

# Aircraft, Defense & Space Domain Business Plan

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**MITSUBISHI HEAVY INDUSTRIES, LTD.**

## 1. Business Overview

## 2. Commercial Aviation Systems Segment

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2-2. FY2016 Summary & FY2017 Outlook

2-3. FY2017 Business Strategy

## 3. MRJ Business

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4-1. Overview

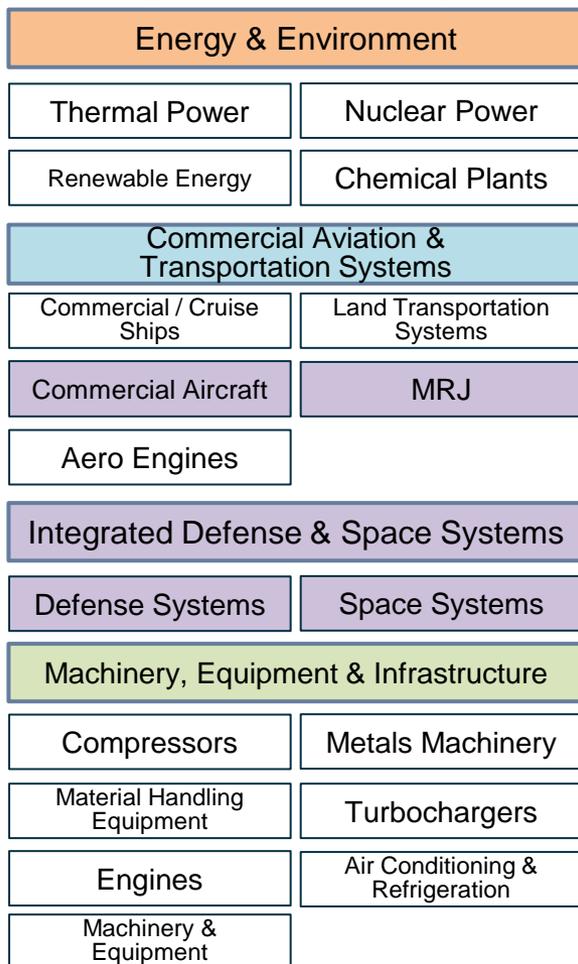
4-2. FY2016 Summary & FY2017 Outlook

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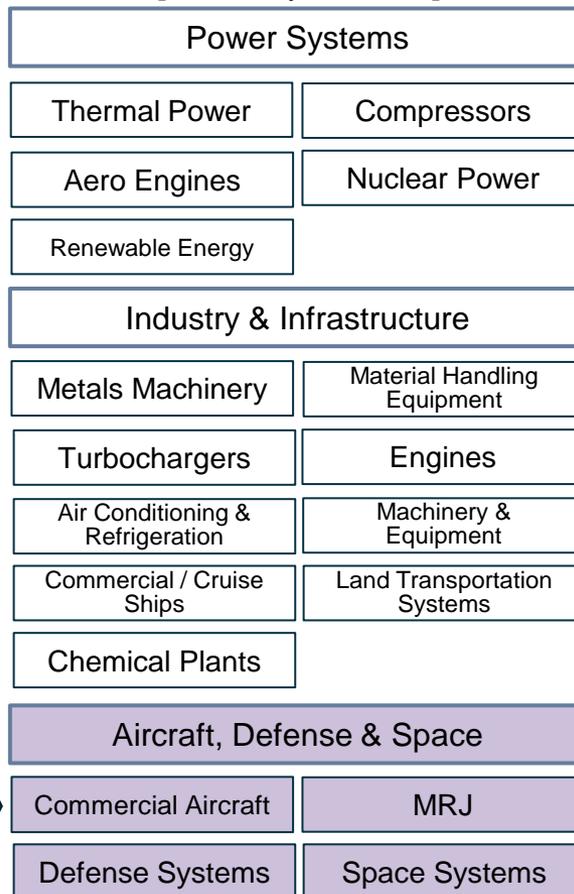
# 1-1. Overview (Domain Reorganization)

The Aircraft, Defense & Space domain was created as a result of MHI's domain reorganization, carried out in April 2017. Under the CEO's direct oversight, the new domain is pursuing prompt formation of a strong development foundation and stable earnings.

