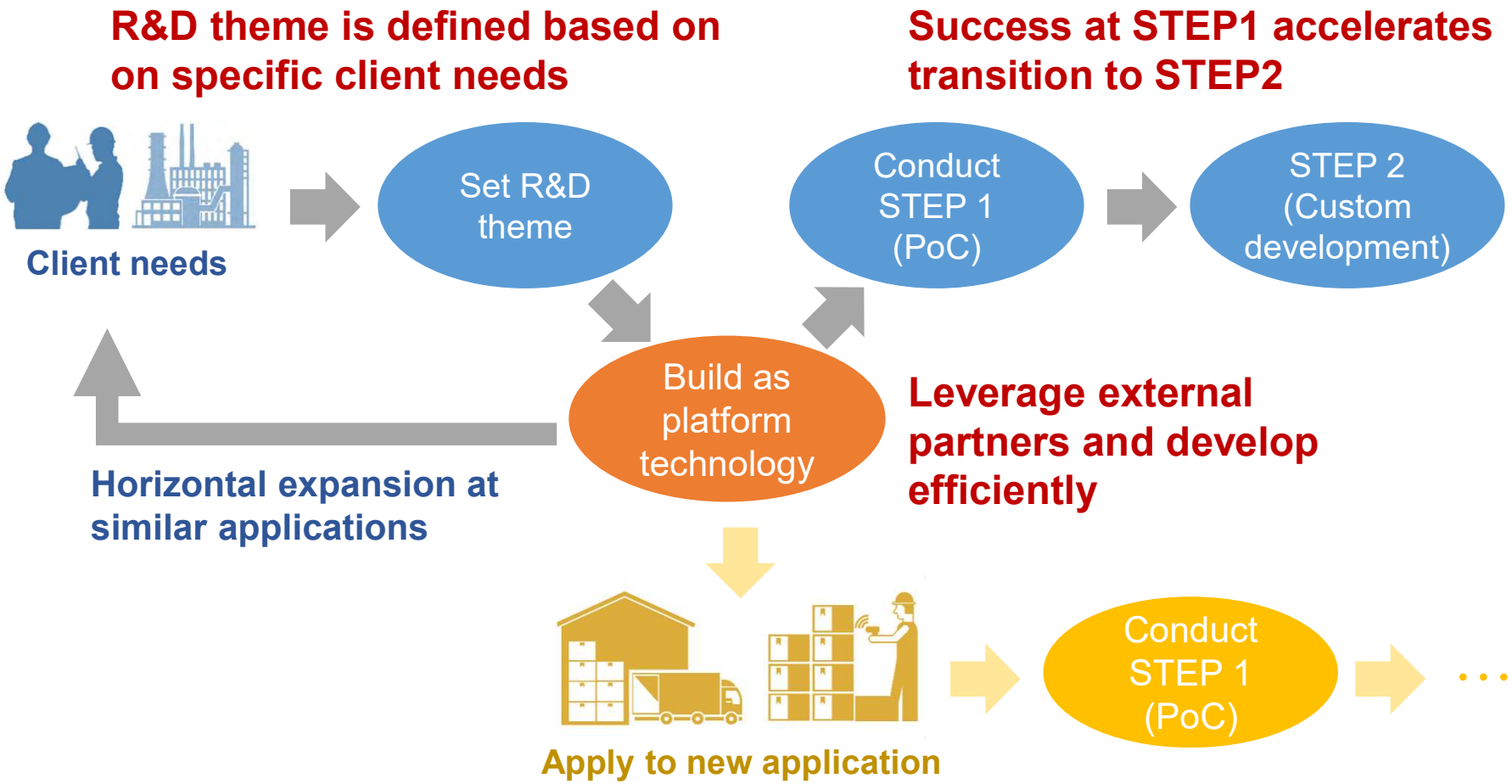
MORITA “Rei-Humming”

MORITA revolutionaries fire fighting by embedding aerial survey drone as part of the fire trucks

- Custom fire-fighter drone
- Switch between wired charging and battery

Growth model – Effective R&D cycle centering on client needs

Themes are defined based on client needs, developed as platform technology, and tested as STEP1 (PoC) for successful transition to STEP 2



