

# Aircraft, Defense & Space Business Plan

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Mitsubishi Heavy Industries, LTD

## 1. Business Overview

## 2. Commercial Aviation Systems Segment

2-1. Overview

2-2. Review of 2015 Medium-Term Business Plan

2-3. Policies and Strategies of 2018 Medium-Term Business Plan

## 3. MRJ Business

3-1. Development Status

3-2. Preparations for MRJ Production

3-3. Efforts aimed at Commercialization

3-4. MRJ Business Restructuring to Assure Long-Term Business Continuity

## 4. Integrated Defense & Space Systems Segment

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4-3. Policies and Strategies of 2018 Medium-Term Business Plan

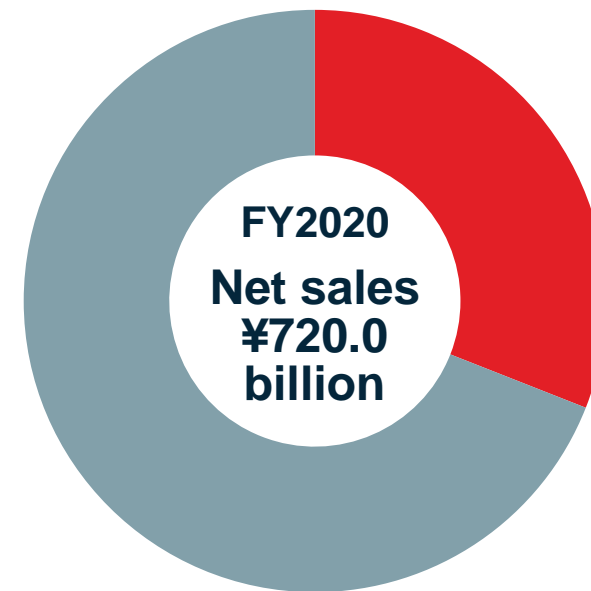
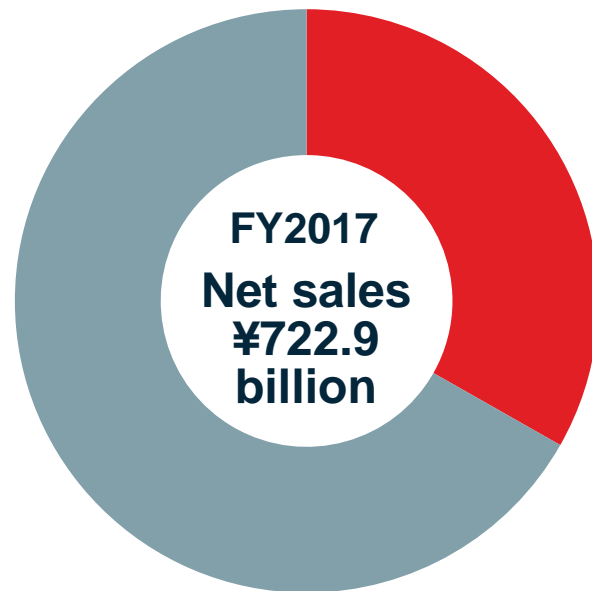
# 1. Business Overview (FY2017 Results and 2018 Business Plan)

## Integrated Defense & Space Systems

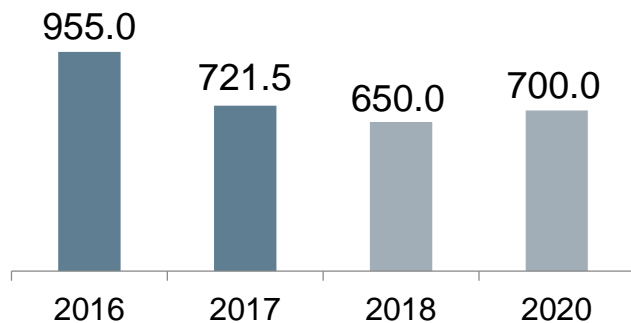
- Naval ships
- Aircraft & missile systems
- Special vehicles
- Space systems

## Commercial Aviation Systems

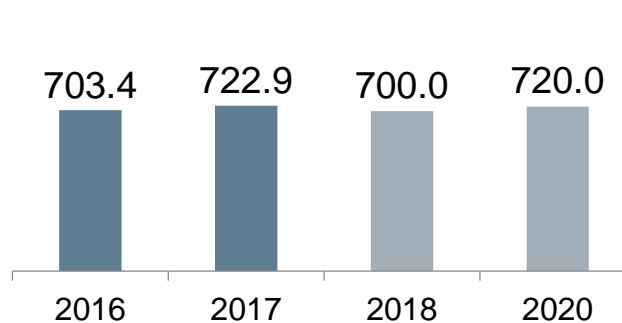
- Aircraft components for Boeing
- Aircraft components for Airbus, Bombardier, etc.
- MRJ



Orders Received

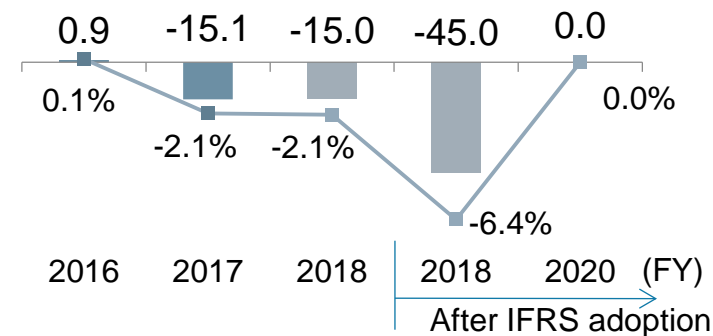


Net Sales



Operating Income / EBIT

(in billion yen)



## MHI FUTURE STREAM In step with social evolution



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# 4. Integrated Defense & Space Systems Segment

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# 2-1. Overview

## Boeing

## Wide-body jets

## Airbus

787



Photo courtesy of Boeing  
MHI: main wing boxes

777



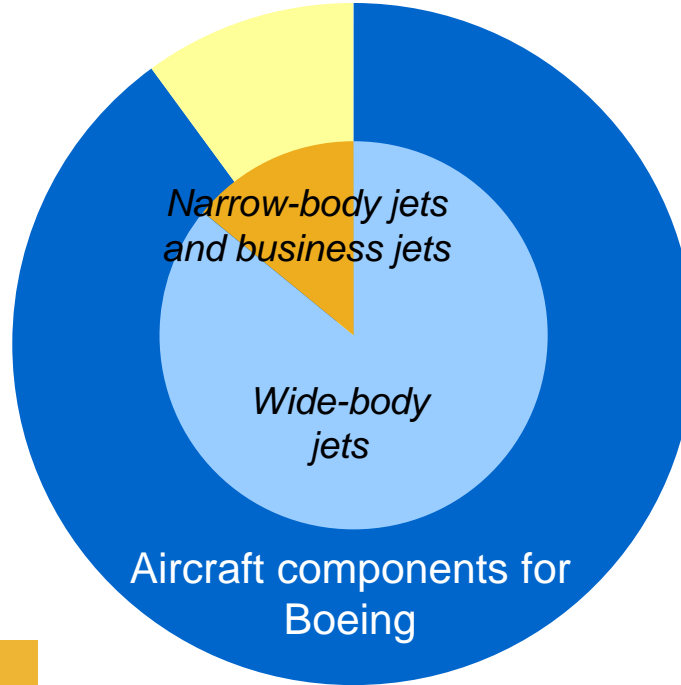
Photo courtesy of Boeing  
MHI: aft fuselage, tail fuselage and entry doors

777X



Photo courtesy of Boeing  
MHI: aft fuselage, tail fuselage and entry doors

Aircraft components for Airbus, Bombardier, etc.