[Until March 2017]



[From April 2017]



Business	Group company
MRJ	Mitsubishi Aircraft Corporation

# 1-1. Overview

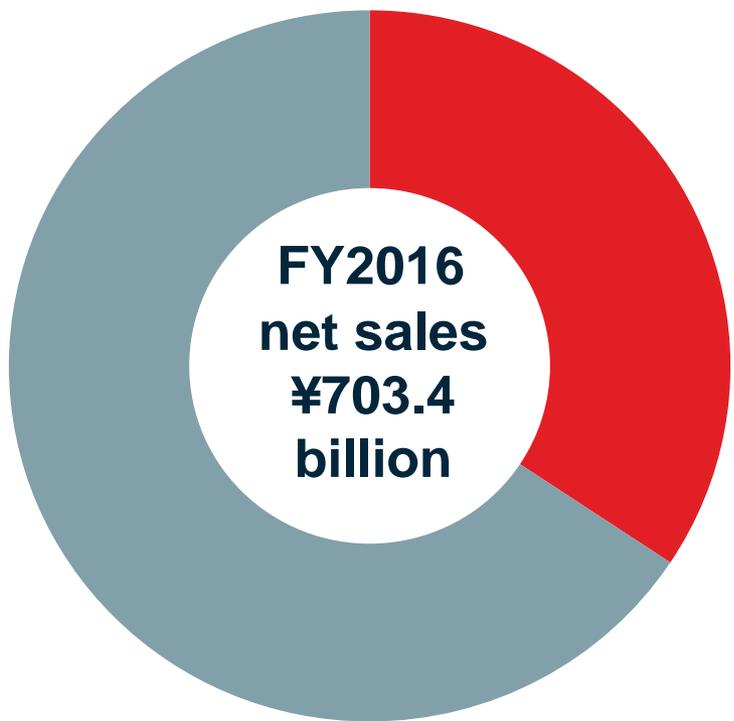
## (Net Sales by Main Businesses, FY2017 Outlook)

### Integrated Defense & Space Systems

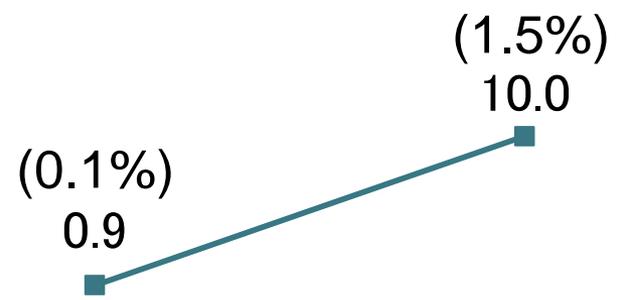
- Naval ships
- Aircraft & missile systems
- Special vehicles
- Space systems

### Commercial Aviation Systems

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

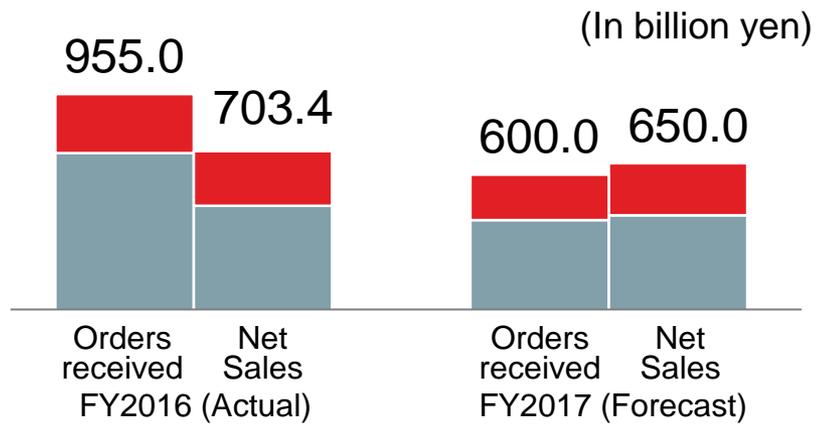


### Operating income (In billion yen)



### Orders received / Net sales

- Commercial Aviation Systems
- Integrated Defense & Space Systems



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## Boeing

787



Photo courtesy of Boeing

MHI : main wing boxes

777



Photo courtesy of Boeing

MHI : aft fuselage, tail fuselage, and entry doors

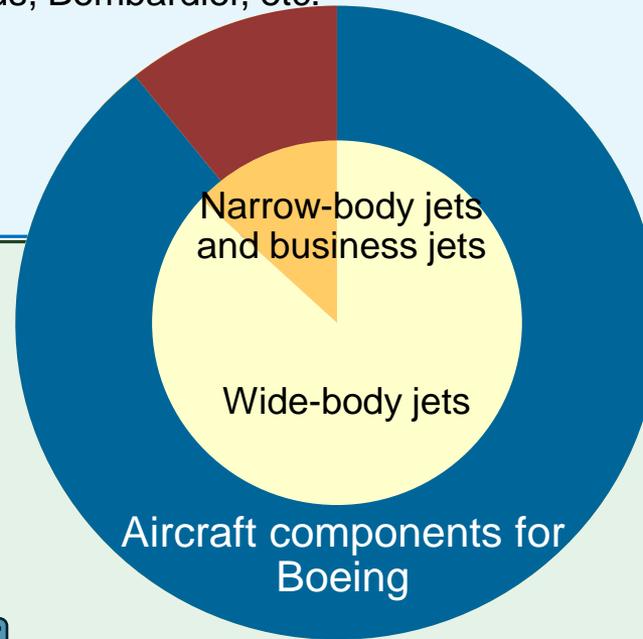
767



Photo courtesy of Boeing

MHI : aft fuselages and cargo doors

Aircraft components for Airbus, Bombardier, etc.



