Commercial Aviation & Transportation Systems Business Plan

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Commercial Aviation & Transportation Systems

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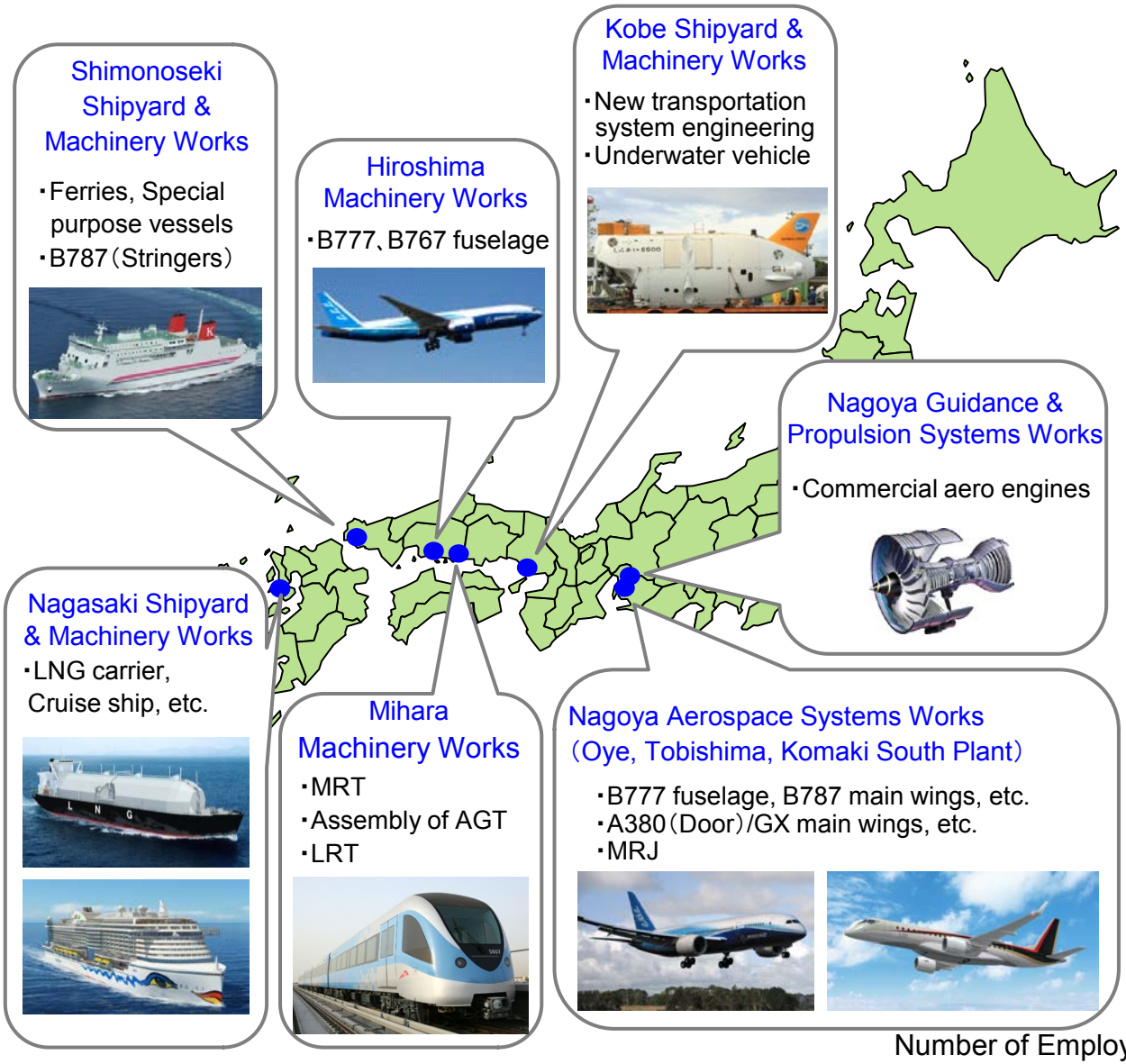
6.8.2015

MITSUBISHI HEAVY INDUSTRIES, LTD.

Table of Contents

1. Business Overview

1. Major Products & Production Bases / Positioning of Commercial Aviation & Transportation Systems



Shimonoseki Shipyard & Machinery Works
- Ferries, Special purpose vessels
- B787 (Stringers)

Hiroshima Machinery Works
- B777、B767 fuselage

Kobe Shipyard & Machinery Works
- New transportation system engineering
- Underwater vehicle

Nagoya Guidance & Propulsion Systems Works
- Commercial aero engines

Nagasaki Shipyard & Machinery Works
- LNG carrier, Cruise ship, etc.