Potential market - Potential market for drone applications

ACSL's main market

>1 trillion JPY

>4 billion packages

>1 trillion JPY

>10,000 contractors

>10,000 flight permits

>1.5 million farmers

Source: Inspection (MLIT; "インフラメンテナンスを取り巻く状況") Delivery (MLIT; "平成28年度 宅配便等取扱個数の調査及び集計方法")
Disaster reconnaissance (Sankei News; 2017/12/22; "公共事業では防災・老朽化対応に重点") Aerial survey (MLIT; "建設関連業 登録業者数調査")
Aerial photography (MLIT; "改正航空法の運用状況") Agriculture (MAFF; "農業労働力に関する統計")

Inspection Case – Autonomous flight at chemical plant

ACSL provides autonomous systems where drone takes images of chemical pipelines, automated analytics by AI and issue inspection report

Inspection Case – Inspection of sewage pipelines

ACSL aims to supplement current sewage pipeline screening inspection with drone systems to reduce cost from 2,000 to 800 JPY/meter

Delivery Case – Japan post started long distance delivery

Japan Post initiated 9km inter-post office flight with ACSL drones after receiving the first permit as Level 3 Flight (BVLOS in unmanned areas)

国土交通省
Ministry of Land, Infrastructure, Transport and Tourism

平成３０年１０月２６日
航　空　局 運航安全課
航空機安全課
総合政策局 物流政策課

ドローンによる荷物配送が始まります！
～効率的な荷物配送の実現に向けて～

国土交通省は、日本郵便株式会社からのドローンによる福島県小高郵便局～浪江郵便局間約 9km の荷物配送（目視外補助者無し飛行）に向けた飛行申請について、平成 30 年 10 月 26 日付けで承認しました。

ドローン等の無人航空機については、官民協議会でとりまとめられた「空の産業革命に向けたロードマップ」に沿い、本年中を目途に離島や山間部等での無人航空機による荷物配送の実現を目指し官民一体となって取り組んでいるところです。

航空局では、本年 9 月に航空法に基づく飛行の許可承認の審査要領を改正し、無人航空機が目視外飛行※1を補助者無しで行うために必要な機体性能や飛行経路下の安全対策等の要件を定めたところです。

※１　操縦者が機体を視認できない範囲を飛行させること。この場合は、原則として、飛行経路下に補助者を配置し、周辺への第三者の立入りや機体の状態等を監視させることが必要。本年９月の審査要領改正により補助者無しで行うための要件を明確化。（別紙参照）

今般、日本郵便株式会社から 10 月 15 日付けで東京航空局に対し申請のあった無人航空機による郵便局間の荷物配送に向けた目視外補助者無し飛行について、10 月 26 日付けで承認を行いました。承認の概要は下記の通りです。なお、今後本番環境にて最終的な試験飛行を行い、その結果を踏まえて運航が行われる予定です。

また、国土交通省が公募した無人航空機による荷物配送の検証実験※2 の一つとして、日本郵便株式会社も参画する郵便事業配送効率化協議会が必要なデータ等を 11 月 5 日～6 日に取得し、調査受託者の株式会社三菱総合研究所が費用対効果等の検証を行う予定です。

※２　無人航空機による荷物配送の検証実験地域、内容等の詳細はこちらでご確認いただけます。
http://www.mlit.go.jp/seisakutokatsu/freight/seisakutokatsu_freight_tk1_20180628kobo.html

記

１．運　航　者：日本郵便株式会社
２．飛行経路：福島県南相馬市 小高郵便局 ～ 双葉郡浪江町 浪江郵便局 （約 9km）
３．飛行日時：平成 30 年 10 月 29 日から１年間
４．使用機材：株式会社自律制御システム研究所製 ACSL-PF1

ACSL realized drone delivery

- Japan Post began automation of luggage delivery in Minamisoma City and Namie Town, Fukushima Prefecture from November 2018
- ACSL offers the first fully autonomous control drone that can handle “BVLOS and non-assistant flight” for the first time after the revision of the Aviation Law Guidelines
- As a result, automatic delivery of approximately 15 minutes over distances that would have taken approximately 25 minutes with conventional trucks

