



# Commercial Aviation & Transportation Systems Business Plan

Member of the Board, Senior Executive Vice President,  
President and CEO,  
Commercial Aviation & Transportation Systems

Yoichi KUJIRAI

June 10, 2016

**MITSUBISHI HEAVY INDUSTRIES, LTD.**

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# 1-1. Domain Statement

We launched new group statement and tagline to increase recognition and understanding of MHI Group in global markets on May 9, 2016

It shows as commitment to customers, society and regions (the role of MHI), MHI Group strengths (and the value we deliver), Proactive contribution for global growth, Clarifies competitive advantage and differentiation

## Tagline

# MOVE THE WORLD FORWARD

## Group Statement

At Mitsubishi Heavy Industries Group,  
we channel big thinking into solutions that move the world forward  
– advancing the lives of everyone who shares our planet.

By bringing people and ideas together as one,  
we continue to pave the way to a future of shared success.

Passionately finding new, simpler and sustainable ways to  
power our cities, improve infrastructure, innovate manufacturing  
and connect people and businesses around the globe  
with ever-increasing speed and efficiency.

This is the power of true harmony.  
This is what moving the world forward is all about.  
This is today's Mitsubishi Heavy Industries Group.

## Philosophy of Domain Statement

Built from elements of Group Statement announced on May 9, 2016 relevant to Commercial Aviation & Transportation Systems domain, as part of MHI Group Brand Story

## Concept behind Commercial Aviation & Transportation Systems domain Statement

The Commercial Aviation & Transportation Systems domain helps build infrastructure that transports people and goods necessary to lives everywhere.

Through integration and harmony, the domain builds bridges on land, at sea and in the air connecting people in ways not possible before, creating a global community beneficial to everyone.



# MOVE THE WORLD FORWARD

We are evolving the power of mobility. Redefining how our social infrastructure runs by moving people and freight forward with ever-increasing safety, efficiency and reliability.

Whether it's in the air, on the ground, or across oceans that once divided us, we're connecting people and business like never before. After all, progress requires forward thinking. The kind that helped us create the world's most environmentally-friendly aircraft and transportation systems. Along with ships that link opportunity and success in the most economical and efficient ways imaginable. By embracing integration and harmony, we're creating a more cohesive global community that benefits everyone it touches.

(In billion yen)

## Commercial Ships



LNG/LPG carriers



Ferries



Cruise ships

## Transportation Systems



Rail transit system



AGT

## Commercial Aircraft



787 main wings



777 fuselage

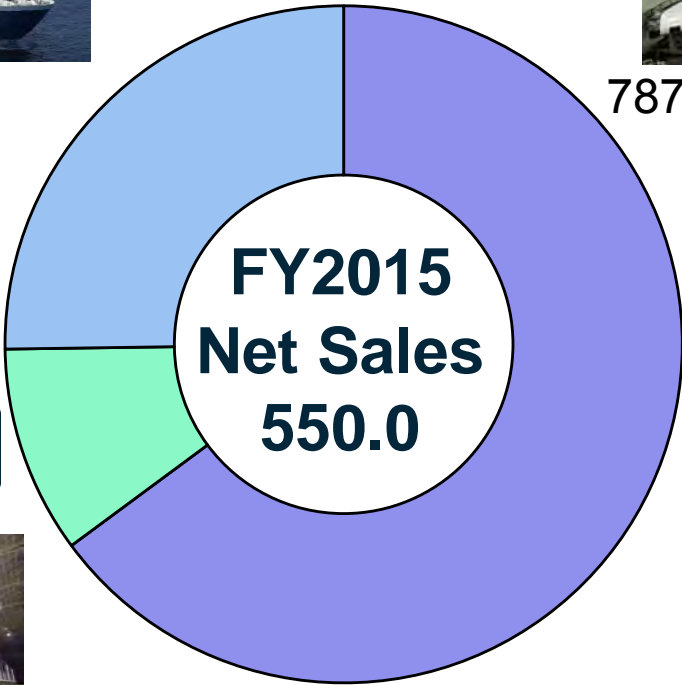
767 fuselage



MRJ



Commercial aero engines



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MRJ: Mitsubishi Regional Jet, AGT: Automated Guideway Transit (for city)

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# 2-1. Main topics in FY2015

## Commercial Aircraft



Robust orders for commercial aircraft 787,777,737, etc.



Boeing 787 production expansion facility goes onstream  
Shimonoseki Composite Wing Box Fabrication Factory



November 2015: Successful first flight of MRJ

## Transportation Systems



October 2015: First delivery of new AGT for Saitama New Urban Transit Co.'s "New Shuttle"



March 2016: Order received to expand APM system capacity at Singapore Changi Airport



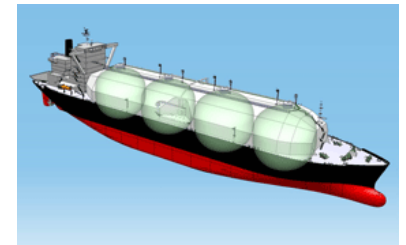
March 2016: Contract awarded for Red Line Construction Project in Bangkok, Thailand

## Commercial Ships

Ship of the year 2015 in Japan awarded



April 2015: Delivery of No.2 large ferry to Hankyu Ferry Co.

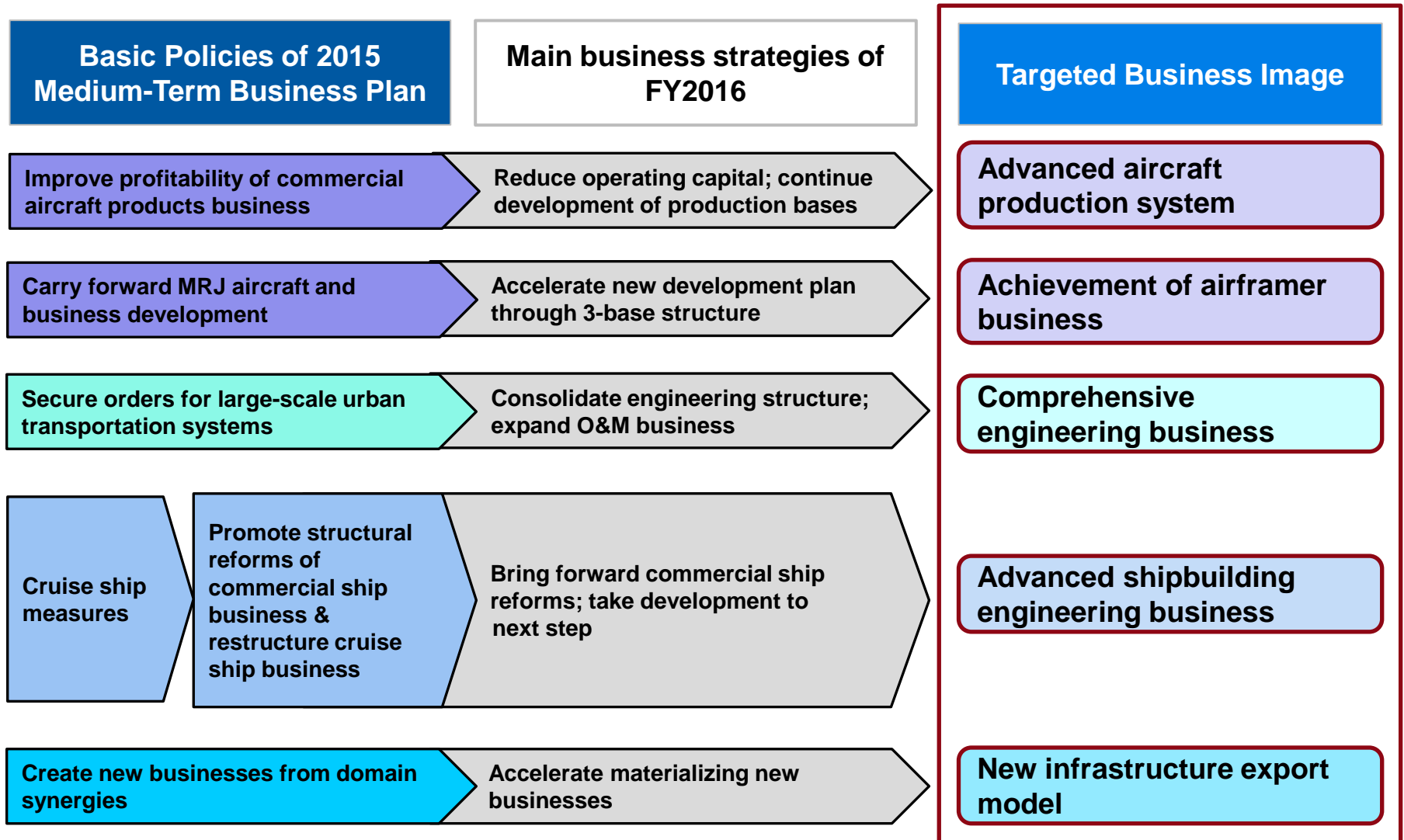


September 2015: Orders received for "SAYARINGO STaGE" next-generation LNG carriers