Mihara Machinery Works
- MRT
- Assembly of AGT
- LRT

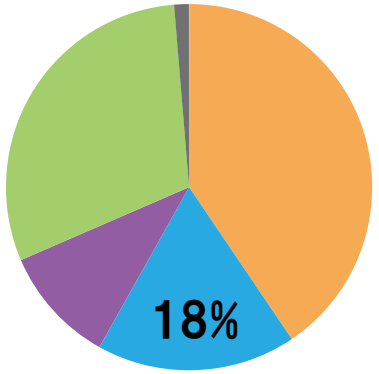
Nagoya Aerospace Systems Works (Oye, Tobishima, Komaki South Plant)
- B777 fuselage, B787 main wings, etc.
- A380 (Door)/GX main wings, etc.
- MRJ

MRT: Mass Rail Transit, AGT: Automated Guideway Transit, LRT: Light Rail Transit

Number of Employees (consolidated)7,129

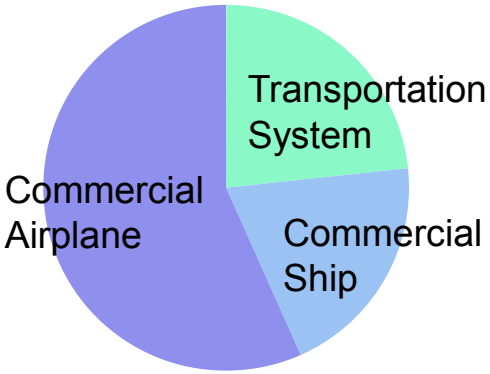
Companywide Positioning (FY2014)

Business Scale



Domain Breakdown (FY2014)

Business Scale



2. Review of 2012 Medium-Term Business Plan

2. Domain Achievement Level

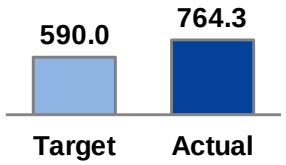
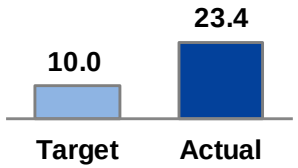
Core Measures of 2012 Medium-Term Business Plan

Measures to address core issues
Formation of domain synergies

- Strengthen Commercial Airplane Product Business
- Preparation/review of MRJ development structures
- Transportation systems: large-scale overseas orders
- Measures for commercial vessels and cruise ships
- Domain formation / Synergy configuration

(In billion yen)

Booking of special loss for cruise ships completed in FY2014; MRJ business development costs covered by other businesses

FY2014	Achievement Level	Contributing factors
Business Scale 	129%	Increased orders for Transportation systems and MRJ
Operating income 	234%	MRJ development costs offset by currency exchange profit and growth in commercial airplane products

- Commercial airplane products business is on the growth track.
  Strengthen the foundations for next production process reformation
- A specific work and delivery schedule was drawn up for the MRJ's first unit.
- Large-scale overseas transportation system orders were received, expanding steady business field .
- In the commercial ships business, measures were taken with respect to cruise ship construction.
  Reforms were also carried out for commercial shipbuilding in Nagasaki.
- Three business areas were integrated, unified management was promoted, and domain synergies were developed.

3. 2015 Medium-Term Business Plan

Lay the foundations for growth to 1 trillion yen business by developing MRJ business and structurally reforming the commercial ships business.