737



Photo courtesy of Boeing  
MHI: inboard flaps

A380



Photo courtesy of Airbus  
MHI: fwd and aft cargo doors

## Bombardier

## Global 5000/6000



Photo courtesy of Bombardier  
MHI: main wings, center-fuselage and center wing

## Challenger 300/350



Photo courtesy of Bombardier  
MHI: main wings

## Narrow-body jets and business jets

## Summary

### ◆ Establish structures to boost production rate

- Automated production line for 777X fuselages
- Preparation for 12/14 shipsets mo. production of 787 wing-boxes
- Restructuring of SCM and reform of procurement processes for commercial aircraft  
(Establishment of “Commercial Aircraft Procurement Center” and the Matsusaka cluster)
- Introduction of new production planning/management system (ERP(Enterprise Resource Management) system)

Automated 777X assembly line



787 main wing assembly line



### ◆ Delay in adapting to changing business environment

- Launched “Business Structure Reform” activities from FY2017 (reductions in flow time and fixed costs, etc.), which resulted in upward trend profitability.

## Business Circumstances

- (1) Market expansion over next 20 years(operating fleets to be doubled)
  - Temporary production decrease through 2018 Business Plan period due to transition period from Boeing 777 to 777X
- (2) Necessity to reduce contract prices due to fierce OEM sales price competition
- (3) Intensified competition with overseas manufacturers
  - Increased performance of Machine Tools
  - Development in IoT technologies
  - Active M&A transactions and acceleration of alliances and market realignment

## Future Initiatives

- ◆ Strengthen cost competitiveness to withstand severe business environment
- ◆ Ensure differentiated competitive advantages to overwhelm the competitors
- ◆ Enhance Value-added proposals to the customers



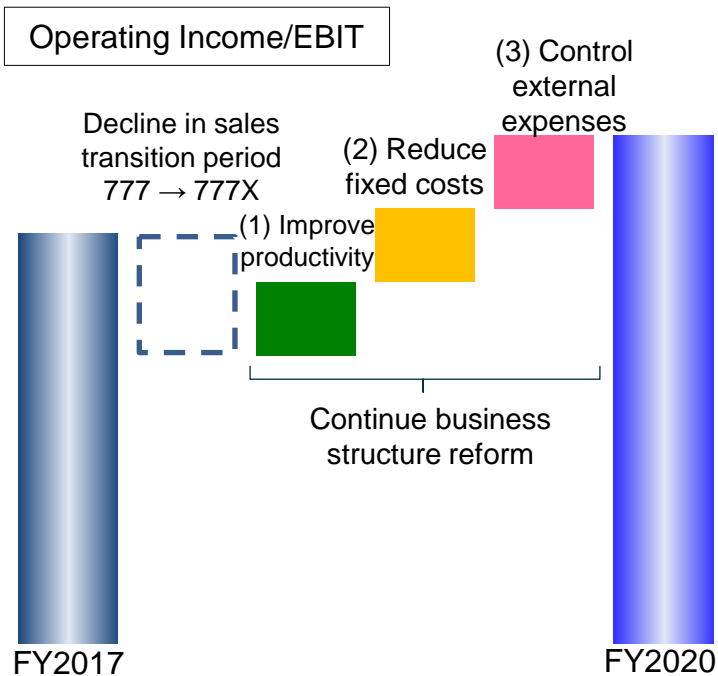
**Continue  
“Business Structure Reform”**

# 2-3. Policies and Strategies

## 2018 Medium-Term Business Plan (1/3)

### Continue Business Structure Reform

1. Maintain Income by improving productivity and reducing fixed costs, etc.
2. Pursue differentiation with competitors



### (1) Improve productivity

- Accelerate manpower savings by introducing automated equipment
- Automate indirect work process using AI/IoT
- Concentrate production capacities to achieve high efficient parts manufacturing (Integrated production lines/Matsusaka cluster)

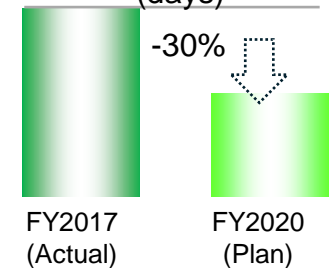
### (2) Reduce fixed costs

- Replace auxiliary/routine man-work by IT systems  
→ Reduce labour costs
- Upgrade personal abilities and skills<sup>(\*)</sup>, optimized reallocation of human resource through multi-skilling educations

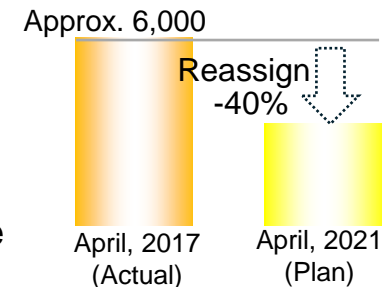
### (3) Control external expenses

- Reduce working capital and generate cash flow by advanced procurement processes<sup>(\*)</sup>
  - Bring outsourced work process in-house through utilization of upskilled human resources
- <sup>(\*)</sup> Introduce systems for acquisition of specialist skills, including information systems such as AI/IoT/RPA, production processes, procurement operations, CAD/NC programs, etc.