November 2015: Mitsubishi Heavy Industries Shipbuilding Co. receives first order for very large LPG carrier

# 2-2. 2015 Medium-Term Business Plan Progress Status and Earnings Outlook

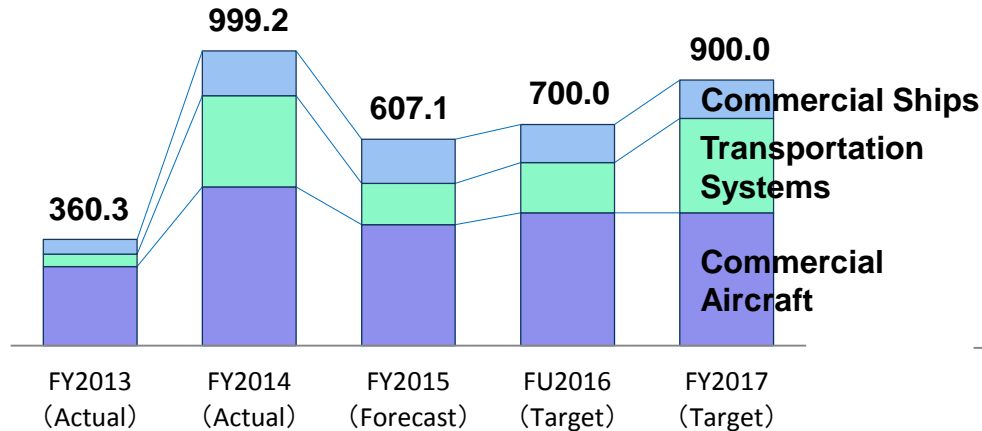


# 2-2. 2015 Medium-Term Business Plan Progress Status and Earnings Outlook

(In billion yen)

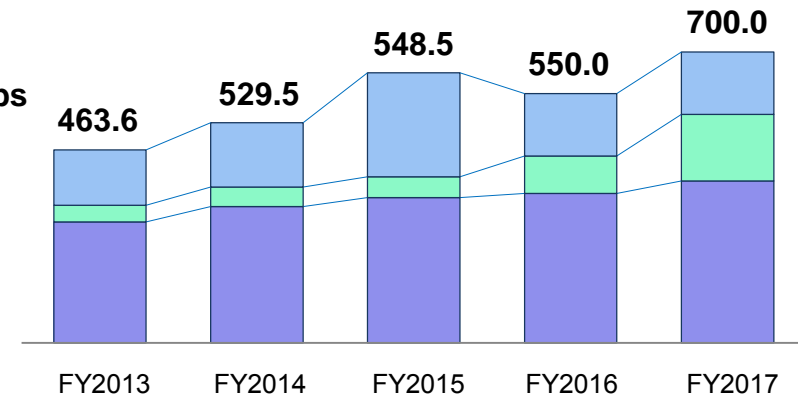
## Orders received

Expand business scale to 900 billion yen



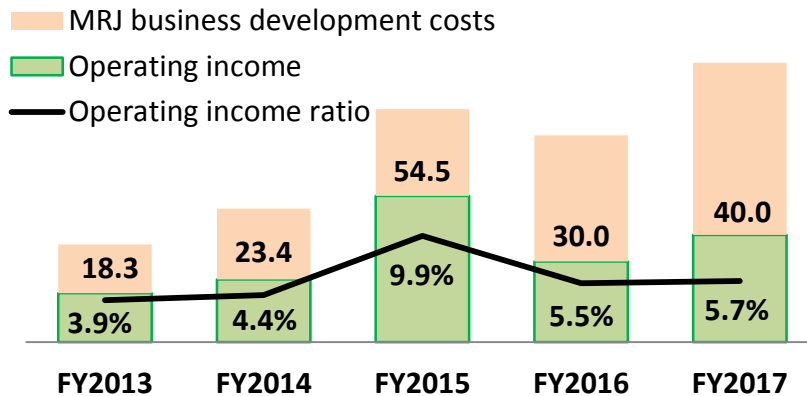
## Net sales

Projected to reach 700 billion yen in final year of 2015 Business Plan



## Operating income

Amid intense orders/price competition between Boeing and Airbus, growing pressure to cut costs



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# 3-1. Commercial Aircraft

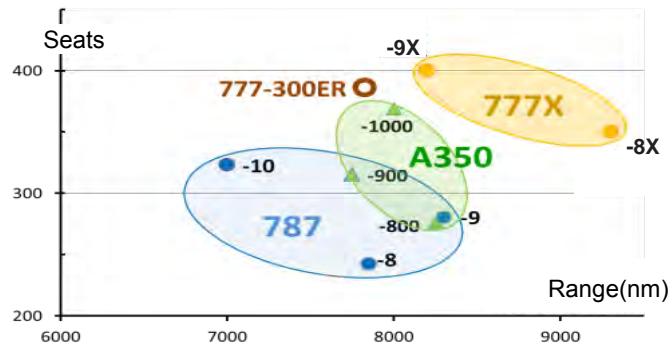
## Market Environment

### Overall

- Market expected to double in next 20 years, to 40,000 airplanes or US\$5 trillion.
- Amid intense orders/price competition between Boeing and Airbus, growing pressure to cut costs

### Twin aisle aircraft

- For the time being, the 777X and A350 are moving from the development phase to the manufacturing phase; development of new generation models is expected to begin in the 2020s.



### Single-aisle aircraft

- The 737 and A320 are competing fiercely, driving volume production up and costs down. The 757X and 737X are considered the 737's next generation.

## MHI's Position

- Strategic partner with Boeing, Pratt & Whitney and Rolls-Royce

## Business Strategies

### Basic Policy

- Improve profitability of commercial aircraft business through production innovations and SCM reforms

### FY2015 results

- Restructured production bases and improved production processes
- Completed consolidation in Hiroshima of 767/777 production bases
- Expanded 787 main wing production facilities (from 10 shipsets/month to 12)

### FY2016 initiatives

- Reform commercial aircraft Tier-1 production system; automate production plant
- Full scale launch of Matsusaka industrial cluster
- Expand production of commercial aero engines

SCM: Supply Chain Management

# 3-1. Commercial Aircraft

## Production base restructuring and capacity expansion

### Facility reinforcement is making steady progress



Production models, etc.	Factory	FY2015	FY2016	FY2017
Composite materials	Oye-nishi	▼ Expansion of 787 main wing assembly plant's paint shop		
	Shimonoseki	▼ September 2015: Completed building expansion ▼ February 2016: Launched operations at expanded plant		
Boeing Panel	Hiroshima	▼ Completed consolidation of 767 production ▼ Completed consolidation of 777 production Completion of Boeing 777X factory refitting		
	Kobe	Introduction of skin formation equipment	Introduction of 777 components facilities	▼ Launch of 777X
737 flap 777 door	MHI Vietnam	Started door production	Expansion of door production	
	MHI Canada	Expansion of local production		

# 3-1. Commercial Aircraft

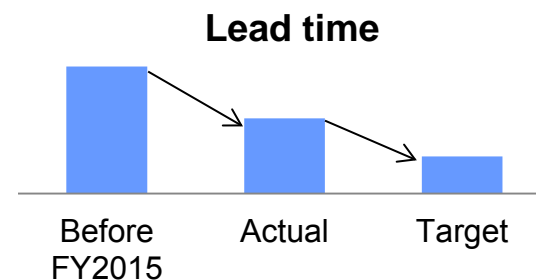
## Reform commercial aircraft production system

Respond to future intensification of commercial aircraft competition, and undertake production system reforms