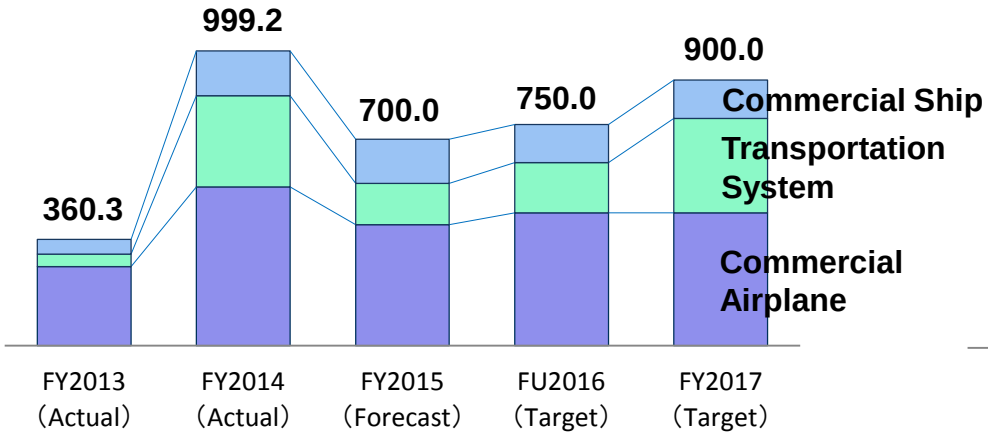
Basic Policies of 2015 Medium-Term Business Plan	Targeted Business Image
Improve profitability of commercial airplane products business	Advanced airplane production system
Carry forward MRJ aircraft and business development	Achievement of finished aircraft business
Secure orders for large-scale urban transportation systems	Comprehensive engineering business
Cruise ships measures → Promote structural reforms of commercial ships business & restructure cruise ships business	Advanced shipbuilding engineering business
Create new businesses from domain synergies	New infrastructure export model

3. Basic Policies & Business Strategies

(In billion yen)

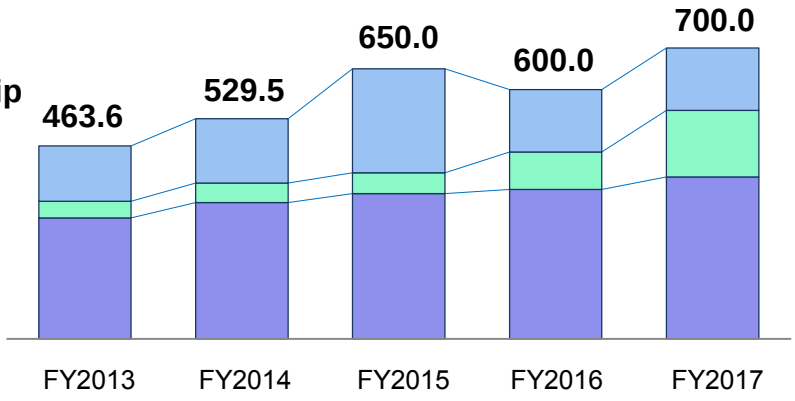
Orders received

Projected business scale expansion to approx. 900 billion yen



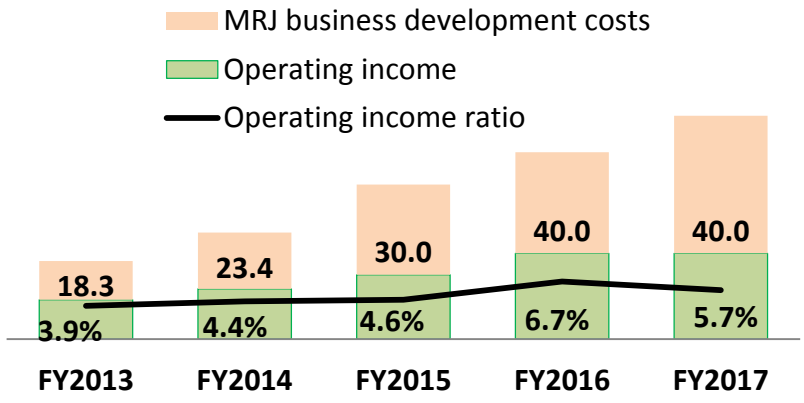
Net sales

Projected expansion to over 700 billion yen in FY2017



Operating income

Over 40 billion yen, with MRJ business development costs offset by other products



4. Business Strategies

4-1. Commercial Airplane

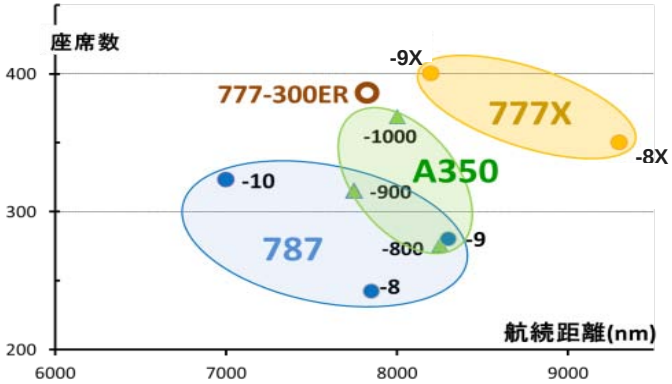
Market Environment

＜Overall＞

・Market expects to grow in double in next 20 years, as the scale of the business, 40,000 airplanes and US$5 trillion.

