Business Briefing on Aerospace Systems

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MITSUBISHI HEAVY INDUSTRIES, LTD.
## Relationship Between Aerospace Systems and Business Domains

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<th>Business domain</th>
<th>Customers/Markets</th>
<th>Segment</th>
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<td></td>
<td>Shipbuilding &amp; Ocean Development</td>
<td>Power Systems</td>
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<tr>
<td><strong>Energy &amp; Environment</strong></td>
<td>• Power companies</td>
<td>• GTCC</td>
</tr>
<tr>
<td></td>
<td>• Gas companies</td>
<td>• Large-scale thermal power plants</td>
</tr>
<tr>
<td></td>
<td>• Resource companies (oil, chemicals, steel)</td>
<td>• Nuclear power plants</td>
</tr>
<tr>
<td><strong>Machinery, Equipment Systems</strong></td>
<td>• Core industries (steel, etc.)</td>
<td>• Stationary engines</td>
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<td></td>
<td>• Automotive industry</td>
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<td></td>
<td>• Logistics, etc.</td>
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<tr>
<td><strong>Transportation</strong></td>
<td>• Airlines (air)</td>
<td>• Commercial Ships</td>
</tr>
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<td></td>
<td>• Shipping companies (sea)</td>
<td></td>
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<td></td>
<td>• Railways (land), etc.</td>
<td></td>
</tr>
<tr>
<td><strong>Defense &amp; Aerospace</strong></td>
<td>• Ministry of Defense (land, sea and air)</td>
<td>• Destroyers &amp; submarines</td>
</tr>
<tr>
<td></td>
<td>• JAXA, etc.</td>
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<td>(1) Market Environment</td>
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<td>(2) Business Strategy</td>
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<td></td>
<td>(1) Market Environment</td>
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<td>(2) Business Strategy</td>
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<td>Summary</td>
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1. Review of FY2011

**Orders received**
- Decreased from the previous fiscal year with the decrease of defense-related orders. The decrease is also attributable to the large-scale order for commercial aircraft received in the previous fiscal year.
- 2010: 708.1 Billion yen
- 2011: 547.8 Billion yen
- Decrease: 160.3 Billion yen

**Net sales**
- Exceeded the previous year because of an increase in all three businesses of defense, commercial aircraft, and space.
- Aircraft deliveries
  - B777: 83 airplanes (+20 planes YOY)
  - B787: 27 airplanes (+10 planes YOY)
- 2010: 472.2 Billion yen
- 2011: 495.5 Billion yen
- Increase: 23.7 Billion yen

**Operating profit**
- The deficit increased from the previous year mainly due to the strong yen.
- 2010: -160.3 Billion yen
- 2011: -10.9 Billion yen
- Increase: 149.4 Billion yen
2. Target of the 2012 Plan

- **Orders received**
  - The overall orders will remain almost flat, with gradual decreases in defense / space related orders offset by an increase of orders for commercial aircraft.

- **Net sales**
  - Increase to the 600 billion yen level with the growth in sales in the commercial aircraft and space business.
  - Aircraft deliveries for FY 2014:
    - B777: 100 airplanes (+17 planes compared to FY 2011)
    - B787: 120 airplanes (+93 planes compared to FY 2011)

- **Operating profit**
  - A return to profitability in 2012 due in part to an improvement in the profitability of commercial aircraft.
  - Operating profit rate: 2.2%
2. Business Policy Aimed for Achievement of the 2012 Plan

Commercial Aircraft
- Complete MRJ development successfully and establish a full production system.
- Develop global SCM.
- Improve profitability through manufacturing innovations.

Defense
- Propose integrated defense systems by coordinating businesses for land, sea and air.

Space
Continuous successes in the launch of H-II A/B
- Enhance competitiveness through development of next-generation primary launch vehicle etc.
3. Commercial Aircraft  (1) Market Environment

Demand for aircraft is right on track for upturn by airline’s recovery and continued growth of economies in emerging countries. High growth is expected in the long term (by 2.5 times in 20 years).