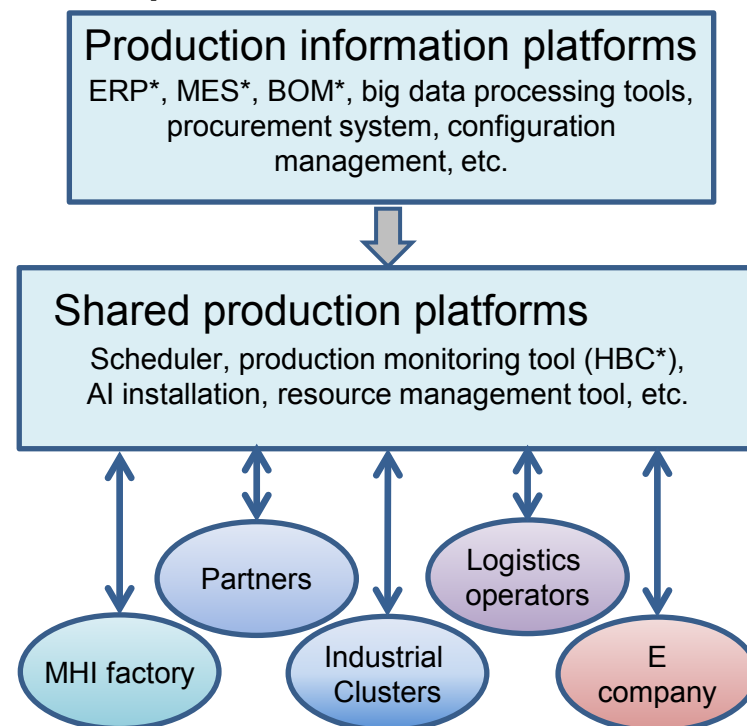
(production elasticity, shorter lead time, reduction of production loss)

### Steps in Production Evolution

	FY2015	FY2016	FY2017
Production process reforms	Fundamental reduction of component production lead time through parts-related supply chain reforms	Launch and development of Matsusaka industrial cluster	
	Production process synchronization through improvements to business processes	Configuration and full-scale adoption of production platforms	
	Realization of automated assembly plants		
Realization of digital factories	Confirmed feasibility of assembly by robot	Installation of factory equipment	Adaptation to 777X
	Manpower saving in inspection work through AI		
IT networking of SCM	Confirmation of feasibility (surface/nondestructive)	AI installation and equipment verification	Adaptation to 777X
		Processing big data of production/quality information management/analysis	
		Confirmation of feasibility	Data collection
		Networking of shared platforms	
		Platform	Networking



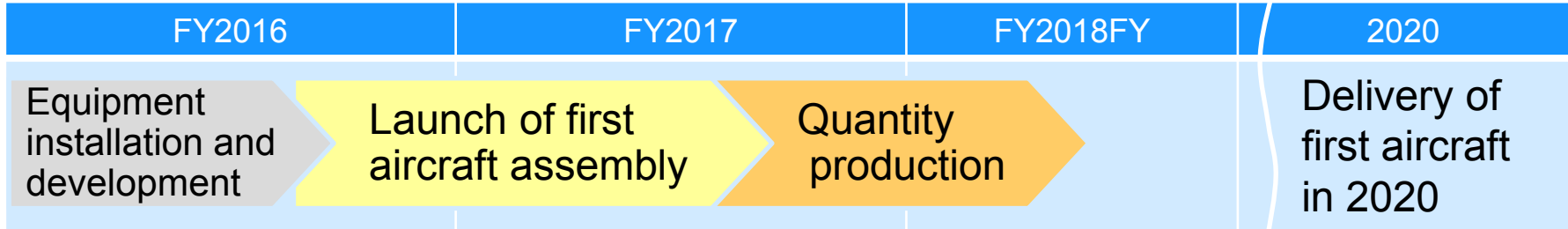
### Aircraft production SCM format



SCM: supply chain management, ERP: Enterprise Resource Planning, MES: Manufacturing Execution System, BOM: Bill Of Materials, HBC: Horse Blanket Chart

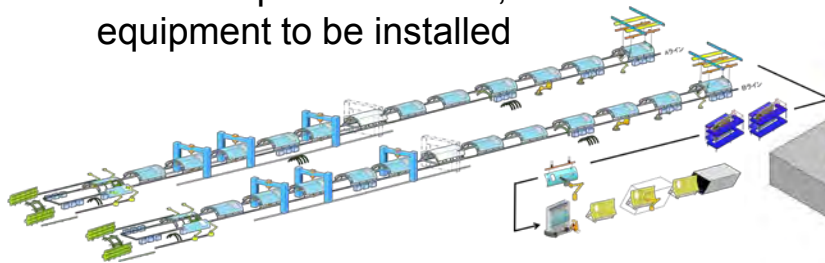
# 3-1. Commercial Aircraft

## Production system reform; production plant automation



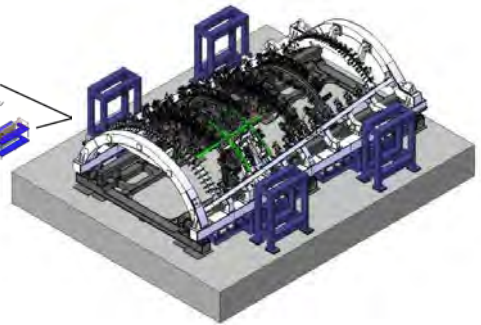
### Equipment Installation

Main assembly plant  
After completion in June, core equipment to be installed

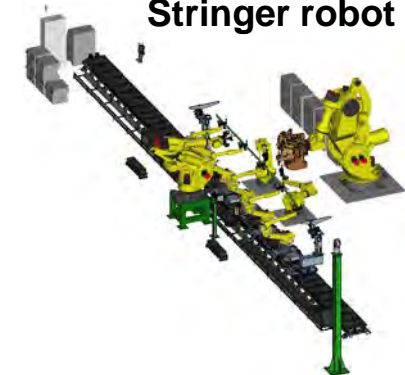


### Development case of automated equipment

Moving jig for large-size panels



Stringer robot



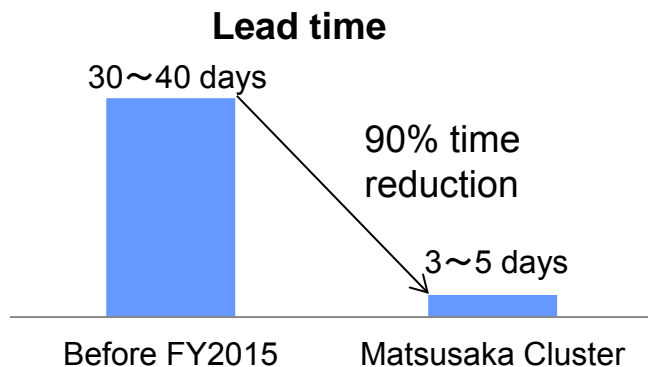
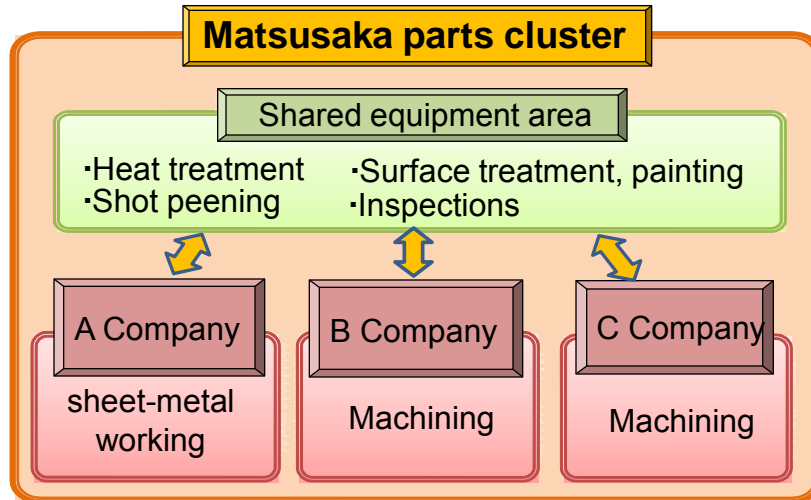
Refitting of former bridge factory



