Aircraft, Defense & Space Domain Business Plan

Keisuke HIROSE
Senior Vice President, Head of Commercial Aviation Systems

Hisakazu MIZUTANI
President, Mitsubishi Aircraft Corporation

Naohiko ABE
Senior Vice President, Head of Integrated Defense & Space Systems

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MITSUBISHI HEAVY INDUSTRIES, LTD.
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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

<table>
<thead>
<tr>
<th>Business</th>
<th>Group company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy &amp; Environment</td>
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</tr>
<tr>
<td>Thermal Power</td>
<td></td>
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<tr>
<td>Renewable Energy</td>
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<tr>
<td>Nuclear Power</td>
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<tr>
<td>Chemical Plants</td>
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<tr>
<td>Commercial Aviation &amp; Transportation Systems</td>
<td></td>
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<tr>
<td>Commercial / Cruise Ships</td>
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<tr>
<td>Land Transportation Systems</td>
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<tr>
<td>Commercial Aircraft</td>
<td>MRJ</td>
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<tr>
<td>Aero Engines</td>
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<td>Integrated Defense &amp; Space Systems</td>
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<tr>
<td>Defense Systems</td>
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<td>Space Systems</td>
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<tr>
<td>Machinery, Equipment &amp; Infrastructure</td>
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<tr>
<td>Compressors</td>
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<td>Metals Machinery</td>
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<tr>
<td>Turbochargers</td>
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<tr>
<td>Air Conditioning &amp; Refrigeration</td>
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<td>Chemical Plants</td>
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<td>Machinery &amp; Equipment</td>
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<td>Engines</td>
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<tr>
<td>Air Conditioning &amp; Refrigeration</td>
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<tr>
<td>Renewable Energy</td>
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### From April 2017

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<th>Group company</th>
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<tr>
<td>Thermal Power</td>
<td>Compressors</td>
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<tr>
<td>Aero Engines</td>
<td>Nuclear Power</td>
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<tr>
<td>Renewable Energy</td>
<td></td>
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<tr>
<td>Industry &amp; Infrastructure</td>
<td></td>
</tr>
<tr>
<td>Metals Machinery</td>
<td>Material Handling Equipment</td>
</tr>
<tr>
<td>Turbochargers</td>
<td>Engines</td>
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<tr>
<td>Air Conditioning &amp; Refrigeration</td>
<td>Machinery &amp; Equipment</td>
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<tr>
<td>Chemical Plants</td>
<td></td>
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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**

<table>
<thead>
<tr>
<th>(In billion yen)</th>
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</thead>
<tbody>
<tr>
<td>(1.5%) 10.0</td>
</tr>
<tr>
<td>(0.1%) 0.9</td>
</tr>
</tbody>
</table>

**Orders received / Net sales**

<table>
<thead>
<tr>
<th>(In billion yen)</th>
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<tbody>
<tr>
<td>955.0 703.4</td>
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<tr>
<td>600.0 650.0</td>
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**FY2016 net sales** ￥703.4 billion

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2-1. Overview

Aircraft components for
Airbus, Bombardier, etc.

MHI : main wing boxes
787

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

767

MHI : aft fuselage, tail fuselage,
and entry doors

737

MHI : inboard flaps

MHI : aft fuselages and
cargo doors

Boeing

Airbus

Wide-body jets
A380

Wide-body jets

MHI : fwd and aft cargo doors

Bombardier

Wide-body jets

Global 5000/6000

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

Challenger 300/350

MHI : main wings

Narrow-body jets

and business jets

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

FY2015 (Actual)

(1) Yen appreciation

(2) Gradual decline in contract prices, decreasing production, etc.

(3) Cost reductions unachieved

FY2016 (Actual)

FY2017 (Forecast)

- 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
2-3. FY2017 Business Strategy

Strengthen aircraft manufacturing superiority

**Integrated system synergies**

- Traffic control-related
- Advanced flight operation support systems
- Completed aircraft
  - Total system integration

**Component-related synergies**

- Aircraft and space-related
- MRJ
- MU-300
- Global Express
- 777
- 787
- 777X

**Overall business synergies**

**Completed aircraft and Tier-1 synergies**

- **Tier1**
  - Structure and flight performance
  - First shipment of fuselage panels in 1980
- **YS-11**
  - First flight in 1962

**Add value, technology level**

- ’70
- ’80
- ’90
- ’00
- ’10
- ’20

**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

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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.

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.