＜Twin aisle airplane＞

For the time being, the B777X and A350 are in the development to sustaining phase; a new development phase is expected to begin in the 2020s.



＜Single-aisle aircraft＞

The B737 and A320 are competing fiercely, driving volume production up and costs down. The B757X and B737X shall be considered the B737's next generation.

MHI's Position

・Strategic partner with Boeing, P&W and R/R

P&W：Pratt & Whitney, R/R：Rolls-Royce

Business Strategies

Basic Policy

・Improve profitability of commercial airplane products business through production innovations and SCM reforms

Measures

(1)Reorganize production sites and strengthen production capacity

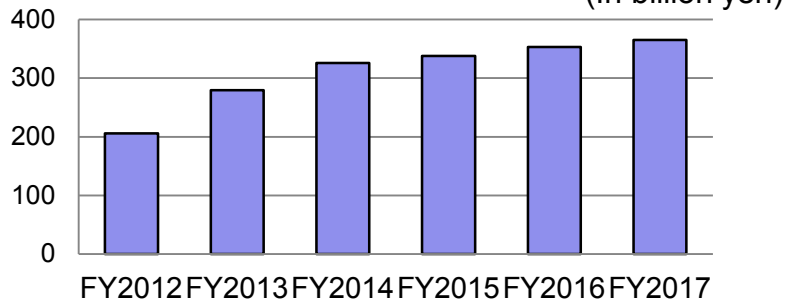
(2) Reform manufacturing processes of airplane products

(3) Lay the long-term growth foundations of the commercial aero engine business

(4) SCM Reform and Create industrial clusters

＜Business Scale＞

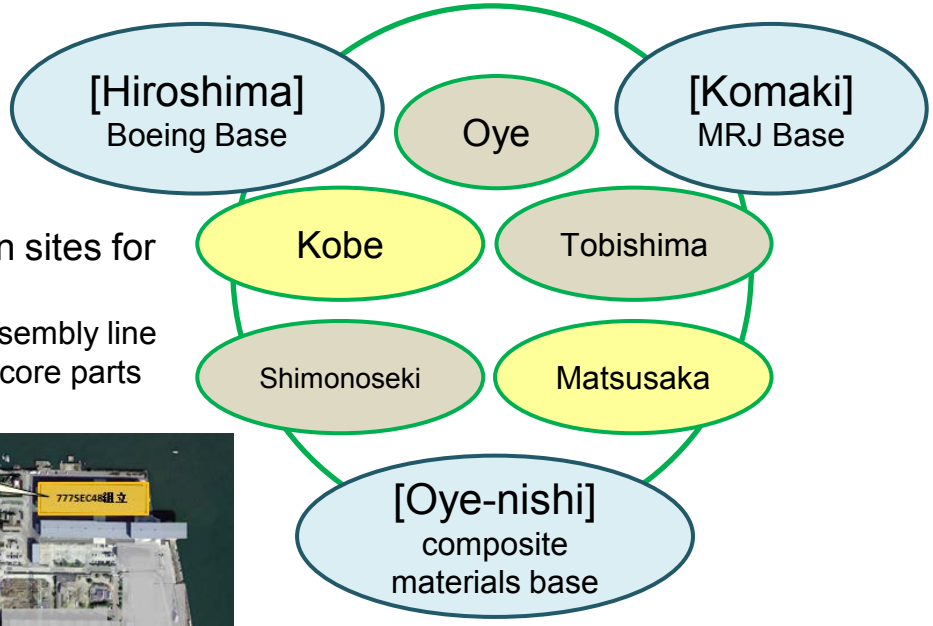
(In billion yen)



SCM：Supply Chain Management

Consolidate parts and components at Komaki, Oye-nishi and Hiroshima plants

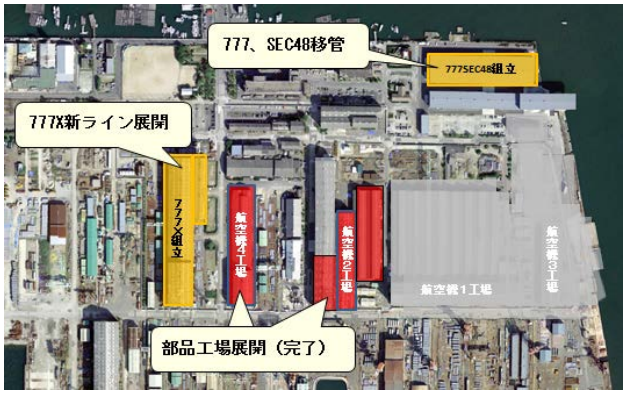
Launch new parts factories in Kobe (integrated production of MRJ main wing parts) and Matsusaka (industrial cluster for manufacturing small parts; assembly of MRJ tail wings)