Forecast of Aircraft Passengers Worldwide

- **Revenue passenger kilometers** (billion passenger km)

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual results</th>
<th>Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>2085</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>1413 (27%)</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>1365 (27%)</td>
<td></td>
</tr>
<tr>
<td>2021</td>
<td>5145</td>
<td></td>
</tr>
<tr>
<td>2031 (market share)</td>
<td>World total 13256</td>
<td></td>
</tr>
</tbody>
</table>

- **AVERAGE ANNUAL GROWTH RATE (%)**

<table>
<thead>
<tr>
<th>Region</th>
<th>1991-2011</th>
<th>2012-2031</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORTH AMERICA</td>
<td>3.0</td>
<td>3.3</td>
</tr>
<tr>
<td>EUROPE</td>
<td>5.4</td>
<td>3.1</td>
</tr>
<tr>
<td>ASIA/PACIFIC</td>
<td>7.2</td>
<td>6.6</td>
</tr>
<tr>
<td>OTHER (Incl. CIS)</td>
<td>4.2</td>
<td>6.0</td>
</tr>
<tr>
<td>WORLD TOTAL</td>
<td>4.8</td>
<td>4.8</td>
</tr>
</tbody>
</table>

Source: Japan Aircraft Development Corporation

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3. Commercial Aircraft  (1) Market Environment

Demand for approx. 30,000 new airplanes in 20 years (2012 - 2031)

Forecast on the number of jet airplanes in service and demand for them by size

<table>
<thead>
<tr>
<th>Number of airplanes</th>
<th>Total number of airplanes in service</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>End of 2011: 18,239</td>
</tr>
<tr>
<td></td>
<td>End of 2031: 36,668</td>
</tr>
<tr>
<td></td>
<td>Demand for airplane for 2012 – 2031</td>
</tr>
<tr>
<td></td>
<td>in terms of quantity:</td>
</tr>
<tr>
<td></td>
<td>29,774</td>
</tr>
</tbody>
</table>

- **Narrow-body**
  - 737
  - 787

- **Wide-body**
  - 777

**Regional Jet**
- MRJ

**Number of airplanes by size**
- 20 – 59 seats
- 60 – 99 seats
- 100 – 119 seats
- 120 – 169 seats
- 170 – 229 seats
- 230 – 309 seats
- 310 – 399 seats
- 400 seats or more

**Source:** Japan Aircraft Development Corporation
3. Commercial Aircraft (2) Business Strategy

Develop global SCM.

- Establish supply chains with two hubs.
- Increase overseas production and overseas procurement (shift to overseas cost base)

Supply chain network of Asia centering on Nagoya Aerospace Systems Works as the hub

Supply chain network of North America centering on MHICA as the hub

EU (procurement)
Materials supplier

Russia (procurement)
Materials supplier

Japan (procurement)
Parts supplier
Materials supplier

Japan manufacturing
Nagoya Aerospace Systems Works

Vietnam (manufacturing)
MHIVA

Asia (procurement)
Parts supplier

North America (customers)
Boeing
Bombardier

North America (manufacturing)
MHICA

North America (procurement)
Parts supplier
Materials supplier

B737 flap assembly line in Vietnam (MHIVA)

Challenger 300 assembly line in Canada (MHICA)
3. Commercial Aircraft  (2) Business Strategy

Improve profitability through drastic manufacturing innovations.

- **Assembly work upgrade**
  - Automation of B787 production
    (Coordination with MHI’s Machine Tool division)
  - Development of “moving line” for B777 assembly

- **Parts procurement innovations**

  1) Enhance production management function
     - Develop an integrated line for each parts group
     - Construction/renewal of surface treatment and painting facilities
     - Just-in-time supply of parts to assembly line

  2) Enhance competitiveness of domestic partners
     - Reorganize SCM flow by enhancing coordination among partners
     - Purchasing parts at low prices by giving bulk orders to partners
1) Status

✓ In September 2011, Boeing delivered the first airplane to ANA.

✓ Increase sales and profit by expanding core facilities such as autoclave and investments for production efficiency towards the increase of the production rate up to 10 aircraft per month.

✓ Dec. 2009: Successful first flight
✓ Mar. 2011: Firm orders for more than 830 airplanes
✓ Apr. 2011: MHI wings for 40 airplanes delivered
✓ Aug. 2011: Type Certification
✓ Sept. 2011: Delivery of first airplane

End 2013: 10 airplanes per month delivery
2) Improve production efficiency and introduce automation (to support production rate of 10 airplanes per month)

- Expand facilities and introduce automated equipment to support production rate increase.

- One of the world's largest autoclaves (Expanded)
- Water-jet cutting machine for skin (Expanded)
- Automatic laminator for stringers (Expanded)
- Stringer end trimmer (Introduced)
- Composite material layup equipment (Expanded)
3. Commercial Aircraft  (4) MRJ

1) MRJ’s competitive edge: Economical fuel consumption

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**MRJ**

- Flight distance:
  - Haneda – Hakodate: Approx. 800 km (420 nm)
  - Haneda – Hiroshima: Approx. 800 km (420 nm)

**Competing aircraft**

- Flight distance: 2,950 liters

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**Fuel consumption per flight**