737



Photo courtesy of Boeing

MHI : inboard flaps

## Wide-body jets

## Airbus

A380



Photo courtesy of Airbus

MHI : fwd and aft cargo doors

## Bombardier

Global 5000/6000



Photo courtesy of Bombardier

MHI : main wings, mid-fuselages, and center wings

Challenger 300/350



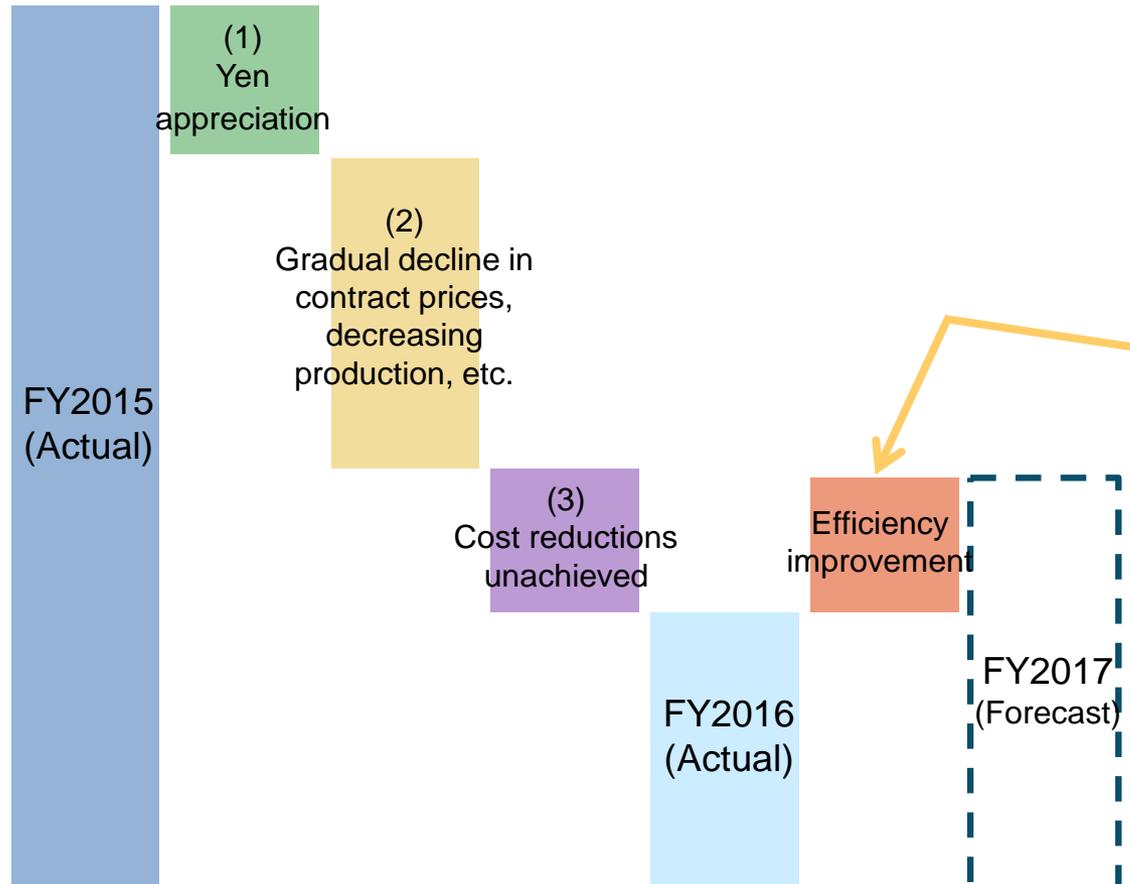
Photo courtesy of Bombardier

MHI : main wings

## Narrow-body jets and business jets

## 2-2. FY2016 Summary & FY2017 Outlook

### Status and operating income of commercial aircraft Tier1 business



- 1) Sales down as result of yen appreciation
- 2) Sales eroded by declines in contract prices, production, etc.
- 3) Cost reductions not achieved

- Improvement in production efficiency
  - Automated assembly through adoption of robotics
  - Enhanced efficiency of management and indirect work processes through use of AI / IoT
- Supply chain reforms
  - Configuration of harmonized production processes
  - Achievement of optimal order placements
  - Establishment of "Commercial Aircraft Procurement Center"

- Leveraging production bases and formation of optimal production system
- Flexible business portfolio

## Strengthen aircraft manufacturing superiority

*Integrated system synergies*

*Component-related synergies*



Traffic control-related



(C)JAXA/NASA



(C)Pratt & Whitney

Aircraft and space-related

Overall business synergies

**Reconfigure business portfolio**

- Creating added value from structure, etc.