Drone leaving post office

Disaster Reconnaissance Case – Survey after rain disaster

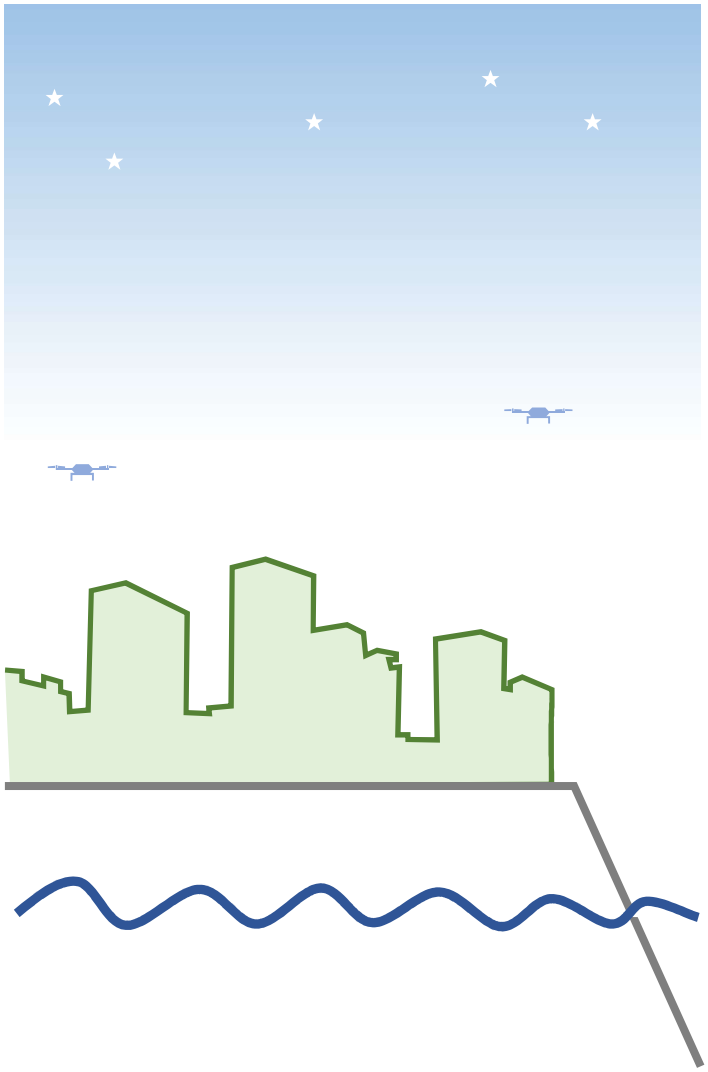
ACSL conducted large area survey of 6km distance at 50km/h flight speed on behalf of the fire department, after receiving special permit from MLIT

Disaster Reconnaissance Case – Survey after rain disaster

Quad-lens camera enabled 8 global shutters per second at 70km/h autonomous flight, realizing 2cm pixel image taken from 100m height