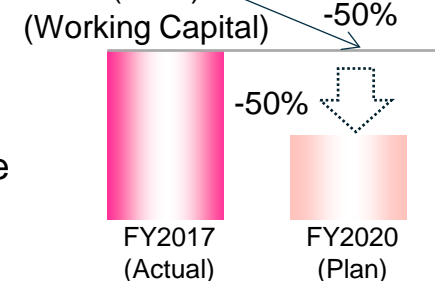
Shorten production lead time (days)



HR Restructuring (headcount)



Working Capital / CCC (CCC)

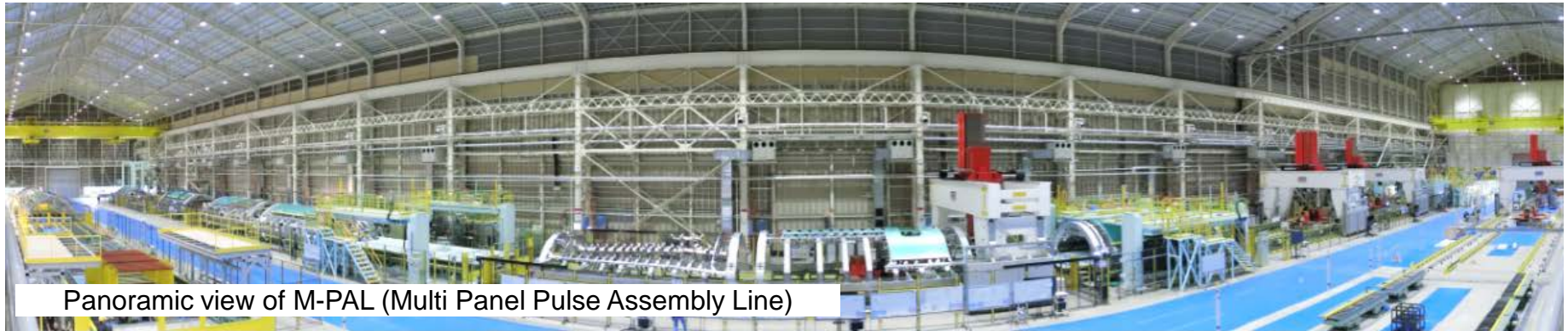




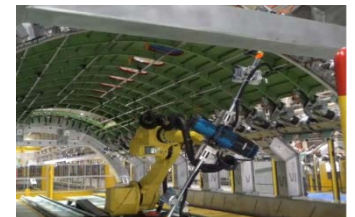
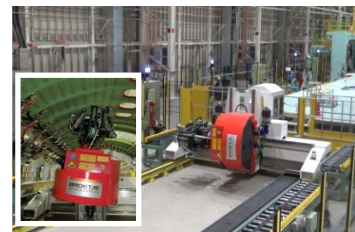
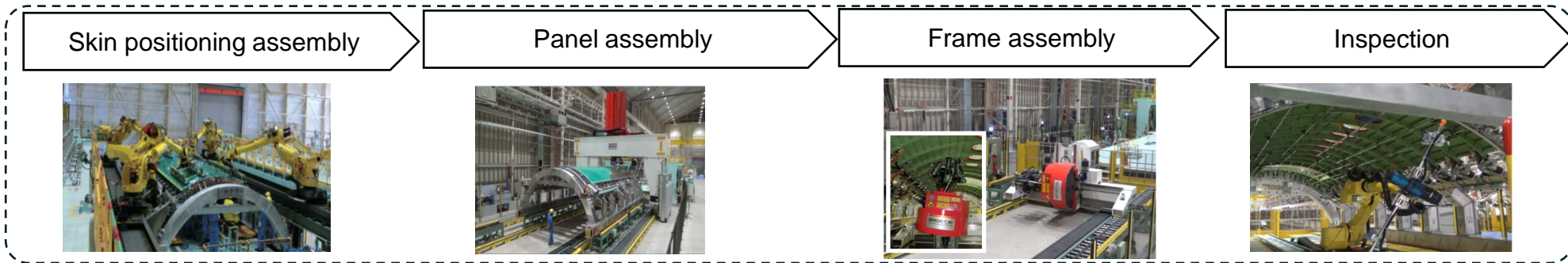
# 2-3. Policies and Strategies

## 2018 Medium-Term Business Plan (2/3)

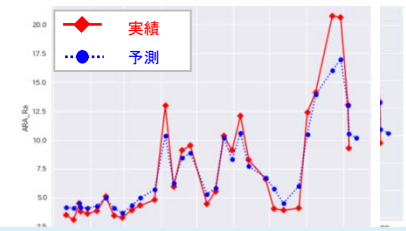
### ◆ World Class Assembly Production Line for 777X and 787



Panoramic view of M-PAL (Multi Panel Pulse Assembly Line)