<table>
<thead>
<tr>
<th>MRJ</th>
<th>Competing aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,180 liters</td>
<td>2,950 liters</td>
</tr>
</tbody>
</table>

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**Fuel cost**

<table>
<thead>
<tr>
<th>MRJ</th>
<th>Competing aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>¥320 million</td>
<td>¥440 million</td>
</tr>
<tr>
<td>¥90 million</td>
<td>¥120 million</td>
</tr>
<tr>
<td>¥410 million</td>
<td>¥560 million</td>
</tr>
</tbody>
</table>

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### Economic efficiency comparison

- Annual consumption:
  - MRJ: 4,770 kiloliters (1,260 kilogallons)
  - Competing aircraft: 6,460 kiloliters (1,700 kilogallons)

- Annual savings:
  - MRJ: Approx. ¥150 million
  - Competing aircraft: ¥560 million

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*Average unit price for 2011*
3. Commercial Aircraft  (4) MRJ

2) Status

✓ Oct. 2007: Authorization to Offer (ATO)
✓ Mar 2008: Launch (Concluded LOI with ANA for 25 airplanes (including 10 options))
  → Jun. 2010: Definitive purchase agreement
✓ Apr. 2008: Started business as Mitsubishi Aircraft Corporation
✓ Oct 2008: Established a sales office in the United States
✓ Sept. 2009: Finalized the MRJ configuration (expansion of cabin space, integration of cargo space, main wing materials change)
✓ Oct. 2009: Announcement of the signing of LOI with Trans States Holdings, Inc. for 100 airplanes (including 50 options)
  → Dec. 2010: Definitive purchase agreement
✓ Sept. 2010: From detailed designing phase to the production phase
✓ Apr. 2011: Start assembly work
✓ Jun. 2011: Conclusion of an agreement with Boeing for MRJ customer support
  Conclusion of an LOI with Hong Kong-based ANI Group Holdings Ltd. concerning purchase of five airplanes
Q3 of FY2013: First flight
FY 2015: Type Certification
Mid - 2nd Half of FY2015: First aircraft delivery

✓ : Actual results
3) Topics

- June 22, 2011: Mitsubishi Aircraft Corporation announced its partnership with Boeing at the Paris Air Show
  (Details of the partnership)
  - Spare parts provisioning
  - Service operations and field services
  - Provision of 24/7 customer support


President Egawa of Mitsubishi Aircraft Corporation (left) and Jim Albaugh, president and CEO of Boeing Commercial Airplanes
3. Commercial Aircraft (4) MRJ

4) Schedule change

- First flight: 1st quarter of FY2012 → 3rd quarter of FY2013
- First aircraft delivery: 4th quarter of FY2013 → Middle to 2nd half of FY2015

Reason for the schedule change:
Confirm respective fabrication processes and provide sufficient time for technical studies.

Actions:
- Accelerate development and manufacturing quality verification processes
- Apply expertise from successful deployment of Taiwan bullet train project
- Flight test in U.S.
- Mass production preparation
Reinforcement of the defense industrial base is needed, given growing tension in the security environment.

1) Increase of security threats such as ballistic missiles
- Aegis destroyer (SM-3) and PAC-3 missiles were deployed against the ballistic missile firing in April. MHI also provided technical support.
- Missile development is promoted by China, India, South Korea, etc.

2) Fighter aircraft
- F-35A was selected as the next-generation fighter aircraft. MHI was selected as Potential Domestic Contractor to Participate in Manufacturing and After-servicing of F-35A.
- Neighboring countries is developing 5th-generation fighter aircraft. Japan is also developing the Advanced Technology Demonstrator-X to prepare for development of future indigenous fighter aircraft.

3) Relaxation of Three Principles on Arms Exports
- Overseas transfer of defense equipment etc. for cases related to peace contribution and international cooperation and international joint development and production of defense equipment etc. with countries in cooperating relationship with Japan was comprehensively exempted from Three Principles on Arms Exports.

4) Measures for maintaining, developing, and upgrading defense production and technological base
- Strategies for maintaining defense industrial base are being developed by the Study Group on Defense Production and Technological Bases of Ministry of Defence.
4. Defense (2) Business Strategy

1) Propose integrated defense systems

- Propose integrated defense systems by coordinating businesses for land, sea and air
- Provide various products to efficiently support joint operating framework of JSDF
- Mutual application of defense / space technologies and commercial technologies

C2BMC: Command and Control, Battle Management, and Communications
CDS: Comprehensive Display System
2) Sustain and enhance fighter aircraft production and technological bases.
- From platform manufacturer to weapon systems integrator for fighter aircraft.
- Conclude licensed production contract on F-35A production.
- Achieve indigenous production of the future fighter aircraft by acquiring state-of-the-art technologies through the Advanced Technology Demonstrator-X project, etc.