• Reinforcement of MHI's comprehensive business strengths

Expansion into new business areas in the aircraft industry

Increase the MRJ's commercial value

• Development of differentiation technologies

- Weight reduction, material development
- 3D laminate modeling technologies

• Initiatives into new fields: functional components, equipment, etc.

Reinforced initiatives in high-added-value parts

• Advanced production process reforms (active use of robotics, AI, IoT)

**Manpower savings**



**Unmanned operation**

Completed aircraft and Tier-1 synergies

**Completed aircraft**  
- Total system integration

Advanced flight operation support systems



YS-11 (first flight in 1962)



MU-300



MRJ



767



777



Global Express



787



777X

**Tier1** (first shipment of fuselage panels in 1980)  
- Structure and flight performance

Strengthen existing businesses

'70

'80

'90

'00

'10

'20

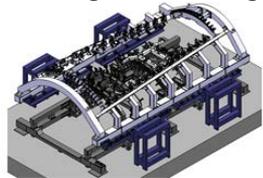
Added value, technology level

## 2-3. Advanced Production Process Reforms (Examples of Automated Production)

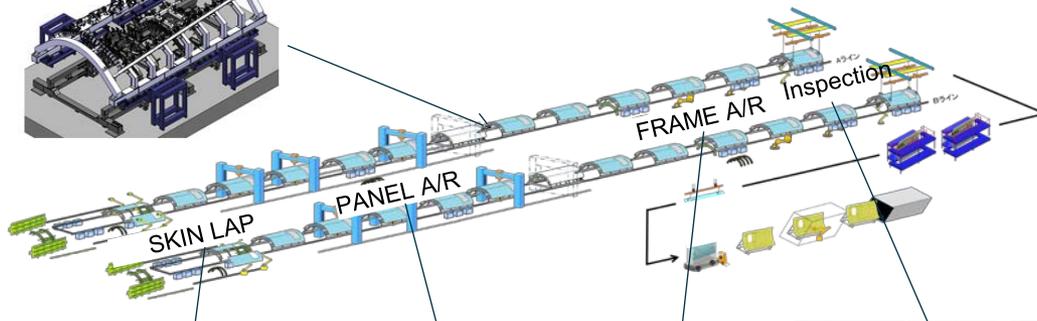
### 777-X Parts Production

- In March 2017 operation began of a newly configured automated production line using robots, to produce parts for Boeing's new 777-X model at our Hiroshima facilities .

<Moving tool for Large panel>



<M-PAL(Multi Panel-Pulse Assembly Line)>



### 787 Painting Process

- Testing is now in progress on the Boeing 787 main wing production line at Nagoya for an automated painting process using robots.

<Painting performed by robots>



By promoting automation of production processes, MHI is shifting focus from saving manpower to achieving unmanned operations.

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## Market trends

### <Market scale>

- Projected scale of market for 70- to 90-seat aircraft during the next 20 years: 3,500 planes

### <Status of competitors>

- Embraer is scheduled to launch E175-E2, a next-generation 90-seat class aircraft, in 2021.
- Bombardier is focusing on C-Series planes with more than 100 seats; its presence in the up-to-90-seats market is declining.

### <Future developments>

- 90-seat class: Competition between MRJ90 and E175-E2
- 70-seat class: MRJ70 will be the sole next-generation contender
  - To maintain competitive superiority, recovery from schedule delays will be critical.
  - Contracts with customers that have placed orders are being maintained.

## Our position

- Sales strategy: Secure a solid position in the regional jet market by raising its airframe value assessment leveraging the MRJ's outstanding durability and airframe performance
- Marketing environment: Owing to delays in launching into the market, measures will be taken to strengthen customer relations and ensure long-range business viability.