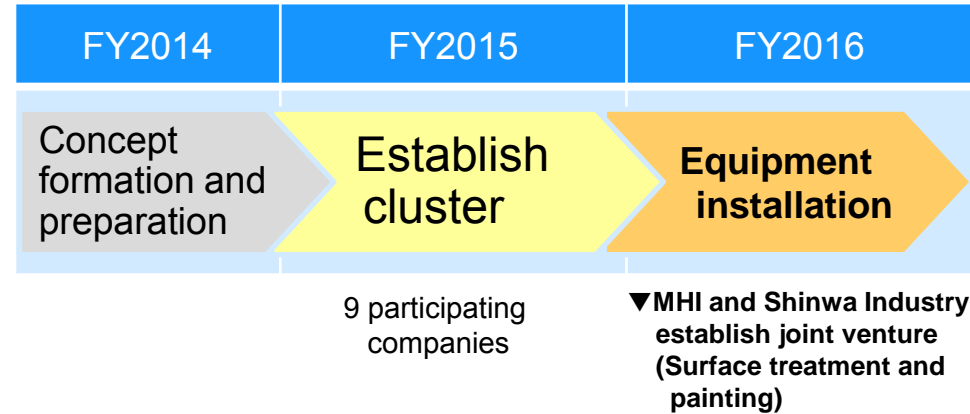


### Cluster concept

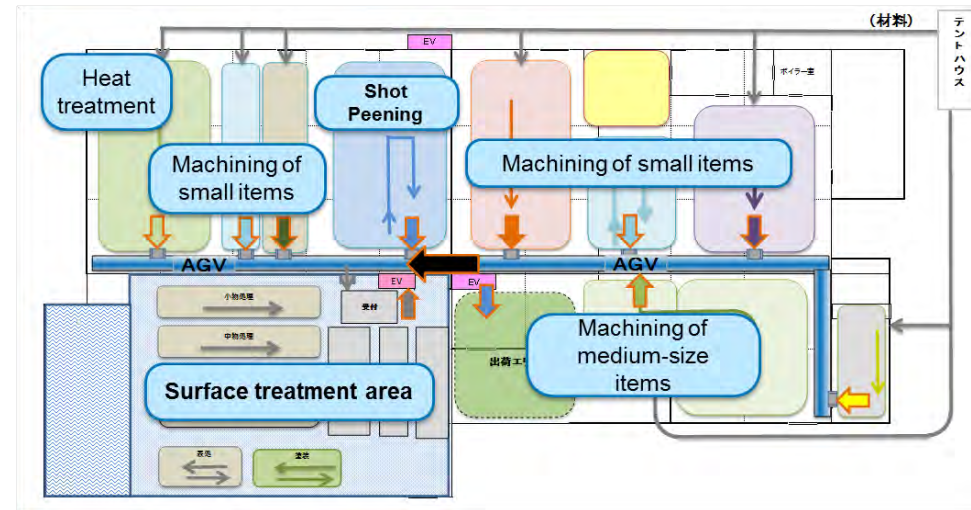
Radically improve lead time and logistics by eliminating outsourcing that spans multiple processes



### Road map



### Matsusaka No.1 Plant



### Secure long-term growth

Strengthen production foundation toward full-scale production expansion and stronger cost competitiveness

#### Starting engine final assembly and expanding MRO activity

- Accelerating start up of full assembly and performance test of MRJ engines.
- Expansion of repair business, adding V2500 engines repair.

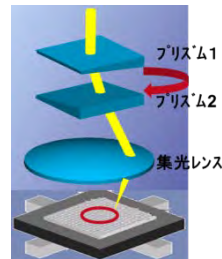


“PW1200G” engine for MRJ

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#### Continuous introduction of cutting-edge technologies into production

- Applying world’s fastest laser cutters to production of combustors (90% reduction in drilling time)

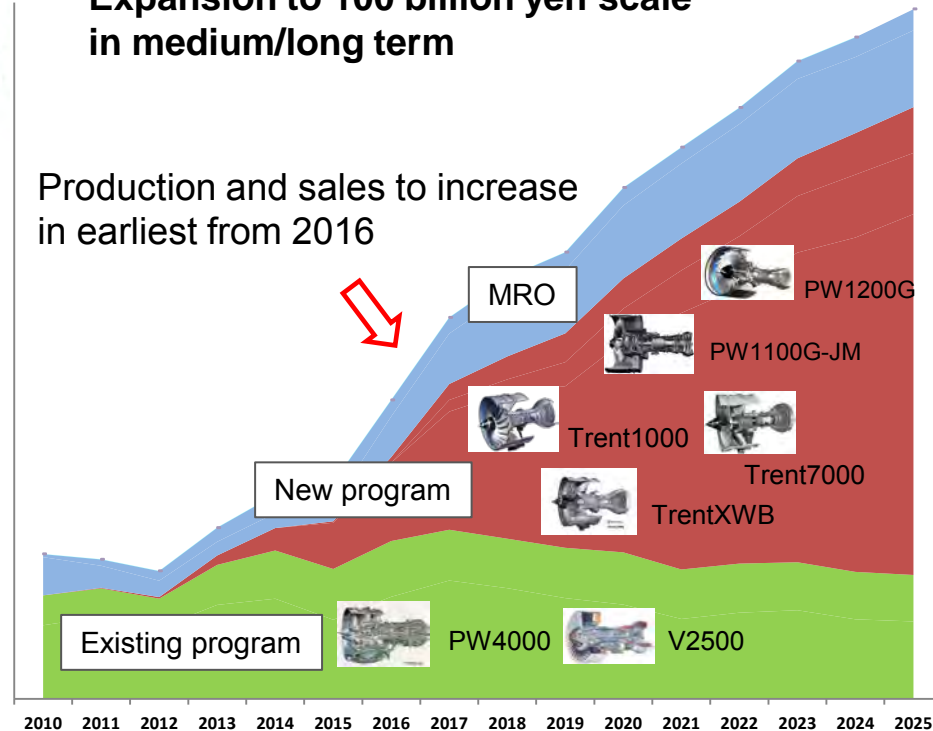


#### Working together with industrial cluster

- Low-pressure turbine blades: mass production already started
- Combustors and cases: accelerating cluster formation

### Commercial aero engine business scale Expansion to 100 billion yen scale in medium/long term

Production and sales to increase in earliest from 2016



MRO: Maintenance, Repair and Overhaul

### Production innovations throughout supply chain

#### Establish integrated SCM methods utilizing IoT technologies

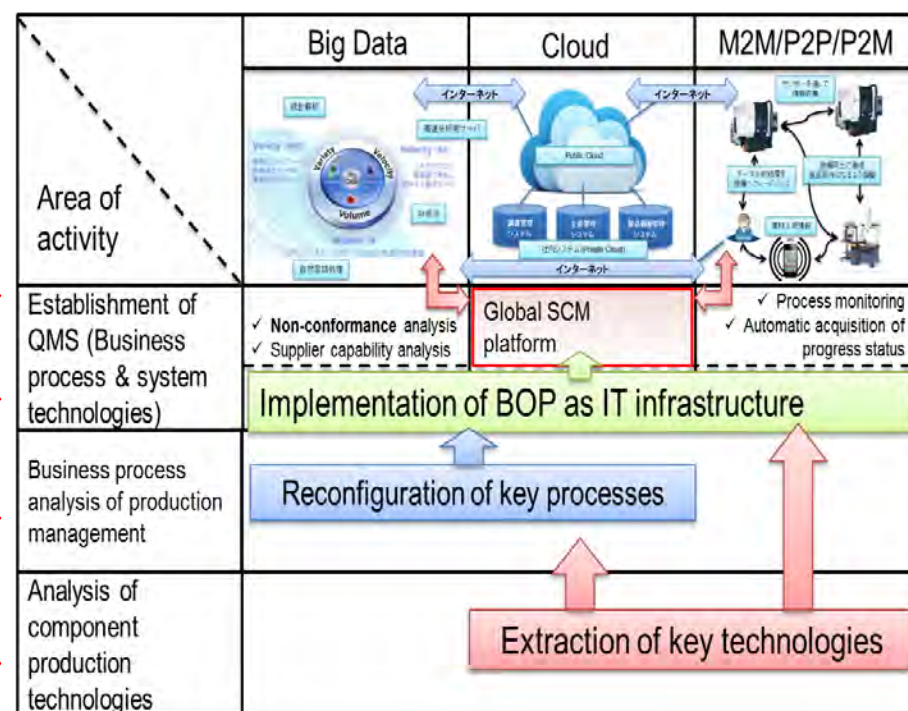
- Expand supply chain along with strengthening of production collaboration
- Urgent need to achieve advanced SCM methods (quality, delivery, cost)



- Improve productivity of production control/technologies
- Build global collaborative framework utilizing IoT technologies

#### Road Map

FY2016	FY2017	FY2018~
<b>STEP1</b> Visualization and Rationalization	<b>STEP2</b> Capability enhancement	<b>STEP3</b> Speed improvement
Global SCM Build global SCM database	Global SCM Build global SCM platform	Advanced SCM information sharing
Real-time visualization		Process simulation
Advanced data analysis	Process Control modeling	Advanced Intelligence
Build BOP platform	Digitize business process	Continuous improvement using business indicators