3) Promotion of international joint development and production
- Promote Japan-US joint development and production of next-generation SM-3 interceptor and supply parts to the U.S. at the production stage.
- Expand the business in response to the comprehensive exemption measures for Three Principles on Arms Exports.
Both the domestic budget for space and overseas demand for the launch of commercial satellites remain flat. Countries are making nationwide efforts to promote space development.

1) The H-II A Launch Vehicle No. 21 was launched successfully. In addition to a JAXA satellite, the Launch Vehicle No. 21 put the first satellite for overseas customers, the Korean Multi-Purpose Satellite 3 (KOMPSAT-3) into orbit successfully.
- In Japan, the restriction on the period for launches has been eliminated and the budget is being shifted from development to utilization.
- Globally, larger satellites are becoming more prevalent (those with a GTO weight exceeding 4 tons are the majority). Demand for the use of satellites has been increasing in emerging countries in Asia, Africa, and South America.

2) Countries are promoting space development. Uses for private-sector initiatives are progressing.
- China is developing a large rocket for the construction of a space station. India is studying the human space activities, including lunar landing.
- The United States uses rockets from the private sector to ship supplies to the space station.

3) Progress in the shift from “non-military use” to “non-aggressive use”
- Preparations for the amendment to the JAXA law in Japan

Satellite launch plan for government use

<table>
<thead>
<tr>
<th>Scheduled date</th>
<th>Rocket</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 21, 2012</td>
<td>H-II B</td>
<td>HTV3 Kounotori</td>
</tr>
<tr>
<td>FY2013 or later</td>
<td>H-II B</td>
<td>HTV4 Kounotori</td>
</tr>
<tr>
<td></td>
<td>H-II A</td>
<td>Global Precipitation Measurement Satellite (GPM)</td>
</tr>
<tr>
<td></td>
<td>H-II A</td>
<td>Global Change Observation Mission 1st – Climate (GCOM-C1)</td>
</tr>
<tr>
<td></td>
<td>H-II A</td>
<td>Advanced Land Observing Satellite – 2 (ALOS-2), etc.</td>
</tr>
</tbody>
</table>

Successful launch of H-II A Launch Vehicle No. 21 (May 18, 2012)

Forecast of demand for commercial satellites

Quoted from “2011 Commercial Space Transportation Forecasts”, May 2010, FAA’s AST and COMSTAC.
5. Space (2) Business Strategy

Improve the ability to launch and increase cost-competitiveness through the development of a next-generation primary launch vehicle. Lead Japan’s space development as the leading company in space products.

1) Secure a base load for launch and transportation services, mainly with governmental demand. Promote activities for receiving orders, including those from overseas customers.
   - Improve launching capabilities by upgrading two-stage rockets and developing next-generation primary launch vehicle to respond to diversified launch needs.
   - Prepare for execute measures aimed at privatization after the successful launch of the H-IIB Launch Vehicle No.3.
   - Suggest shared use with government satellites and promote exports of packages to emerging countries as methods for increasing price competitiveness so as to win orders from overseas customers.

2) Support the operation of the International Space Station and study the development of the human space activity
   - Continue to succeed in reliably launching HTV.
   - Launch new projects including HTV-R (with return functions).

H-III Rocket Series (Tentative name)

An example of future rockets envisioned by MHI

- Product family sharing modules
- Modernization of electronic equipment
- Affordable, first-stage engine (LE-X engine)

MHI’s sales to increase 1.7 times

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6. Summary

Increase the business size to 1 trillion yen in the future through global expansion of each business

Present

- **Commercial aircraft**
  - 30%
  - Improve profitability with international co-development at the core.

- **Defense**
  - 60%
  - Sustain production and technological base for fighter aircraft.
  - System integration upgrade program
  - Propose integrated defense systems by coordinating businesses for land, sea and air.

- **Space**
  - 10%
  - Improve reliability through successful launches.

2012 Plan

- Manufacturing innovations and global SCM innovations
  - Reduction of cost and inventory assets
  - MRJ penetration in the global market

Future

- 60%

- 30%
  - Improve profitability by participating in the joint international development of high value-added components.
  - International joint development and production of defense equipment
  - Enter the global market for defense equipment.

- 10%
  - Lead space development in Japan.
  - Enter the global market.

**Proportion of business (%)**

- **Present**
  - Commercial aircraft: 30%
  - Defense: 60%
  - Space: 10%

- **Future**
  - Commercial aircraft: 60%
  - Defense: 30%
  - Space: 10%

**Summary**

Increase the business size to 1 trillion yen in the future through global expansion of each business.
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