## Business strategies

### Basic policy

- Drive forward development and commercialization toward “achieving airframe performance and excellent customer support superior to Embraer”
- Minimize development costs, which will peak in FY2019
- Propose and implement a cost reduction strategy while maintaining the schedule through type certification acquisition, and development & marketing strategies for subsequent commercial production and the MRJ70's commercial viability

### FY2016 results

- Concluded definitive agreements with preferred airframe MRO(Maintenance, Repair & Overhaul) partners, aiming to enhance after-sale services in North America
- Ferried four aircraft to Moses Lake
- Launched corporate culture reforms to achieve greater company-wide globalization

### FY2017 initiatives

Under direct oversight of MHI's CEO:

- Development activities by two dedicated teams
- Utilization of global industry experts

### Steady implementation of development timetable

Ex.: FAA type certification has been acquired for the PW1200G engine.

FAA: Federal Aviation Administration

## 3-2. Development Activities by 2 Dedicated Teams

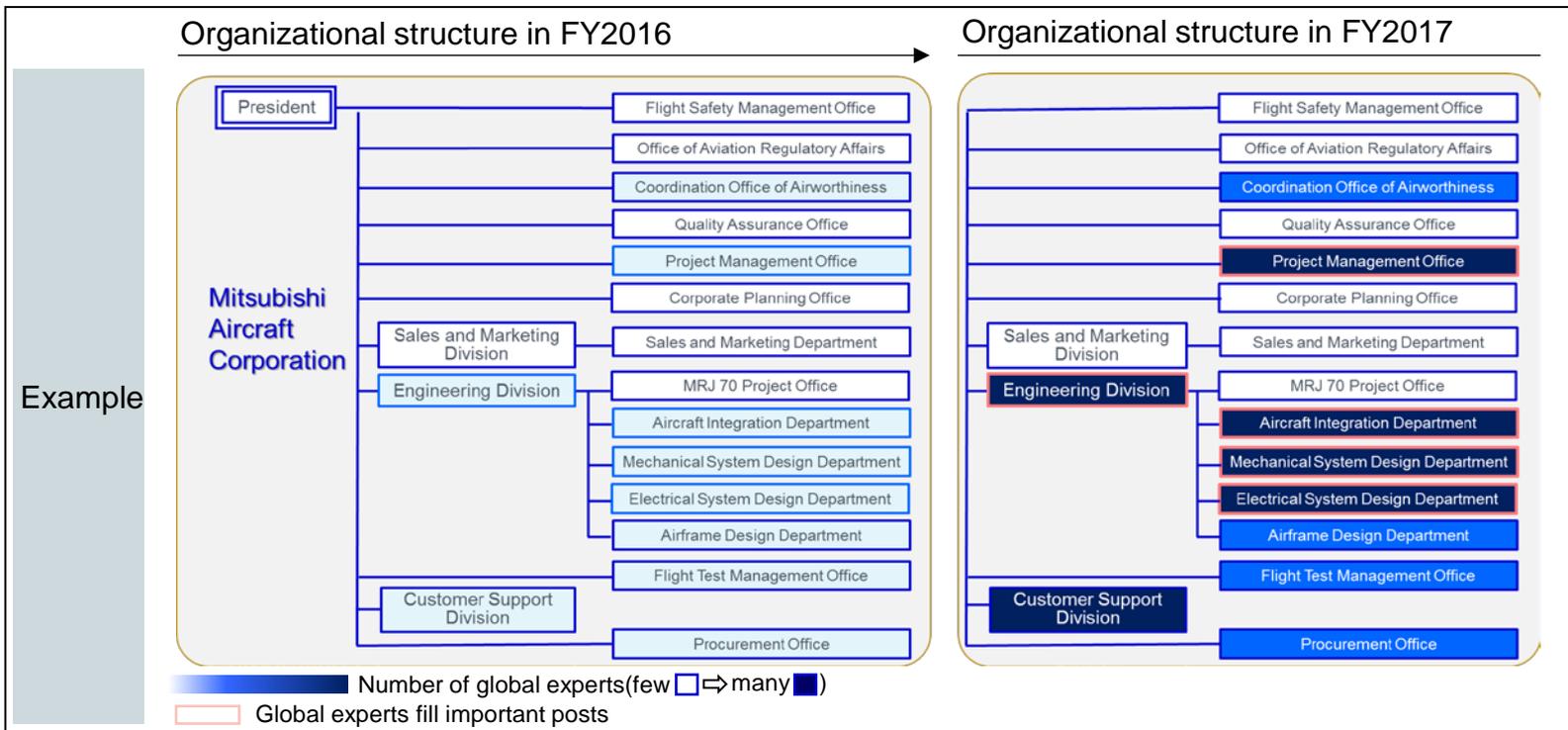
Areas of focus	Activities
Strengthening of business promotion structure	<ul style="list-style-type: none"> <li>Strengthen structure under direct oversight of MHI's CEO and 3-base development structure                             <ul style="list-style-type: none"> <li>- Establishment of MRJ Business Promotion Committee</li> <li>- Swift decision making and improved communication among global facilities</li> </ul> </li> </ul>
Strengthening of development activities	<p>MRJ development team</p> <ul style="list-style-type: none"> <li>- Stay on schedule using strict KPI management of development progress</li> </ul> <p>Future differentiation technology development team</p> <ul style="list-style-type: none"> <li>- Development of further differentiation technologies</li> <li>- Proposal and development of technology strategies for next-generation aircraft concept</li> </ul>