IoT: Internet of Things, QMS: Quality Management System, BOP: Business Operations Platform, M2M: Machin to Machine, P2P: People to People, P2M: People to Machine

# 3-2. MRJ (Mitsubishi Regional Jet)

## Market Environment

### Market scale

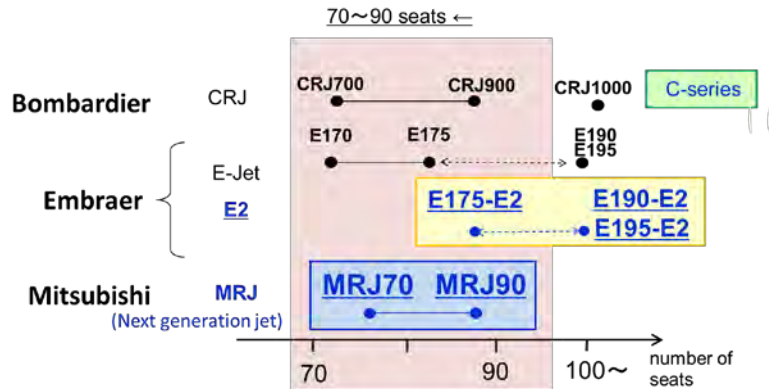
- Over next 20 years, the market for 70-90 seat jets is projected to be around 3,500 units.

### Competitive status

- Embraer plans to introduce its next-generation 90-seat class E175-E2 in 2020.
- Bombardier is focusing on the 100+ seat C-series; presence in the under-90 seat market is to weaken.

### Future outlook

- 90-seat class: Competition between MRJ90 and E175-E2
- 70-seat class: MRJ will be the only next-generation aircraft



## MHI's Position

- MRJ's robust durability and aircraft performance will foster high aircraft value appraisal, giving MHI a solid position in the regional jet market.

## Business Strategies

### Basic Policy

- Aircraft and business development to achieve aircraft performance and outstanding customer support above those of Embraer.
- Development costs, which will peak in FY2018, have been fully factored into the 2015 Business Plan.
  - ⇒ Efforts will focus on a selling price to recover these costs, and cost improvements.

### FY2015 results

- First flight carried out on November 11, 2015. More than 30 test flights already completed.
- Letter of Intent (LOI) signed with Aerolease Aviation, LLC on maximum 20 MRJ aircraft. (first order from aircraft leasing company)

### FY2016 initiatives

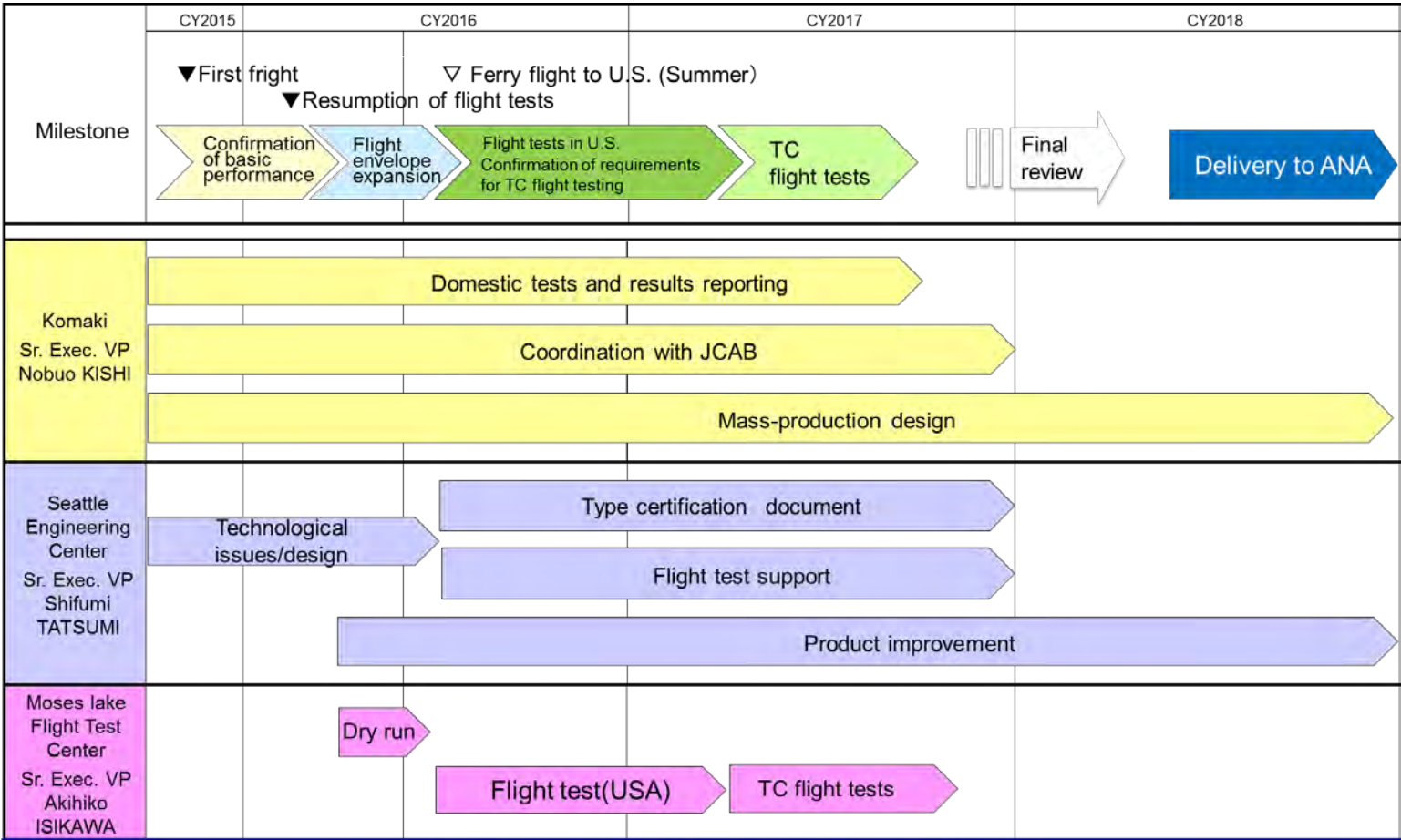
- Develop 3-base development structure in Japan and U.S.
- Prepare mass production structure



Hironichi Morimoto, President Mitsubishi Aircraft Corporation | Jep Thornton, Partner Aerolease Aviation, LLC

### Plans for launching and developing 3 bases in Japan and U.S.

- 3 bases, under the oversight of 3 Vice Presidents, will be linked but operated autonomously
- Basic performance has been confirmed during 22 flight tests of the first test aircraft. Following modifications, testing resumed May 13. The first flight of the second aircraft was carried out on May 31.



TC: Type Certificate, JCAB: Japan Civil Aviation Bureau

# 3-2. MRJ

## Development progress

### Test status

1st Aircraft  
(Flight tests in progress)



2nd Aircraft  
(First flight on May 31)



### Conducted test items

simulation of single engine in-flight shutdown, simulation of power supply in-flight shutdown, tower flyby at Noto Airport, ram air turbine operation, in-flight engine restart, in-flight APU restart, stall characteristics, etc.