Real time monitoring of production line



Equipment check / preventive maintenance



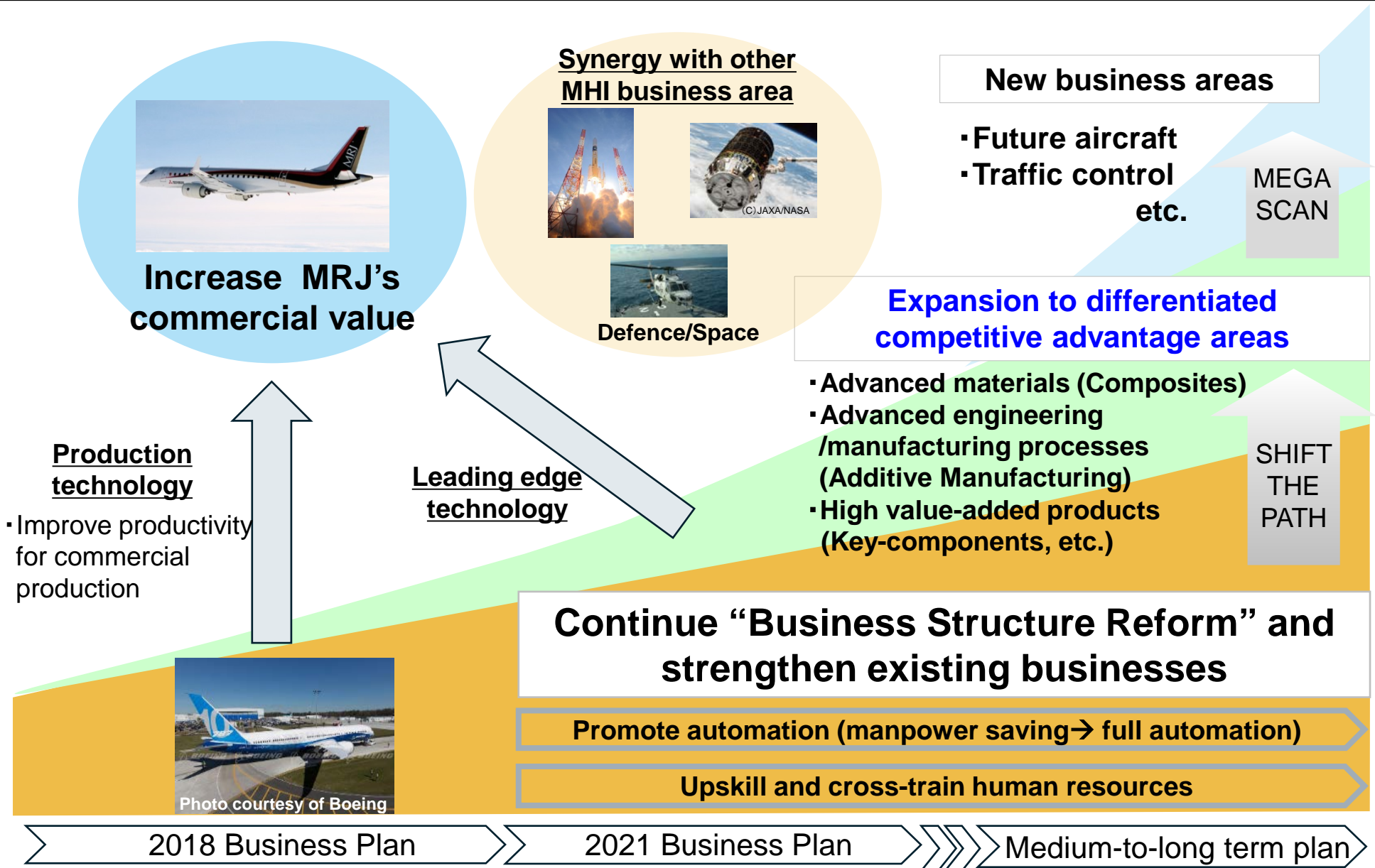
Apply AI/IoT to inspection work



Expand scope of automation (manpower saving → unmanned operation)

# 2-3. Policies and Strategies

## 2018 Medium-Term Business Plan (3/3)



Increase MRJ's commercial value

Synergy with other MHI business area



Defence/Space

New business areas

- Future aircraft
- Traffic control etc.

MEGA SCAN

Expansion to differentiated competitive advantage areas

- Advanced materials (Composites)
- Advanced engineering /manufacturing processes (Additive Manufacturing)
- High value-added products (Key-components, etc.)

SHIFT THE PATH

Production technology

- Improve productivity for commercial production

Leading edge technology



Photo courtesy of Boeing

Continue "Business Structure Reform" and strengthen existing businesses

Promote automation (manpower saving → full automation)

Upskill and cross-train human resources

2018 Business Plan

2021 Business Plan

Medium-to-long term plan

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# 3-1. Development Status

## FY2017 Achievements

- ◆ Established development organization with global aviation industry experts assigned to key positions
- ◆ Enhanced development structure with cross-functional organizations
- ◆ Type certification acquisition from Federal Aviation Administration (FAA) for Pratt & Whitney (P&W) PW1200G engine
- ◆ MRJ exhibited at Paris Air Show
- ◆ Started part fabrications for the modification of flight test aircraft
- ◆ Achieved over 1,800 flight hours  
Natural icing test



## FY2018 Solutions

### Development

- Accelerate type certification (TC) flight tests
- Proceed the assembly of additional flight test aircrafts



### Farnborough Air Show

- Following Paris Air Show last year, plan to exhibit the MRJ and conduct flight demonstration



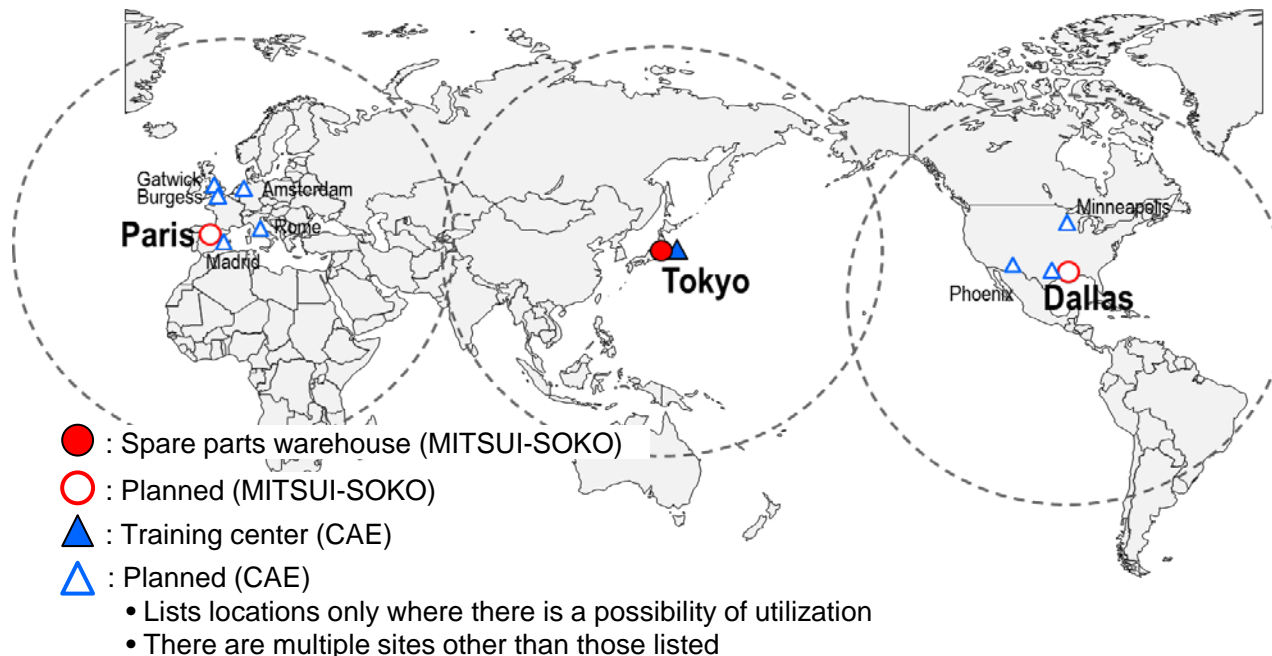
## 3-2. Preparations for MRJ Production (1/2)

### Preparations for MRJ Production/Customer Support (CS)

Establish CS Business Operation Bases in Japan and the U.S., then expand operations to other regions

- ◆ Establish three bases for global spare-parts logistics and support networks, with the U.S. and Europe to be our second and third hubs
- ◆ Expand global training centers in accordance with customer base expansion