Activities	<p>Natural icing test</p> 	<p>Cold soak test</p> 
	<p>Hot soak test</p> 	<p>Acquisition of FAA type certification of PW1200G engine</p>  <ul style="list-style-type: none"> <li>Selection of partner, and commencement of work, to support reworking of EWIS design that caused schedule delays</li> </ul> <p>EWIS : Electrical wiring interconnection systems</p>

# 3-3. Steady Execution of Development Schedule with Global Experts

Formation of global-standard commercial aircraft development structure manned by global experts working with Japanese staff

Main areas of activity	Activities
Further enhancement of decision making	<ul style="list-style-type: none"> <li>• Leadership and transfer of authority</li> <li>• Achievement of swift decision making</li> </ul>
Pursuit of higher level of teamwork	<ul style="list-style-type: none"> <li>• Information and knowledge sharing</li> <li>• Open-minded top-down/bottom-up approach</li> </ul>
Global level of workplace efficiency	<ul style="list-style-type: none"> <li>• State-of-the-art IT environment</li> <li>• Ongoing improvement of business processes</li> </ul>



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## Defense



F-2 Fighter



SH-60K Maritime Patrol Helicopter



PAC-3



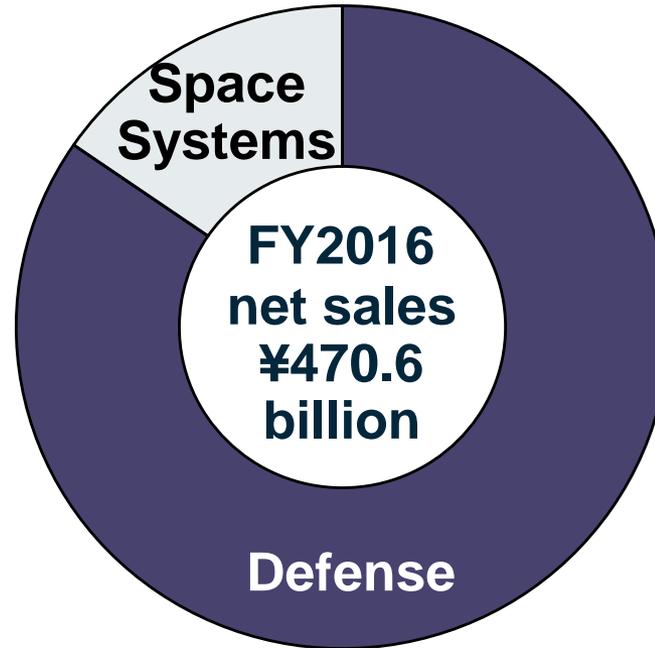
SM-3



“Jinryu” Submarine



“Akizuki” Destroyer



## Space Systems



H-IIA Launch Vehicle



H-IIB Launch Vehicle



H-II Transfer Vehicle (HTV)



Type 16 Mobile Combat Vehicle



Type 10 Main Battle Tank

## Defense

- Advanced Technology Demonstrator

April 2016 First flight  
 June Delivery  
 November Commencement of flight test



- PATRIOT system modification

March 2017 Order received for MSE\*1

\*1 MSE: Missile segment enhancement



Source: Japan Air Self-Defense Force website

- Launching ceremonies

October 2016 Asahi-class destroyer "Asahi" Nagasaki  
 Soryu-class submarine "Seiryu" Kobe



- Type 16 Mobile Combat Vehicle

June 2016 Start of production



Source: Japan Ground Self-Defense Force website

## Space Systems

- Launch vehicles

- 1) H-IIA/B

November 2016 Launch of H-IIA No.31  
 December Launch of H-IIB No.6  
 January 2017 Launch of H-IIA No.32  
 March Launch of H-IIA No.33



- 2) H3

March 2017  
 Preparation for FY2017 LE-9 Engine's combustion test in Tanegashima



- HTV

- 1) KOUNOTORI

December 2016 Launch of No.6  
 February 2017 Reentry (Mission completion)