### Moses lake flight test center



### Seattle engineering center

Engineering center



Cooperation with experts



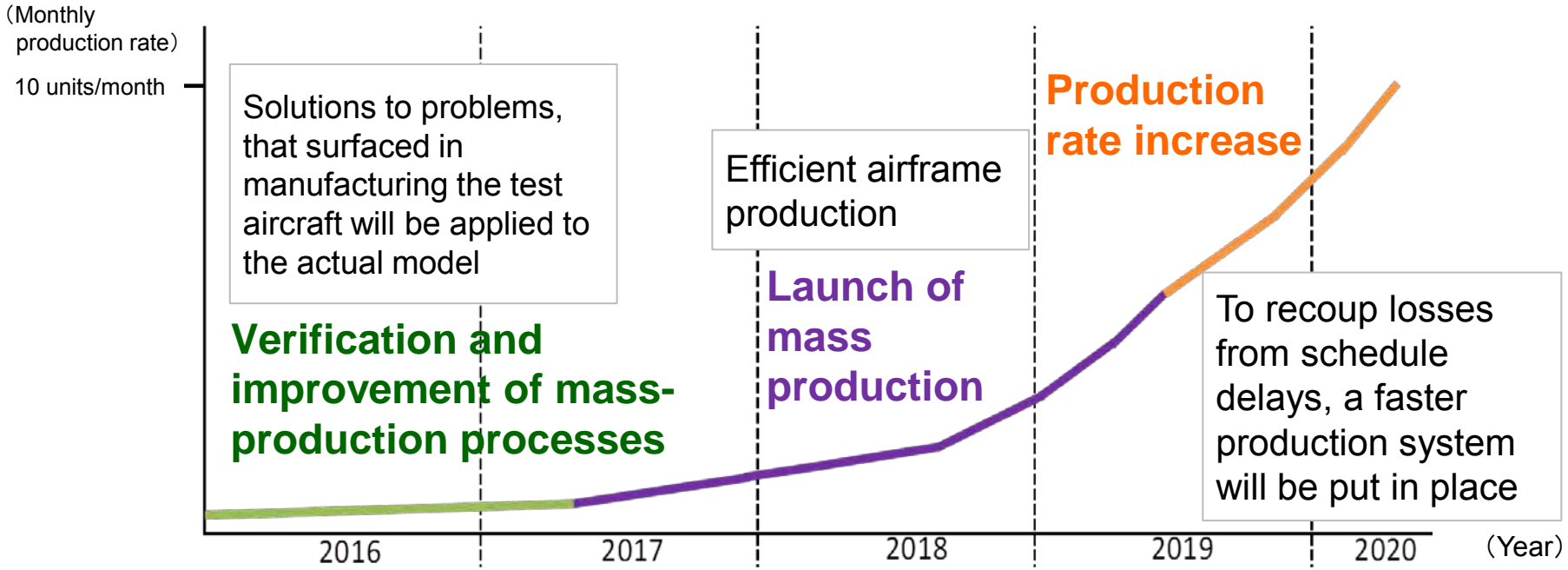
Dry run Start



Kick-off speech for dry run by Sr. Exec. VP, Mr. ISHIKAWA

### Mass-production structure

In line with the development schedule, preparations for mass-production are underway.



Komaki-minami New Plant (final assembly plant) (completed March 1)



Komaki-minami New Plant panoramic view



Paint shop and heavy maintenance Typo hanger rendering (Under construction next to the final assembly plant)

# 3-3. Transportation Systems

## Market Environment

### Market scale

Annual growth: 2-3%. Current scale: 22 trillion yen/year.  
Infrastructure demand is firm in the emerging economies.

### Market trends by area

- North America  
APM projects and high-speed railway plans on underway.
- South America  
Demand to relieve traffic congestion remains high.  
PPP projects are expected future expansion.
- Middle East  
Some plans have been deferred due to oil prices down  
Urban transportation systems market grows steadily.
- South-Eastern Asia  
Projects proceed in Malaysia, Taiwan etc. with their own financing capability.  
High-speed railway plans are also moving forward

## MHI's Position

To accessible markets areas of urban transportation business  
With MHI total solutions  
Based on our strengths in system integration & AGT systems.

## Business Strategies

### Basic Policy

Targets for large-scale urban transportation systems

### FY2015 results

- Design work for the Doha Metro (order received in March 2015) is progressing smoothly.
- Order received (in March 2016) for Bangkok's Red Line, marking the first such order from Thailand.
- Engineering Headquarters was established (in April 2016) to secure human resources and strengthen EPC execution structure.

### FY2016 initiatives

- Receive orders for large-scale transportation projects in the Middle East, Southeast Asia, etc.
- Promote O&M business and Utilization of MIHARA Test Center



# 3-3. Transportation Systems

Strengthening of EPC execution capability, to achieve orders expansion



## Business developments involving large-scale urban transport projects

- 1. Doha Metro
- 2. Jeddah Metro
- 3. Cairo Metro line No.4
- 4. Dubai Metro Extension
- 5. Abu Dhabi Metro



- 1. Bangkok Red line
- 2. KVMRT Line2
- 3. Taiwan Taoyuan MRT Green line

\* Blue lettering indicates orders received.  
 Order received (in March 2016) for Bangkok's Red Line

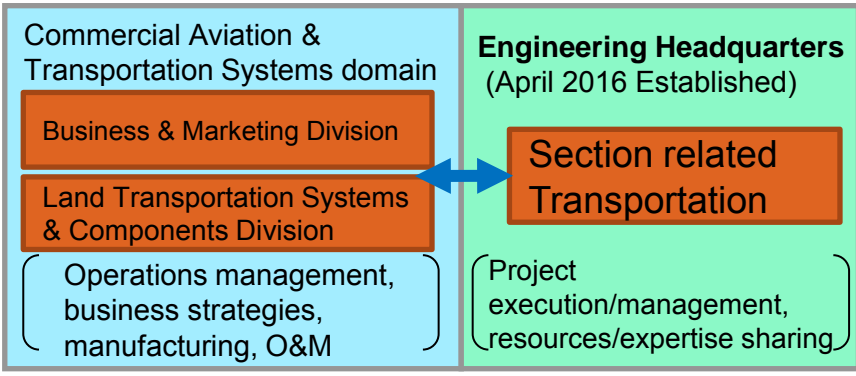
- > Work scope; Design, construction and installation of rail way E&M (Electric and Mechanical) system (except for civil and building works)
- > Railway line length; North line 26.4km, West line 14.6km
- > Delivery; CY2020 (scheduled)

- ### Longer-term high-speed railway projects
- 1. Malaysia/Singapore high-speed railway
  - 2. Texas high-speed railway
  - 3. India high-speed railway



## Strengthening of EPC execution capability

- Engineering Headquarters consolidated the EPC execution functions of the each domains (transportation systems, chemical plants, etc.)
- Enhance overall EPC execution capability, sharing the experience, expertise and human resources currently spread throughout the Company



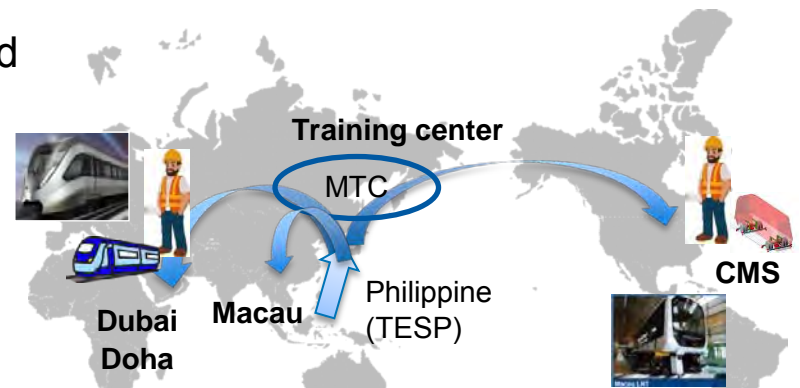
EPC: Engineering Procurement Construction, O&M: Operation & Maintenance  
 MRT: Mass Rapid Transit

# 3-3. Transportation Systems

## Creation of O&M business foundation; AGT business development

### O&M business initiatives

- Acquire O&M work within existing received & planned EPC projects
- Organize formation of O&M business execution
  - Business operators with efficient, safe operation know-how
  - Operators with global experience
  - Local partners in the regional line
- Human resources from overseas group O&M companies moved to the MIHARA Test Center (MTC) and trained there  
MTC developed as base of HR training center



### High-speed AGT development Promotion AGT system business

- High-speed AGT test line dedicated tracks in operation;  
Speed up development of high-speed AGT (80⇒120km/h)
- Lead the AGT market through an expanded AGT lineup (last year operations started on the Saitama New Urban Transit and Nippori Toneri Liner lines in Japan)



March 2016 High-speed AGT test line completed  
June 2016 120km/h trial run (progress)

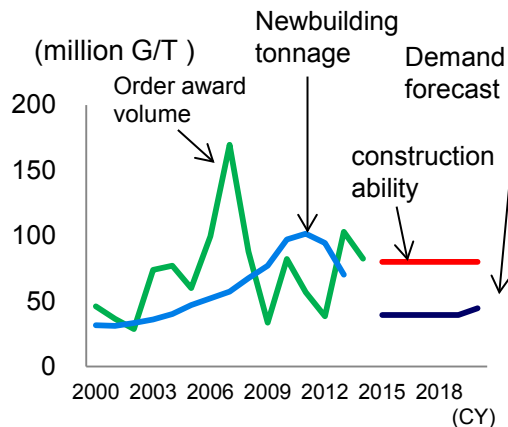


O&M: Operation & Maintenance, AGT: Automated Guideway Transit (for city) CMS: Crystal Mover Service

# 3-4. Commercial ships

## Market Environment

Supply/demand gap expected to remain wide, over-supplied tonnage stays longer



- **Cruise ship**  
Steadily growing. Orders are brisk, with European shipyards operating at full capacity until 2020.
- **Gas carriers**  
After shale gas development projects in North America, projects in east Africa and Canadian west coast to emerge, along with replacement demand for existing LNG carriers.
- **Domestic**  
Existing demand for domestic ferry replacements; emerging demand for training ships, research vessels, etc., especially from public sector

## MHI's Position

- Relatively immune to overall market trends; focus to be on gas carriers, special-purpose domestic ships and cruise ships -- products capable of technical differentiation

## Business Strategies

### Basic Policy

Promotion of structural reforms of commercial ships business; restructuring of cruise ship business.