Hiroshima Eba Plant

Consolidate production sites for B777/B767

- Develop new B777X assembly line
- Facilities for machining core parts



Komaki Minami New Plant

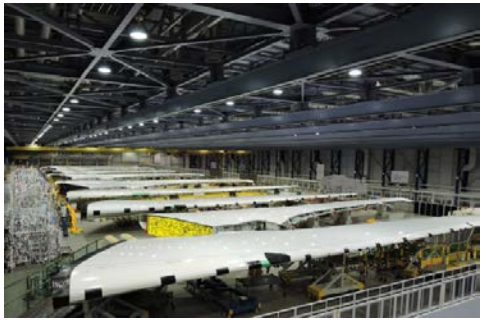
Accommodate production of 10 MRJ units per month

- Final assembly
- Painting factory, heavy equipment hangar, etc.

Oye-nishi Plant

Implementation of B787 production rate 12/14 shipsets per month

- Implement production rate up: building expansions of composite factory and assembly factory
- Automated facilities: painting robots, automated composite lay-up machines, etc.



4-1. (2) Reform manufacturing processes of airplane products

Production Process Management Innovation ～ Timetable management → Shorten L/T, reduce inventories

→ Automated assembly through use of robots → Eliminate labor-intensive manufacturing

→ **Global SCM employing IoT**

Automated panel handling + automated riveting + robots

→ Unmanned assembly / assembly without jigs / automated handling

- Real-time monitoring of production/quality information
- proactive use of AI

Quality stabilization and robust production through proactive use of massive data from production lines.

Automatic skin attachment to jigs

Automated assembly through collaborative control of robots

- Jig communization / minimization
- Handling of long/low-rigidity parts by multiple robots

Automated drilling through collaborative control of robots

Defect detection

Measuring technology advancement

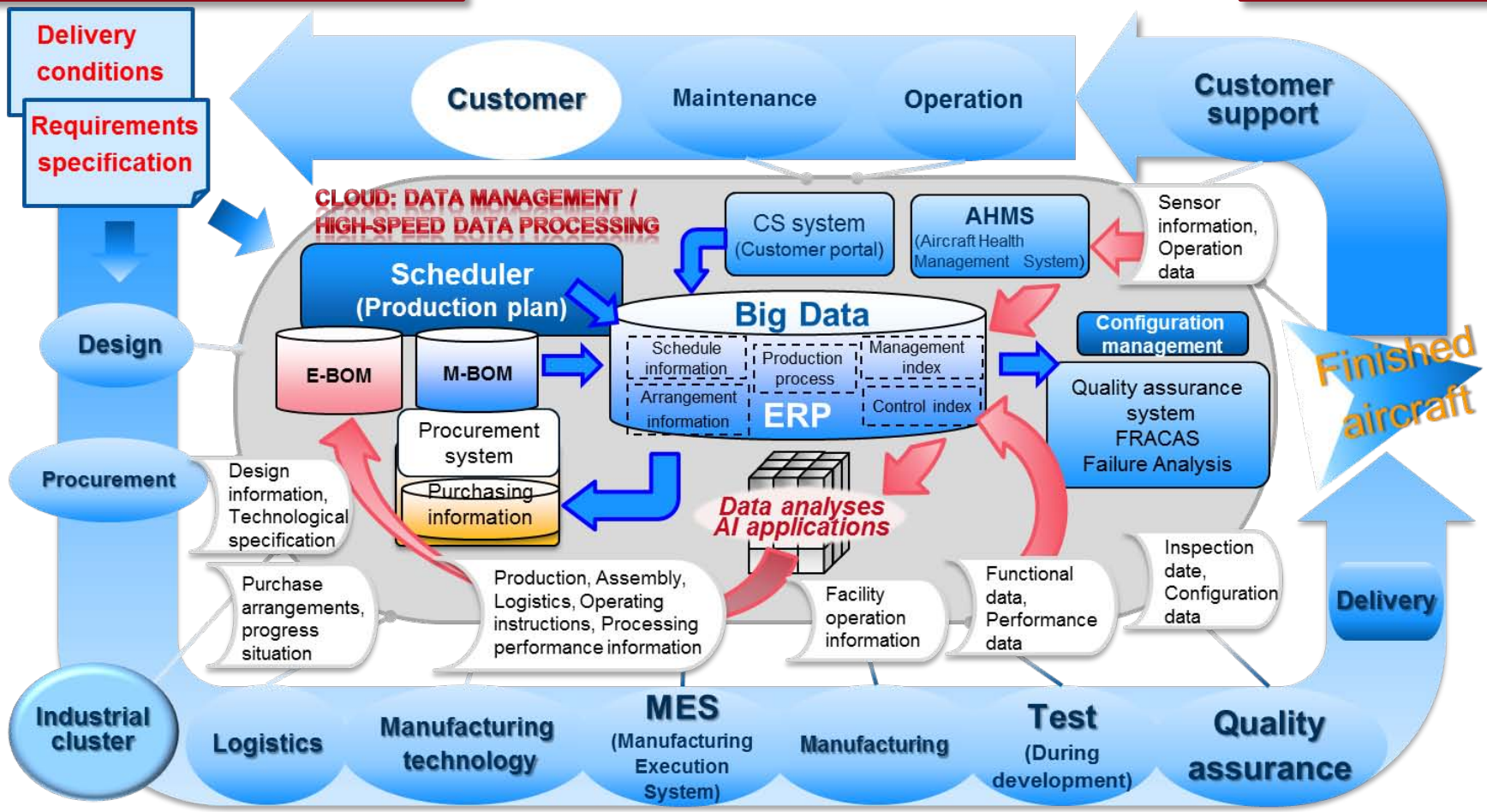
- Automation of inspection for work shape, gap, etc.
- Automation of evaluation of sealing, detection of defects difficult to quantify