#### Global Bases for Spare-Parts and Training



#### Status of Initiatives

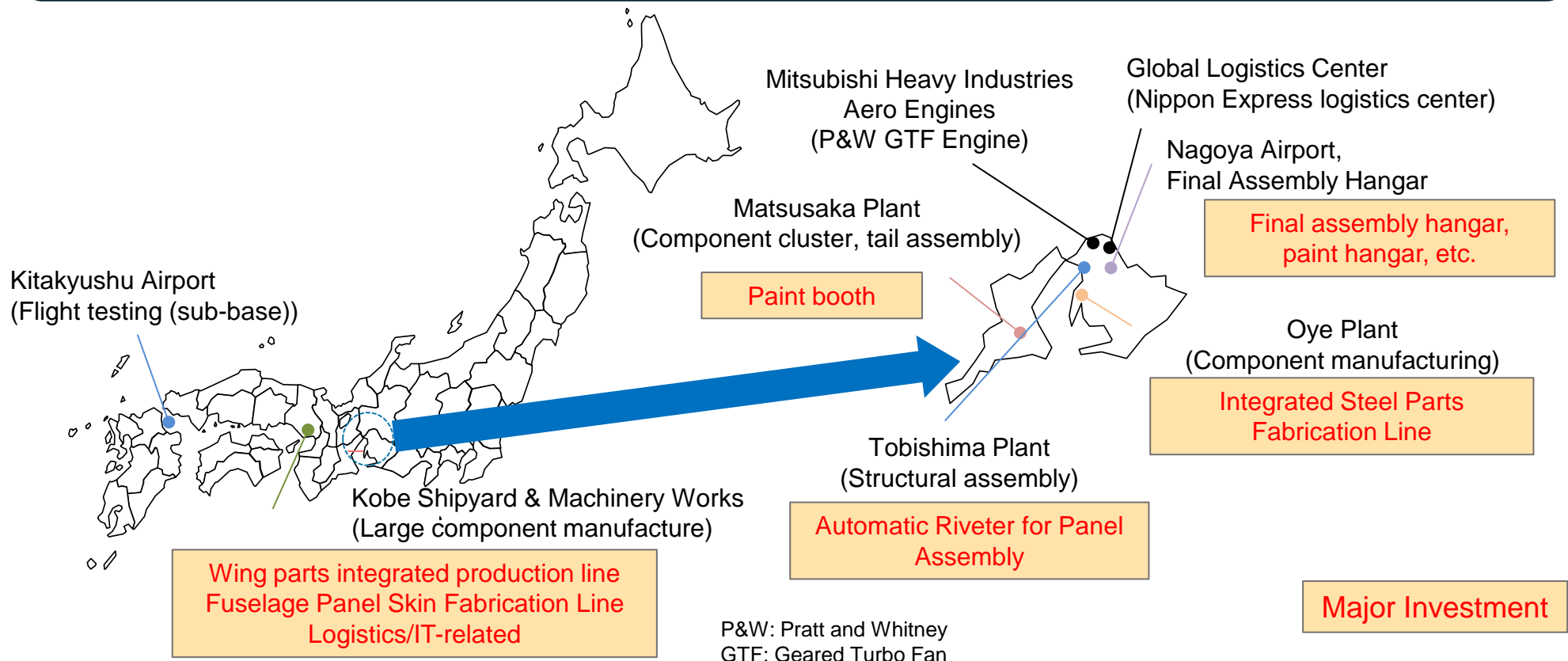
- Completed development of enterprise resources planning (ERP) system and commenced operational testing
- Developed MRJ web portal with Boeing's support
- Selected Mitsui-Soko as Logistics Partner to utilize their infrastructure in US/Europe
- Selected HAECO Americas, Pemco World Air Services (PEMCO), and MRO Japan as the preferred MRO service providers in North America and Asia
- Crew Training by CAE with using their training network

MRO: Maintenance, Repair and Overhaul

## 3-2. Preparation for MRJ Production (2/2)

### Preparation for MRJ Production / Production Organization

- ◆ Consider additional capital expenditure in line with orders as well as market and customer trends to meet demand with eye on maximum 10 aircraft per month production rate
- ◆ Planning to introduce automated structural assembly and state-of-the-art IT tools and IoT for production processes to achieve cost reduction and prompt production rate up



## 3-3. Efforts aimed at MRJ Commercialization (1/3)

### Value of MRJ Program

- ◆ Global air traffic has raised by 5% every year, and preference in the market for low cost and high frequency air operation is stimulating demand for single-aisle aircraft like the 737/320. The upgrade and expansion of the single-aisle network also brings an increase in demand for smaller category aircraft operations covered by Regional Jet (RJ).
- ◆ Secure a future business profit base by establishing the position as airframe OEM in the commercial aviation industries, which is expected to grow over the medium-to-long term.
- ◆ Aimed at expanding business opportunities into high value-added sectors, such as systems and components, by utilizing experience in the airframe OEM business and technical capabilities in the Tier 1 business.
- ◆ Increase the global brand strength of MHI Group by making an image leader out of the aviation business, with a spotlight on its leading edge technology.
- ◆ Establish a business foundation of total aircraft integration in Japan, creating the foundation for the development of Japanese aerospace industry, including equipment.