### FY2015 results

- Commercial ship business affiliated companies established in Nagasaki
- Delivery of 1st ship to AIDA Cruises (March 2016)
- Orders received for LNG/LPG carriers will cover operations through FY2018.  
(Current projects: 11 LNG ships, 9 LPG ships)

### FY2016 initiatives

- Accelerate structural reforms in commercial ship business
- Complete 2nd ship for AIDA Cruises and evaluate feasibility of cruise ship construction business (by cruise ship business evaluation committee)
- Ropax market initiatives

Ropax : Roll-on/Roll-off Passenger Ship/Ferry

# 3-4. Commercial ships

## Commercial ship business structural reforms

Accelerating reforms under a new organization with two affiliated companies established in October 2015: Mitsubishi Heavy Industries Shipbuilding Co., Ltd. and Mitsubishi Heavy Industries Hull Production Co., Ltd.

### Mitsubishi Heavy Industries Shipbuilding Co.

#### Production

- Consolidation and enlargement of area dedicated to on-site subcontracted work
- Shorter lead time: Shorter processing of outfitting and spherical tanks, etc.  
(24 months from construction start to delivery ⇒ target: 17 months)

#### Design & procurement

- Efficiency enhancements through common use of drawings for similar type ships (target: 80%)
- Cluster formation, standardization, etc. for imported outfitting equipment and piping unit

#### Management

- Introduction of area/function based WBS management through reform of cost management
- Visualization and sharing of production information: More efficient setup through preparation of standard BOM

### Mitsubishi Heavy Industries Hull Production Co.

- Carry out capital investment with focus on production streamlining
- Promotion of external marketing of hull blocks: expecting order from Imabari Shipbuilding for large container ship blocks, etc.

WBS : Work Breakdown Structure, BOM : Bill Of Materials

### Status of 1<sup>st</sup> cruise ship

- Christening ceremony held in Hamburg on May 7
- Customer evaluation
- Realized latest technologies with a high level of quality

### Progress of 2<sup>nd</sup> cruise ship

- Launched on March 20; outfitting work now in progress
- Now in discussions with customer on extension of delivery schedule

### Measures

Improvement measures taken based on experience with 1st ship

#### Main improvement measures

- Clarify responsibilities and authority of each area manager; remove top-down management culture
- Schedule design based on manageable scale of personnel to work onboard ship
- Take measures together with the customer concerning work risk arising from quality non-conformities or quality specifications



AIDA prima Christening ceremony



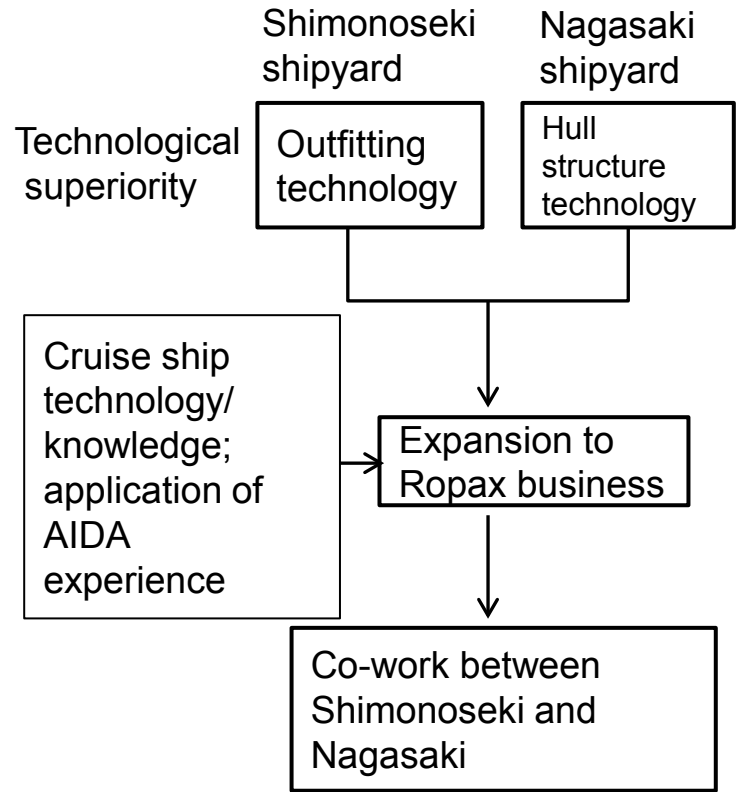
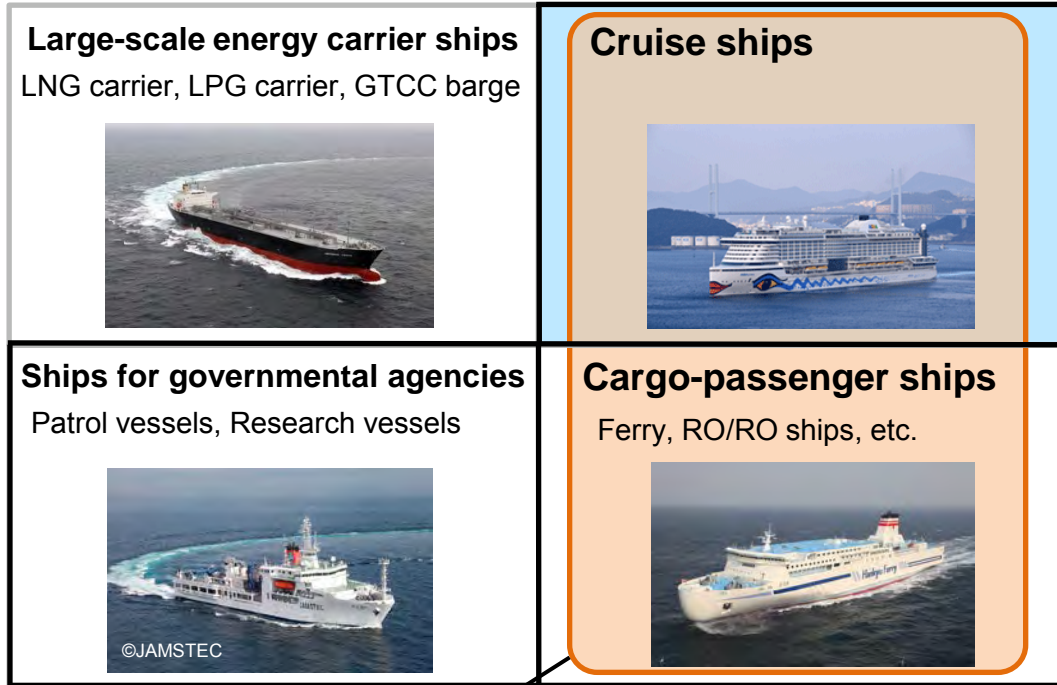
2nd ship under construction

# 3-4. Commercial ships

## Changes of business and production schemes

### Restructuring of commercial ship business scope and operations

Focus on Ropax scope, availing of design and construction capabilities cultivated through construction of cruise ships and domestic ferries