L/T : Lead Time, IoT : Internet of Things, SCM : Supply Chain Management, AI : Artificial Intelligence

Production Process Management Innovation ～ Timetable management → Shorten L/T, reduce inventories

→ Automated assembly through use of robots → Eliminate labor-intensive manufacturing

→ **Global SCM employing IoT**

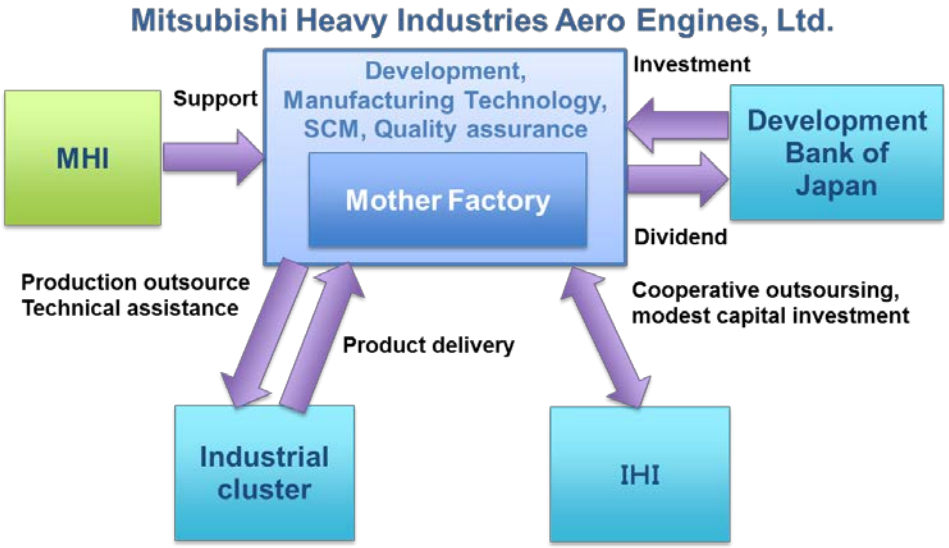


L/T : Lead Time, IoT : Internet of Things, SCM : Supply Chain Management, BOM : Bill of Materials, E-BOM : Engineering-BOM, M-BOM : Manufacturing-BOM, ERP : Enterprise Resource Planning, FRACAS : Failure Reporting, Analysis, and Corrective Action System, AI : Artificial Intelligence, MES : Manufacturing Execution System

Enhancement of long term business foundation

Strengthen financial and production bases through establishment of company dedicated to engine business (Oct 2014)