- 2) Start of HTV-X development

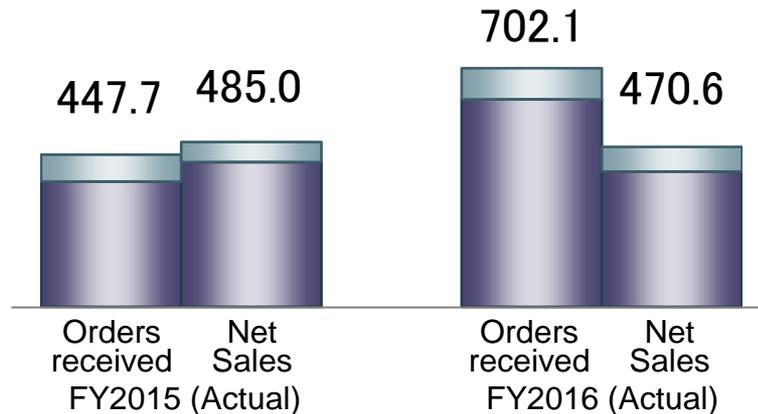


Conceptual rendering (C)JAXA

## 4-2. FY2016 Summary & FY2017 Outlook

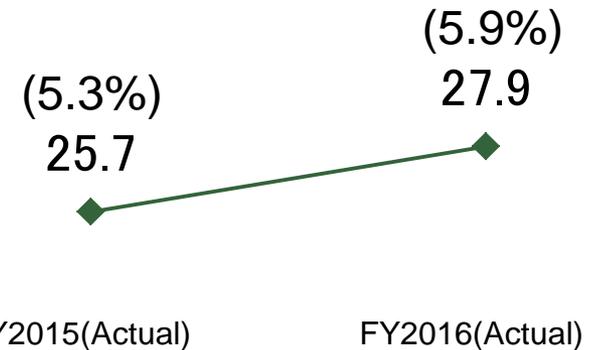
### FY2016 Summary

#### ■ Orders received / Net sales



#### ■ Operating income

(In billion yen)



**[Orders received]** Bulk purchases of Patriot missiles (MSE), patrol helicopters etc., meant orders received increased ¥250 billion from FY2015.

**[Net sales]** Sales declined slightly year-on-year under impact of decreased deliveries of missiles, etc.

**[Operating income]** Despite the sales decline, income rose year-on-year following streamlining of operations .

MSE : Missile segment enhancement

### FY2017 Outlook

**[Orders received]** Orders received are projected to undershoot the FY2016 level under the impact of last year's bulk purchasing.

**[Net sales]** Sales on the scale of FY2016 are secure, given the steady execution of existing construction and inclusion of peripheral construction.

**[Operating income]** Operating income on FY2016's scale is secure, owing to further operating streamlining.

### Market environment

#### Defense

- Cabinet authorized **the Three Principles on Transfer of Defense Equipment and Technology** (2014)
- 4th year of **Medium Term Defense Program** (FY2014-FY2018)
- A review of **the next Medium Term Defense Program** (FY2019-FY2023) and **National Defense Program Guidelines** is under consideration by the Government.

#### Space Systems

- Revision of **new Basic Plan on Space Policy and Implementation Schedule**
  - ⇒ Average 4 launches per year through 2020
  - H3 development
  - Start of HTV-X development
- Formulation of **Vision for the Space Industry**
  - ⇒ Increasing demand for products and services relating to space utilization and satellite data usage

### Situation and Challenges

- Business scale: Almost unchanged for more than 20 years
  - ⇒ Growth strategies for expanding business scale are needed.
- Gain/loss: Fragile profit structure
  - ⇒ Sustained improvement of bottom line through various streamlining activities is needed.