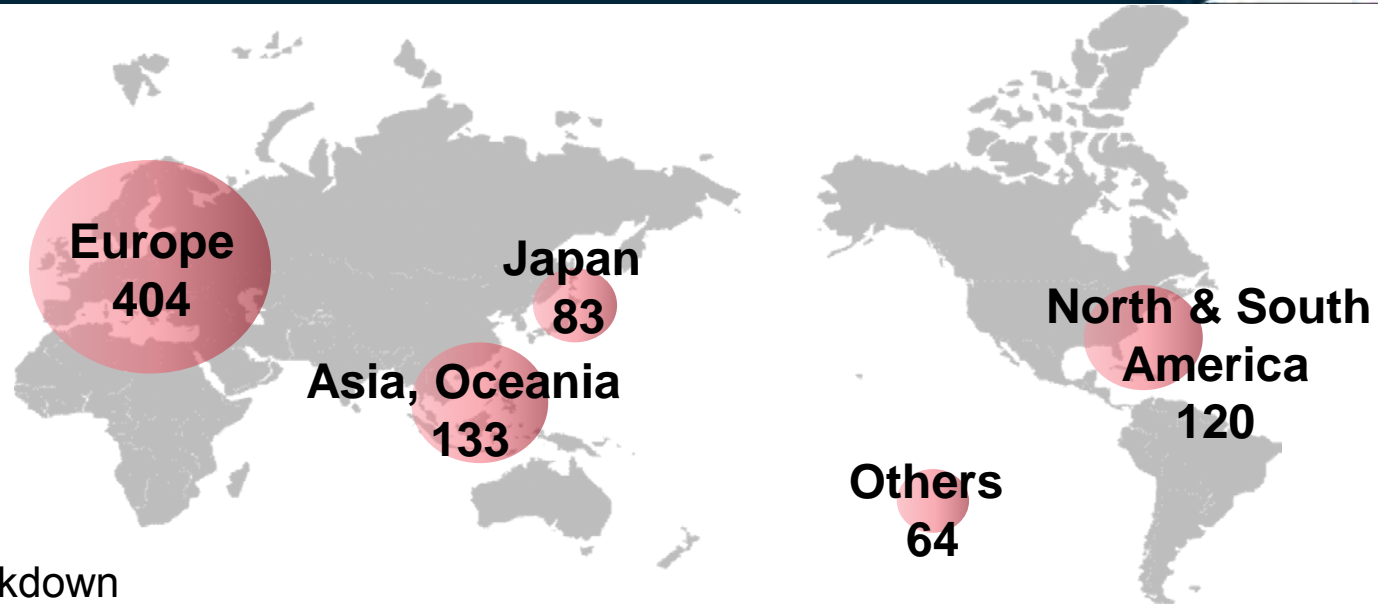
**Cargo-passenger ship market**



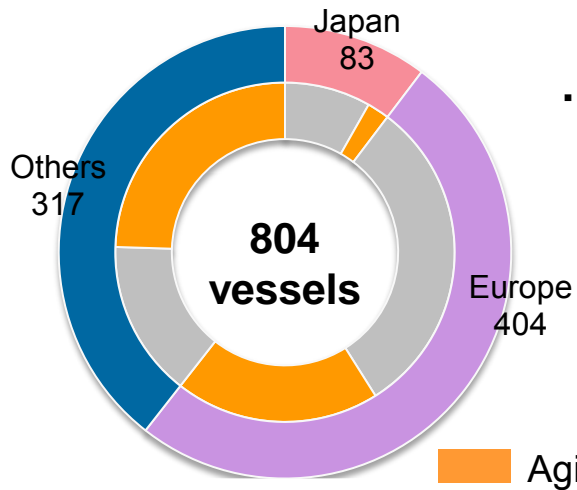
Ropax : Roll-on/Roll-off Passenger Ship/Ferry

# 3-4. Commercial ships

## Ropax market initiatives



Ropax breakdown by vessel age and areas



- Demand to replace aging ships exists in all regions.
- Modal shift in cargo-passenger ships projected in Japanese and Asia/Oceania markets.

European market

Passenger > Cargo

Japanese and Asia/Oceania markets

Passenger < Cargo



Representative Ropax

Ropax : Roll-on Roll-off Passenger Ship/Ferry

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2-2. 2015 Medium-Term Business Plan Progress Status and Earnings Outlook

## 3. Business Strategies

3-1. Commercial Aircraft

3-2. MRJ

3-3. Transportation Systems

3-4. Commercial Ships

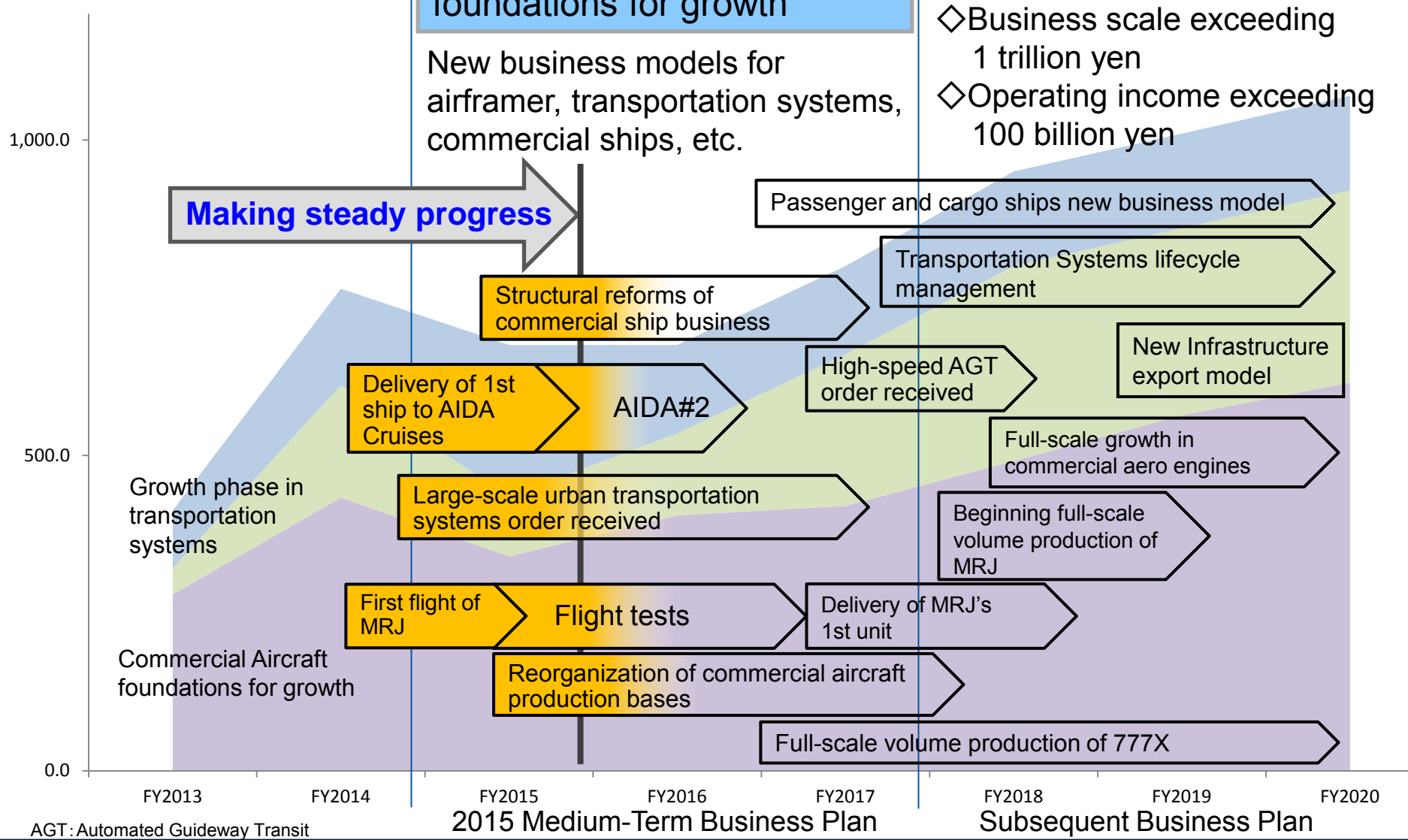
## 4. Summary



# 4-1. 2015 Medium-Term Business Plan: Summary and Outlook



Business scale  
(In billion yen)



**Focus on building foundations for growth**  
New business models for airframer, transportation systems, commercial ships, etc.

**Toward growth track**

- ◇ Business scale exceeding 1 trillion yen
- ◇ Operating income exceeding 100 billion yen

**Making steady progress**

Commercial Aircraft foundations for growth

2015 Medium-Term Business Plan

Subsequent Business Plan

**MITSUBISHI  
HEAVY  
INDUSTRIES  
GROUP**



**MITSUBISHI  
HEAVY INDUSTRIES**

Our Technologies, Your Tomorrow

A red arrow graphic that starts as a thin line under the text and then curves upwards and to the right, ending in a pointed arrowhead.