- Readiness for further investment which require huge initial investment and long term recovery
- Cooperative and long term outsourcing to industrial cluster & IHI

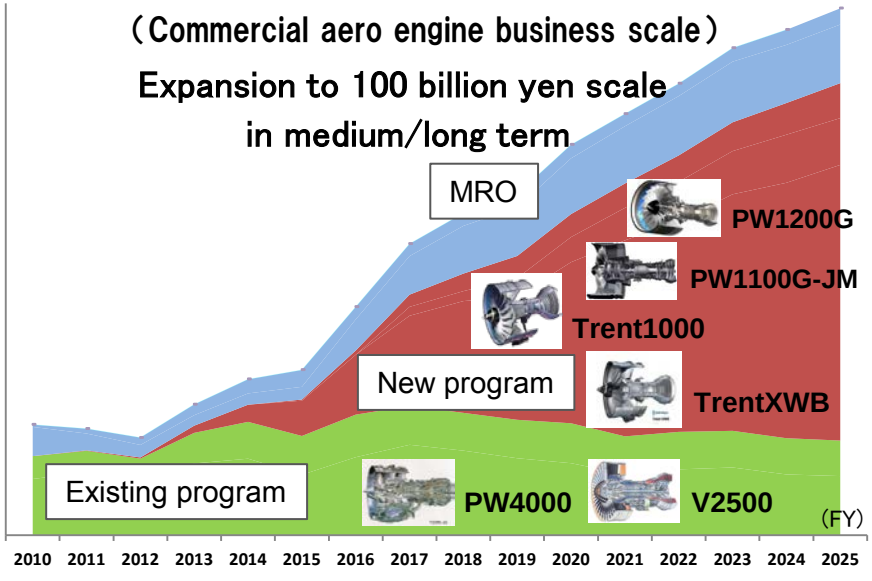


MRO：Maintenance, Repair and Operations

Foothold for growth

Strengthen business portfolio & competitive operations

- Combination of continuous & robust growing programs
  Trent1000/B787, TrentXWB/A350, PW1100G–JM/A320, PW1200G/MRJ, MRO, etc.
- Expansion of industrial cluster
  Low-pressure turbine blades - formed with Hoden Seimitsu Kako Kenkyusyo as core company
  Planning for combustor and casings also



Production flow innovation and expanded production capacity from cluster formation

Aims of cluster formation

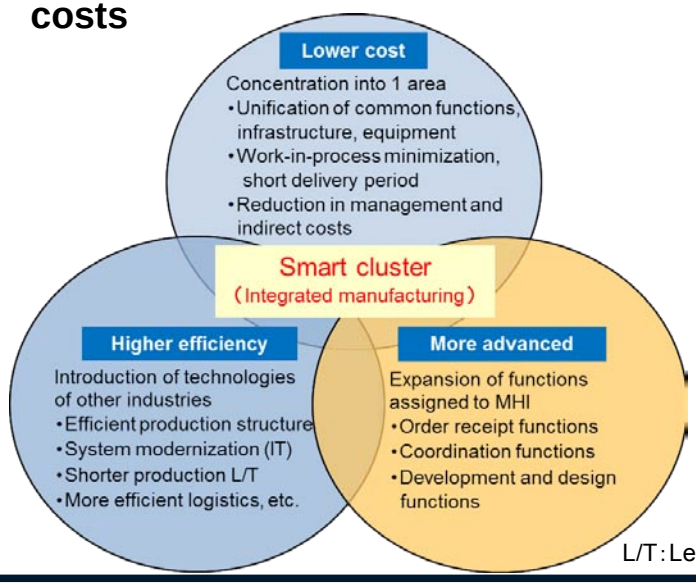
Current Status

Numerous specialized processes cause many repetitive come-and-go transaction in outsourcing Longer L/T, loss costs