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

<table>
<thead>
<tr>
<th>Areas of focus</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strengthening of business promotion structure</td>
<td>• Strengthen structure under direct oversight of MHI’s CEO and 3-base development structure</td>
</tr>
<tr>
<td></td>
<td>- Establishment of MRJ Business Promotion Committee</td>
</tr>
<tr>
<td></td>
<td>- Swift decision making and improved communication among global facilities</td>
</tr>
<tr>
<td>Strengthening of development activities</td>
<td>MRJ development team</td>
</tr>
<tr>
<td></td>
<td>- Stay on schedule using strict KPI management of development progress</td>
</tr>
<tr>
<td></td>
<td>Future differentiation technology development team</td>
</tr>
<tr>
<td></td>
<td>- Development of further differentiation technologies</td>
</tr>
<tr>
<td></td>
<td>- Proposal and development of technology strategies for next-generation aircraft concept</td>
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</tbody>
</table>

**Activities**

- Natural icing test
- Cold soak test
- Hot soak test
- Acquisition of FAA type certification of PW1200G engine
- Selection of partner, and commencement of work, to support reworking of EWIS design that caused schedule delays

**Abbreviations**

- EWIS: Electrical wiring interconnection systems
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

<table>
<thead>
<tr>
<th>Main areas of activity</th>
<th>Activities</th>
</tr>
</thead>
</table>
| Further enhancement of decision making         | • Leadership and transfer of authority  
• Achievement of swift decision making                                                        |
| Pursuit of higher level of teamwork            | • Information and knowledge sharing  
• Open-minded top-down/bottom-up approach                                                        |
| Global level of workplace efficiency           | • State-of-the-art IT environment  
• Ongoing improvement of business processes                                                     |

Organizational structure in FY2016

Example

Organizational structure in FY2017

Number of global experts (few ☐ many ☑)  
Global experts fill important posts
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Defense

Space Systems

FY2016 net sales ¥470.6 billion

Defense

Space Systems

F-2 Fighter

SH-60K Maritime Patrol Helicopter

H-IIA Launch Vehicle

H-IIB Launch Vehicle

H-II Transfer Vehicle (HTV)

PAC-3

SM-3

“Jinryu” Submarine

“Akizuki” Destroyer

Type 16 Mobile Combat Vehicle

Type 10 Main Battle Tank

Source: Japan Ground Self-Defense Force website

(C) JAXA/NASA
4-1. Overview (FY2016 Major Projects and Orders Received)

**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

- **Launching ceremonies**
  - October 2016  Asahi-class destroyer "Asahi" Nagasaki
  - Soryu-class submarine “Seiryu” Kobe

- **Type 16 Mobile Combat Vehicle**
  - June 2016  Start of production

**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 2017  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

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4-2. FY2016 Summary & FY2017 Outlook

**FY2016 Summary**

- **Orders received / Net sales**
  - Orders received: FY2015-Actual: 447.7 billion yen, FY2016-Actual: 485.0 billion yen
  - Net sales: FY2015-Actual: 702.1 billion yen, FY2016-Actual: 470.6 billion yen

- **Operating income**
  - FY2015(Actual): 5.3%, 25.7 billion yen
  - FY2016(Actual): 5.9%, 27.9 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.

**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.

MSE : Missile segment enhancement
# 4-3. FY2017 Business Strategy

## Market environment

<table>
<thead>
<tr>
<th>Defense</th>
<th>Space Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cabinet authorized the Three Principles on Transfer of Defense Equipment and Technology (2014)</td>
<td></td>
</tr>
<tr>
<td>• 4th year of Medium Term Defense Program (FY2014-FY2018)</td>
<td></td>
</tr>
<tr>
<td>• A review of the next Medium Term Defense Program (FY2019-FY2023) and National Defense Program Guidelines is under consideration by the Government.</td>
<td></td>
</tr>
<tr>
<td>• Revision of new Basic Plan on Space Policy and Implementation Schedule</td>
<td></td>
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<tr>
<td>→ Average 4 launches per year through 2020</td>
<td></td>
</tr>
<tr>
<td>H3 development</td>
<td></td>
</tr>
<tr>
<td>Start of HTV-X development</td>
<td></td>
</tr>
<tr>
<td>• Formulation of Vision for the Space Industry</td>
<td></td>
</tr>
<tr>
<td>→ Increasing demand for products and services relating to space utilization and satellite data usage</td>
<td></td>
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</tbody>
</table>

## 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.
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

Develop overseas business through existing business partners or relationships

Development of businesses based on commercial market demand

Development of new overseas businesses

Existing businesses

Defense

Space Systems
4-3. Growth Strategy #1  Overseas Expansion

**F-35 fighter**

- **FY2016 achievement**
  - Final assembly and check out of the first F-35 fighter

- **Future initiatives**
  - Delivery of the first domestically assembled aircraft
  - Preparation for MRO&U facility

- Source: http://www.jsf.mil/
- Assembly work
- MRO&U: Maintenance, repair, overhaul and upgrade

**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)

- **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

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

- Image of joint production system
  - (Source: MHI, based on Acquisition, Technology & Logistics Agency website)

**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

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4-3. Growth Strategy #2 Dual-use Development

Cybersecurity

FY2016 achievement

- Completed prototype of InteRSePT®*1 cybersecurity technology for control systems
- 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

*1 InteRSePT: Integrated Resilient Security and Proactive Technology

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

**Future fighter program**

- **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**

- **FY2016 achievement**
  - Received order for MSE contract under FY2016 supplementary budget
  - Steady manufacture and delivery of MSE missiles
  - Develop business proposals for further BMD capability enhancement

- **Future initiatives**
  - MSE : Missile segment enhancement
  - BMD : Ballistic missile defense

**Launch vehicles**

- **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

- **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