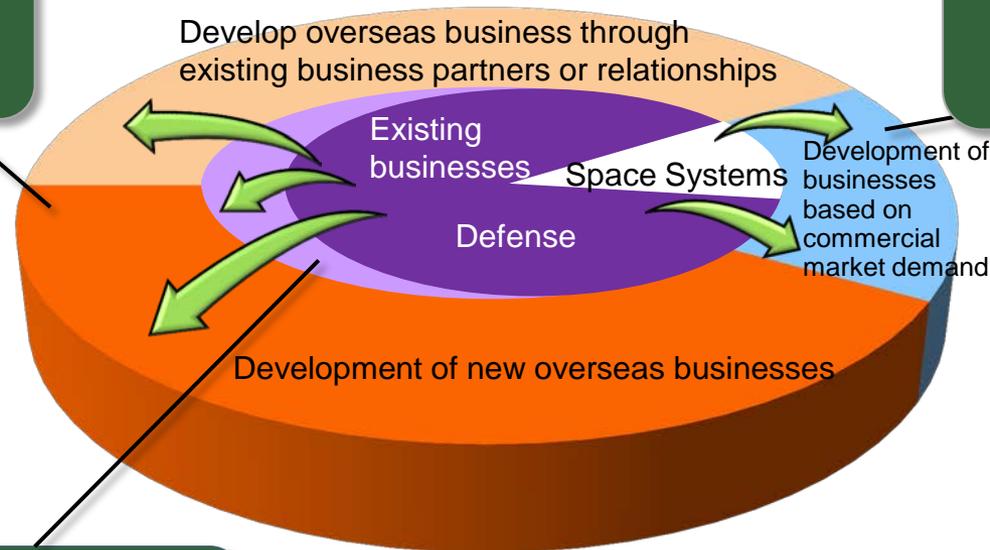
## Basic policy

Continuously strengthen existing businesses and prepare for next expansionary step (initiatives targeting overseas opportunities and application to commercial market demand)

Growth strategy #1  
Overseas expansion

Growth strategy #2  
Dual-use development

Growth strategy #3  
Expansion of existing fields



# 4-3. Growth Strategy #1 Overseas Expansion

Defense

## F-35 fighter

### FY2016 achievement

- ✓ Final assembly and check out of the first F-35 fighter



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

Assembly work

### Future initiatives

- ✓ Delivery of the first domestically assembled aircraft
- ✓ Preparation for MRO&U facility



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

MRO&U: Maintenance, repair, overhaul and upgrade

Defense

## Joint development and production of SM-3

### FY2016 achievement

- ✓ Supported flight test mission (intercept test) under Government's leadership. Confirmed prescribed operations.
- ✓ Manufacturing SM-3 components for Research, Development, Evaluation & Test by U.S. Government (direct contract with Raytheon)



Flight test mission: Feb 3 2017(U.S. time)  
(Source: Acquisition, Technology & Logistics Agency website)

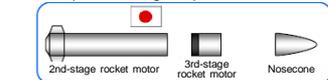
### Future initiatives

- ✓ In line with Government policy, commence preparation of joint production system
- ✓ As contracted, produce and export components for Japan / U.S. deployment missiles

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



Components developed by Japan side  
⇒ 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 components for use in overseas equipment

## Cybersecurity

### FY2016 achievement

- ✓ Completed prototype of InteRSePT<sup>®</sup>\*1 cybersecurity technology for control systems  
\*1 InteRSePT: Integrated Resilient Security and Proactive Technology
- ✓ Started adaptation for defense products
- ✓ Assessing potential applications in control systems for power and chemical plants

### Future initiatives

- ✓ Operationalization: through testing and field data analysis
- ✓ Seek business opportunities based on commercial market demand
- ✓ Product capability enhancement: anomaly detection through machine learning /AI
- ✓ Added value enhancement: broad application of accumulated data



**Cyber lab**  
(technology development and demonstration facility)

Adaptability verification



Data usage



Adaptation to commercial market demand

# 4-3. Growth Strategy #3 Expansion of Existing Fields

## Future fighter program

Defense

### FY2016 achievement

- ✓ Successfully completed first flight of Advanced Technology Demonstrator
- ✓ Demonstrated enhancement of fighter jet-related technologies
  - *Stealth aircraft design technologies*
  - *Stealth radome technologies*
  - *Total heat control management technologies*

### Future initiatives

- ✓ Achieve the world's most advanced technologies for future fighter integration (F-2 successor)

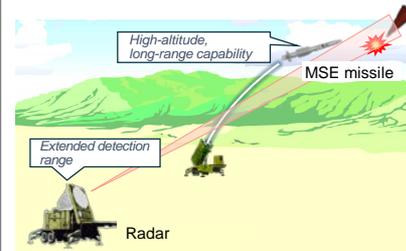


## PATRIOT System

Defense

### FY2016 achievement

- ✓ Received order for MSE contract under FY2016 supplementary budget



MSE : Missile segment enhancement  
BMD : Ballistic missile defense

### Future initiatives

- ✓ Steady manufacture and delivery of MSE missiles
- ✓ Develop business proposals for further BMD capability enhancement



MSE missile

## Launch vehicles

Space Systems

### FY2016 achievement

- ✓ Conducted three H-IIA launches and one H-IIB launches
- ✓ Started preparation for combustion testing of H3 launch vehicle's 1st/2nd stage engines
- ✓ Started business development for H3 launch services



Preparation of combustion testing of 1st-stage engine

### Future initiatives

- ✓ Strengthen MHI brand recognition through high reliability and on-time launches
- ✓ With price-competitive H3 launch vehicle, obtain more launch service orders from overseas customers (also promote public awareness of MHI Launch Services through speaker session and exhibitions at international meetings)



**MOVE THE WORLD FORWARD**

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