# 3-3. Efforts aimed at MRJ Commercialization (2/3)

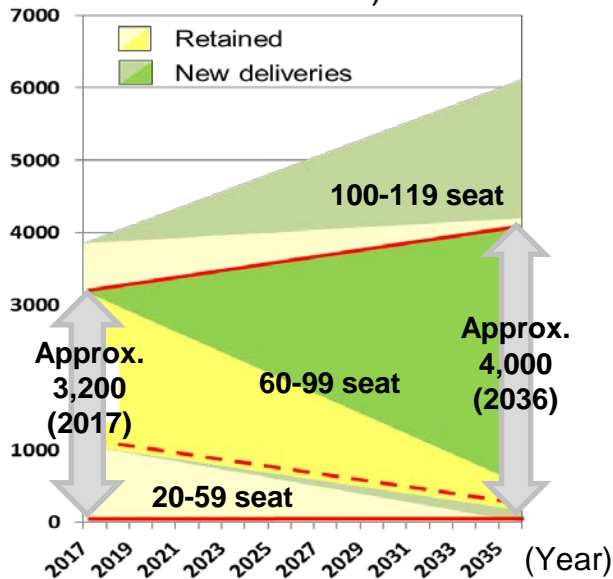
## Market Outlook

### RJ market overall

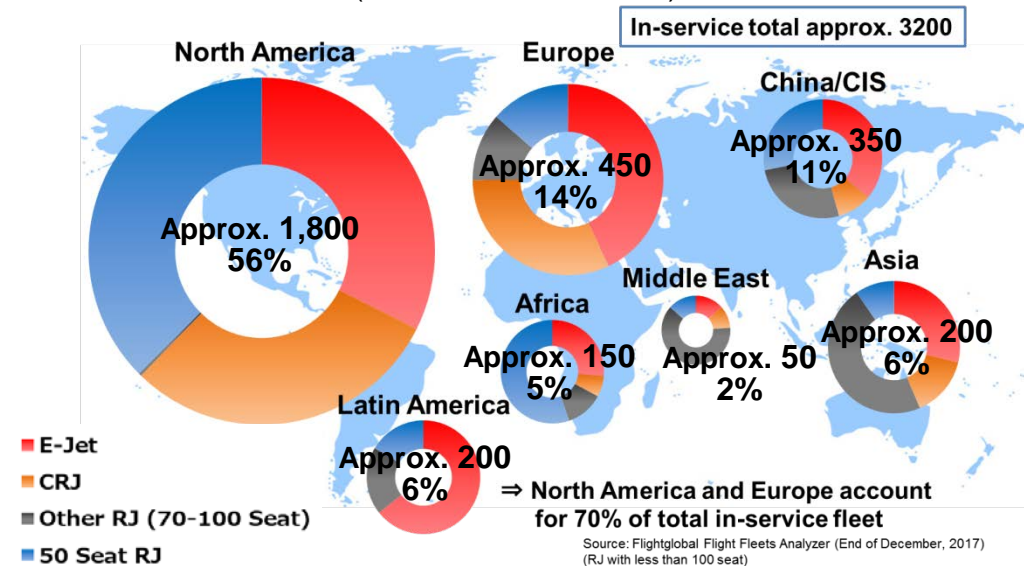
- ◆ The 60-99 seat-class aircraft market, which is the target market for the MRJ, also includes replacement demand for “out-of-product” RJ (59 seats-or-less), and demand is expected to be around 3,500 aircraft over the next 20 years.
- ◆ There are currently approximately 3,200 RJs in service worldwide, and many of them are likely to generate future replacement demand, with North America and Europe accounting for 70% of that demand.

North America	<ul style="list-style-type: none"> <li>◆ World's largest RJ market, approx. 1,800 aircraft in service at end of 2017.</li> <li>◆ Due to the Scope Clause, it is currently difficult for the MRJ90 to operate at major US airlines. However, the MRJ70 can operate under the current Scope Clause.</li> </ul>
Europe	<ul style="list-style-type: none"> <li>◆ Trend for demand at major airlines to shift toward 100+ seat- class. Meanwhile, suitable routes for RJs exist, and a given level of demand is expected to continue.</li> </ul>
Asia	<ul style="list-style-type: none"> <li>◆ Currently majority of small size aircraft is by Turboprop, but growth is expected due to development of airport infrastructure and maturing of operations.</li> </ul>

RJ (less than 100 seat-class) demand forecast



Number of RJs in service (As of the end of 2017)





### 3-3. Efforts aimed at MRJ Commercialization (3/3)

#### Business Opportunities in Commercial Aviation Industry

◆ Identify business opportunities across the entire aircraft sales life cycle for future revenue growth

Players and service content		
Player	Roles	Details
Airframe OEM	Aircraft sales	Aircraft sales to Operators
	Spare part sales	Spare part sales to Operators
Component Supplier	Manufacture and sale	Component sales to Airframe OEMs
	Spare part sales	Spare part sales to Operators
Lease & Finance	Secure slots	Secure aircraft in anticipation of vacant slots at airlines
	Financing	Providing leasing aircraft with using Lessor's better finance position
	Residual value risk	Offset Residual risk from Operator to Lessor (by leasing aircraft)
	Create used aircraft market	Used aircraft sales
MRO	MRO	Maintenance and repair services for aircraft and components

Life cycle

**MRJ/Airframe OEM business**

**Opportunity for high value-added Market**

**Cooperate with outside partners**

OEM: Original Equipment Manufacturer

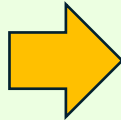
MRO: Maintenance, Repair and Overhaul

#### Steady Progresses at MRJ90 Development

- ◆ MRJ90 Development and TC acquisition
- ◆ Delivery of first aircraft to ANA in mid-2020

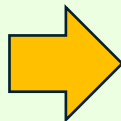
#### Approach to assure Long-Term Business Continuity

Strengthen ties with Tier 1 businesses



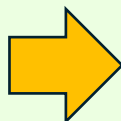
Expand profitability through business synergy and entry into high value-added markets

Strengthen sales and customer support structures



Enhance human resources and consider partnerships with outside agencies

Pursue full-scale development and early TC acquisition of MRJ70



Secure business base in the commercial aviation industry by quickly establishing a firm presence in the largest RJ markets

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## Defense

## Space Systems



F-2 Fighter



SH-60K Maritime Patrol Helicopter



PAC-3



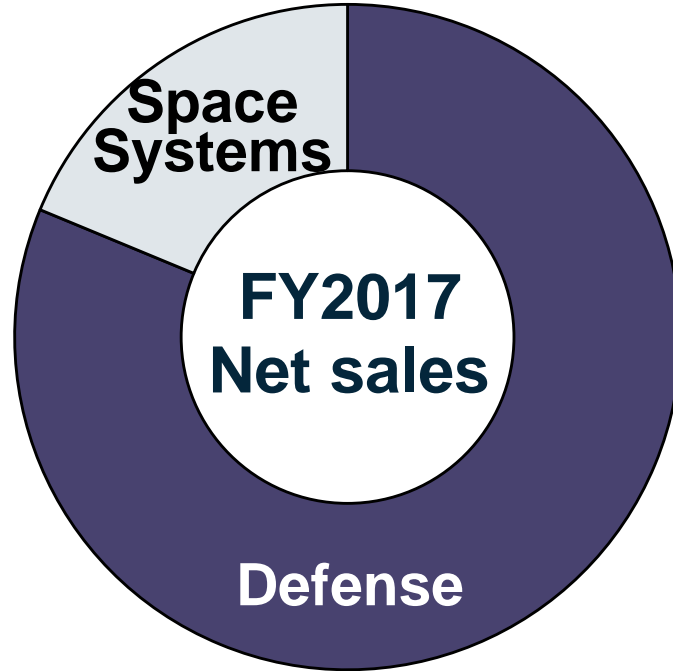
SM-3



“Seiryu” Submarine



“Asahi” Destroyer



H-IIA Launch Vehicle



H-IIB Launch Vehicle



H-II Transfer Vehicle (HTV)



Source: Japan Ground Self-Defense Force website

Type 16 Mobile Combat Vehicle



Type 10 Main Battle Tank

# 4-1. Overview (FY2017 Major Projects and Orders Received)

## Defense

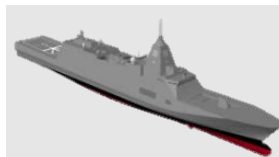
- **F-35**

- 2017 Jun Unveiling ceremony for first plane assembled in Japan
- Nov First Aircraft Delivery
- 2018 Jan Second Aircraft Delivery



- **New type of destroyers**

**2017 Aug Selected as primary contractor**



- **Delivery ceremonies**

- 2018 Mar Asahi-class destroyer "Asahi" Nagasaki
- Soryu-class submarine "Seiryu" Kobe



- **Type 16 Mobile Combat Vehicle**

- 2017 Aug Start of delivery
- Oct Production vehicle delivery ceremony at Sagamihara