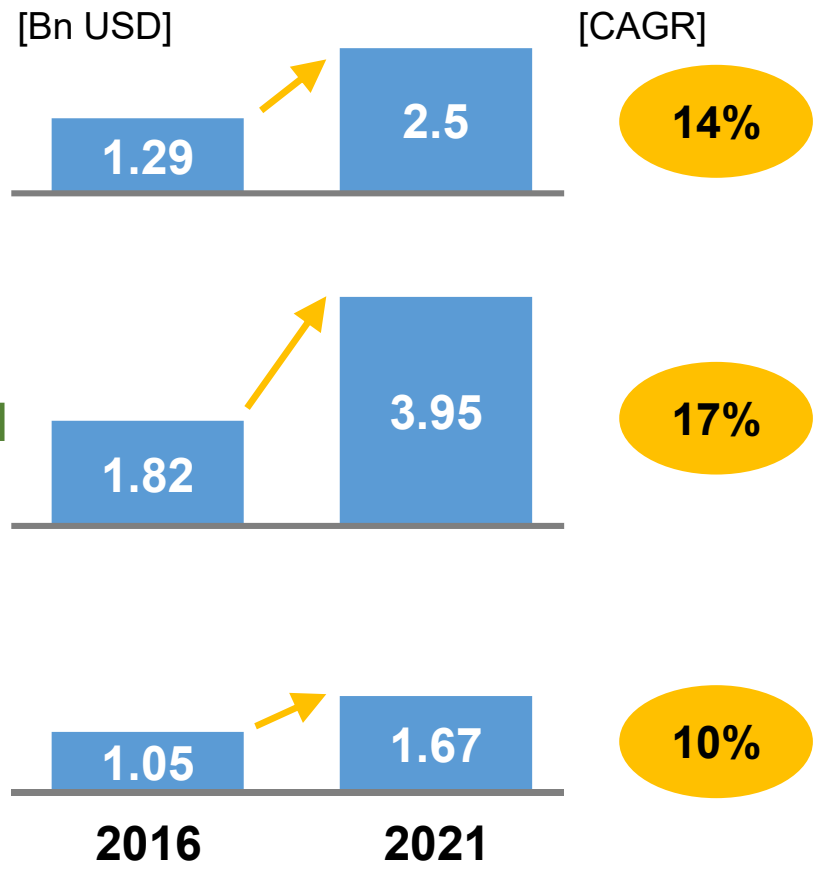
Date：2017/07/08

Potential market – Potential application to UGVs and Space



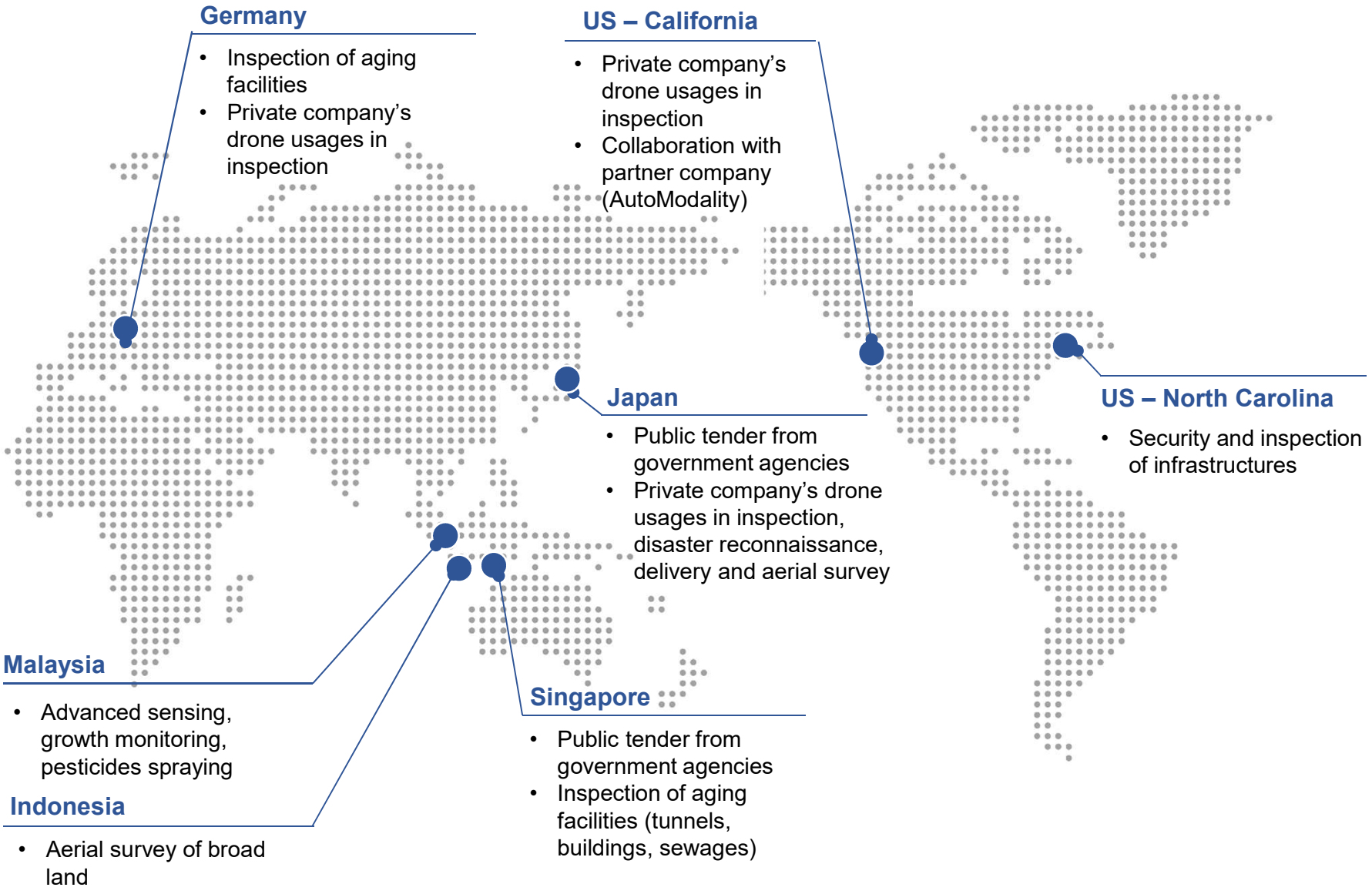
World autonomous robot market(*2)

Space High potential for robotics



*2: Source is Global Autonomous Mobile Robots Market; Technavio (Infiniti Research Limited)

Potential market – Similar demand seen overseas



Disclaimer

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