## Space Systems

- **Launch vehicles**

### **1) Launch of H-IIA/B**

- 2017 Jun H-IIA No. 34
- Aug No. 35
- Oct No. 36
- Dec No. 37
- 2018 Feb No. 38



### **2) Order received for launch services**

**2017 Sep**

**Received order for H-IIA Launch Services from U.K. Inmarsat, launch scheduled for 2020**



### **3) H3**

2017 Apr

Started LE-9 engine hot firing tests at Tanegashima



©JAXA

- **HTV**

### **1) HTV-X in preliminary design**



©JAXA

### Achievements and Status of 2015 Business Plan

- Continuous strengthening of existing businesses
  - Main indicators such as sales and operating income achieved 2015 Business Plan figures
- Preparing for next expansionary step
  - Implementing growth strategy activities to expand business

### New Challenges

- Strengthening structure
  - Continued squeezing of fixed costs to contribute to company-wide improvement in operating margins
- Accelerate and strengthen growth strategy
  - Steadily get next core businesses up and running
  - Accelerate 2015 Business Plan growth strategies

# 4-3. Policies and Strategies of 2018 Medium-Term Business Plan (1/6)

## Basic Policies

- Expand business through acceleration of growth strategies
- Continuously strengthen existing businesses

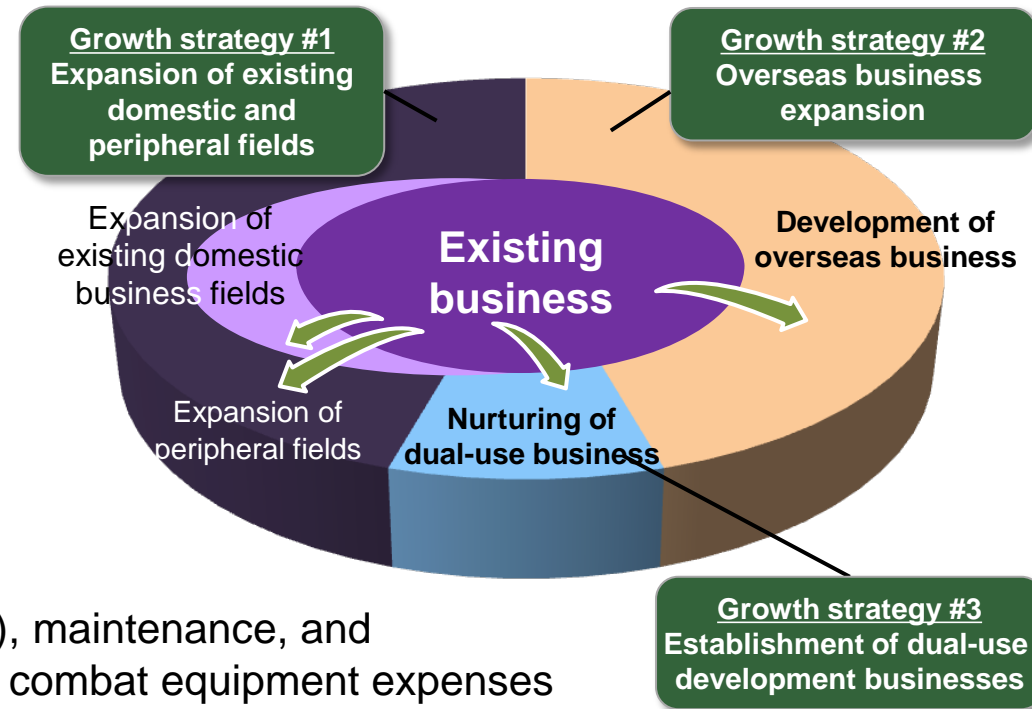
## Market Trends

### ■ Government/domestic

- Foreign military sales (imported components), maintenance, and servicing expenses to increase and front line combat equipment expenses to decrease
- Increased use of outer space in national security field

### ■ U.S./global

- Review of U.S. strategy due to increasing technical capabilities of threat countries
  - ⇒ Pursuit of superiority in **unmanned vehicle and links network**
  - Importance of ensuring superiority in **cyberspace**
- Mounting tension in peripheral region
  - ⇒ Necessity for equipment to respond to counter threats
  - Importance of interoperability with alliance



# 4-3. Policies and Strategies of 2018 Medium-Term Business Plan (2/6)

## Strategy

### ■ Growth strategy #1: Expansion of existing domestic and peripheral fields

#### (1) Existing business

- Steadily get next core businesses up and running
- Expansion of business territory (command and control, M&S, etc.)

#### (2) Peripheral fields

- Expand MRO business in maintenance and servicing fields
- Expand into new peripheral fields (unmanned vehicles, utilization of big data, etc.)

M&S: Modeling and simulation MRO: Maintenance, Repair and Overhaul

### ■ Growth strategy #2: Overseas business expansion

#### (1) Adapting MHI components for use in overseas equipment

- Utilize channels with overseas manufacturers cultivated through existing businesses
- Lobby Japanese government in parallel with inter-company consultations

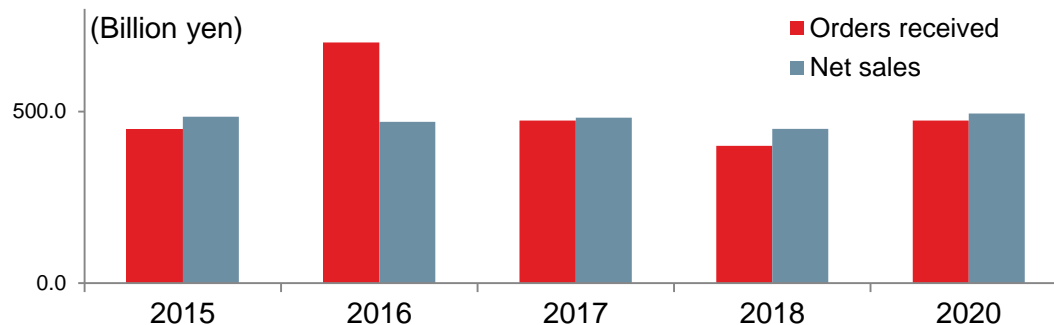
#### (2) Potential international joint development projects

- Enter joint development projects with alliance countries
- Promote start-up in collaboration with Japanese government

### ■ Growth strategy #3: Establishment of dual-use development businesses

- Utilize core technologies of defense business
- Meet private sector demand particularly in security field



## Targets





# 4-3. Policies and Strategies of 2018 Medium-Term Business Plan (3/6)

## Growth Strategy #1 Expansion of existing domestic and peripheral fields

	Defense	Space Systems
Existing	<h3>BMD</h3>	<h3>Launch Services</h3>
	<div style="display: flex; justify-content: space-between;"> <div style="background-color: #8db4c1; padding: 5px;">FY2017 achievements</div> <div style="background-color: #e31a1c; padding: 5px; color: white;">Future solutions</div> </div> <p> <b>MSE missile</b>  <ul style="list-style-type: none"> <li>Initial product preparation in (full) progress.</li> <li>Continuing production contracts</li> </ul> <b>SM-3Block II A</b>  <ul style="list-style-type: none"> <li>Commencement of missile delivery for U.S. government</li> </ul> </p> <div style="display: flex; align-items: center;"> <div style="text-align: center;"> <p>MSE missile</p> <p>Source: Lockheed Martin website</p>  </div> <div style="margin: 0 20px; font-size: 2em;">}</div> <div style="text-align: center;">  <p>Aegis Ashore</p> </div> </div> <p> <ul style="list-style-type: none"> <li>Stable MSE missile manufacturing and delivery</li> <li>Business proposal to integrate Aegis Ashore and MSE, etc. to enhance BMD capabilities</li> </ul> </p>	<div style="display: flex; justify-content: space-between;"> <div style="background-color: #8db4c1; padding: 5px;">FY2017 achievements</div> <div style="background-color: #e31a1c; padding: 5px; color: white;">Future solutions</div> </div> <ul style="list-style-type: none"> <li>Launched five H-IIA rockets</li> <li>Started hot firing tests of 1<sup>st</sup> and 2<sup>nd</sup> stage engines of H3 Launch Vehicle</li> <li>Received order for H-IIA Launch Services from a global satellite operator, Inmarsat</li> </ul> <div style="margin-left: 20px; font-size: 2em;">}</div> <ul style="list-style-type: none"> <li>Continue successful launches</li> <li>Steadily accomplish H3 development</li> <li>Increase presence in the commercial/ overseas market</li> </ul>
Peripheral	<h3>MRO business</h3>	<h3>Satellite Data Utilization</h3>
	<ul style="list-style-type: none"> <li>Entry into government maintenance work under private sector</li> <li>Integrated management of armed forces and in-house maintenance data, contributing to streamlining of maintenance</li> <li>Expand into MRO business for U.S. forces stationed in Japan</li> <li>Field that can utilize equipment models common to Japan and U.S. and owned facilities</li> </ul>	<ul style="list-style-type: none"> <li>Analyze satellite images and other data for maritime domain awareness and disaster response (Japan and surrounding seas).</li> </ul>

MRO: Maintenance, Repair and Overhaul

# 4-3. Policies and Strategies of 2018 Medium-Term Business Plan (4/6)

## Growth Strategy #2 Overseas business expansion

### F-35 fighter

#### Defense

##### FY2017 achievements

- Maiden flight of the first aircraft assembled at MHI
- The first and second aircraft delivery



Source: <http://www.jsf.mil/>

Ferry flight to Misawa Air Base

##### Future solutions

- Continuous On-Schedule delivery
- Stand-up MRO&U capability

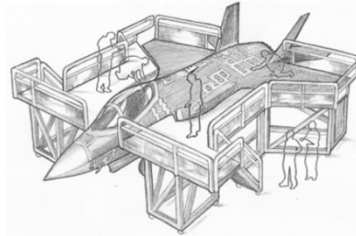


Image of MRO&U

MRO&U: Maintenance, Repair, Overhaul, and Upgrade

### Joint development and production of SM-3

#### Defense

##### FY2017 achievements

- Japanese Cabinet has approved procurement plan for SM-3 production (FMS procurement from U.S. government)
- Commenced delivery of SM-3 for U.S. integration test

(MHI → Raytheon → delivered to U.S. government)



Flight test mission: Feb 3 2017 (U.S. time)

(Source: Acquisition, Technology & Logistics Agency website)

FMS: Foreign Military Sales

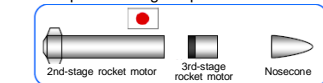
##### Future solutions

- Commence smooth commercial production under joint Japan-U.S. production system

Components developed by U.S.  
⇒ U.S. in charge of production



Components developed by Japan  
⇒ Japan in charge of production



Missile assembly

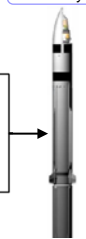


Image of joint production system

(Source: MHI, based on Acquisition, Technology & Logistics Agency website)

Make use of key technologies and channels cultivated in defense and space systems business

### New Business

- ✓ Initiatives underway together with Government, toward potential international joint development projects
- ✓ Discussions underway among international companies toward adapting MHI key components for use in overseas equipment

## Growth Strategy #3 Establishment of dual-use development businesses

Leverage core technologies cultivated in the defense and space area to develop new business in the **advanced security, automation, and autonomy fields.**



### Advanced security

#### Cybersecurity



InteRSePT®

##### FY2017 achievements

- Completed InteRSePT® product commercialization
- Applied to defense products
- Started business development for overseas consumer applications



##### Future solutions

- Enhance capabilities and expand functions
- Expand product applications and build up track record
- Strengthen sales capabilities through alliances

### Automation and autonomy

#### Coast guard system using unmanned vehicles



##### FY2017 achievements

- Demonstration using prototype
- Market survey in Japan and overseas



CoasTitan®

##### Future solutions

- Add components and enhance level of autonomy
- Product commercialization through joint development with partners



# 4-3. Policies and Strategies of 2018 Medium-Term Business Plan (6/6)

## 2018 Medium-Term Business Plan – Long-term vision

**Expand business territory from land, sea, air and space to cyberspace and provide total solutions enabling safety and security**

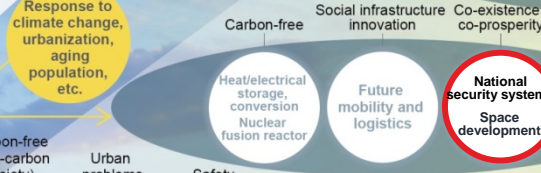
Under "MHI FUTURE STREAM," MHI aims to:

- ▶ Resolve complex and difficult social issues of today and the near future
- ▶ Take on challenges of the distant future
- ▶ Carry out continuous reforms to make MHI a company always in demand by humanity and society

Society where all human beings can live with peace of mind

Take on challenges of the distant future

**SDGs**  
Realization of a sustainable world  
**SUSTAINABLE DEVELOPMENT GOALS**



- ▶ **Mega Scan** Exploring all realms of opportunity  
Finding business opportunities in the uncertain trends of the future
- ▶ **Shift the Path** Converting existing businesses  
Responding to emergent trends  
Mulling ways to convert current businesses
- ▶ **Technology Scouting** Exploring for innovative technologies  
Reflecting technological trend analysis in  
Mega Scan and Shift the Path

A new set of initiatives under the 2018 Business Plan focused on MHI's future  
**MHI FUTURE STREAM**

New market needs

Existing market needs

Today → Near future → Distant future



**MOVE THE WORLD FORWARD**

**MITSUBISHI  
HEAVY  
INDUSTRIES  
GROUP**