CompanyA → MHI → CompanyB → MHI → CompanyC ……

Cluster formation

Radical reduction of L/T and management costs

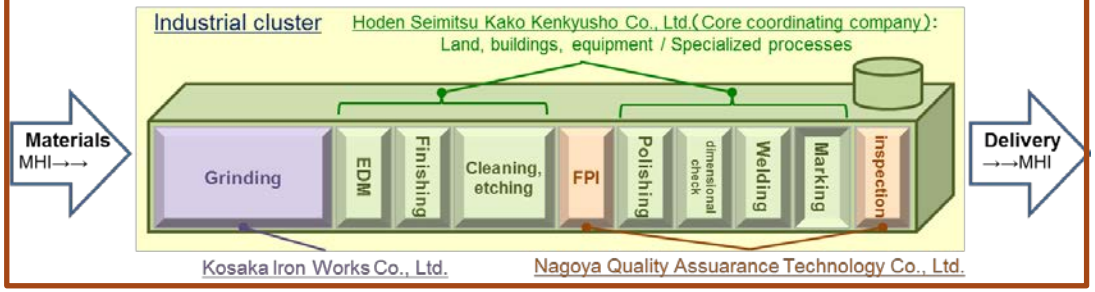


L/T : Lead Time

Formation of industrial clusters

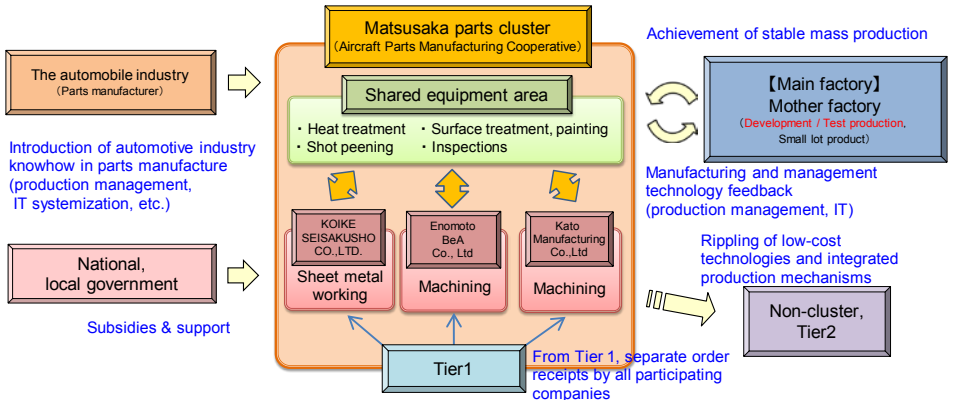
Backed up by government cooperation at national and local levels.

Cluster for aero engines, low-pressure turbine blades



FPI : Fluorescent Penetrant Inspection

Aircraft parts cluster



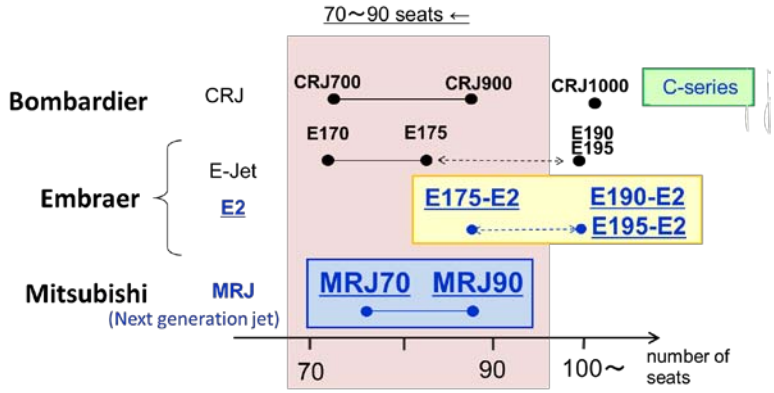
4-2. MRJ (Mitsubishi Regional Jet)

Market Environment

<Market scale>
- Over next 20 years, a market for 70-90 seat jets is projected around 3,500 units.

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

<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 airframe performance will foster high airframe value appraisal, giving MHI a solid position in the regional jet market.

Business Strategies

Basic Policy

- Aircraft and business development to be advanced toward achieving airframe performance* and outstanding customer support above those of Embraer.

*MRJ superiority
- Cabin comfort, outstanding cost efficiency, durability, environmental performance
  - Advanced aerodynamic design, noise analysis, structural technology
  - More advanced structural design will extend the time frame from first flight to large-scale inspection from 40,000 to 60,000 flight cycles.
    → Substantial reduction in maintenance costs
- Development costs, which will peak in FY2017, have been fully factored into the 2015 Business Plan.
  ⇒ Efforts will focus on a selling price to recover these costs, and cost improvements.

Measures

(1) Carry development forward
(2) Lay the foundations for finished aircraft business

4-2. (1) Carry development forward

Accelerate acquisition of flight test data and preparation of TC-related documents, toward TC acquisition and CS network formation.

＜Latest status＞

Flight Test Aircraft No.5 painted with ANA livery

Status of Flight Test Aircraft No.1 and No.2

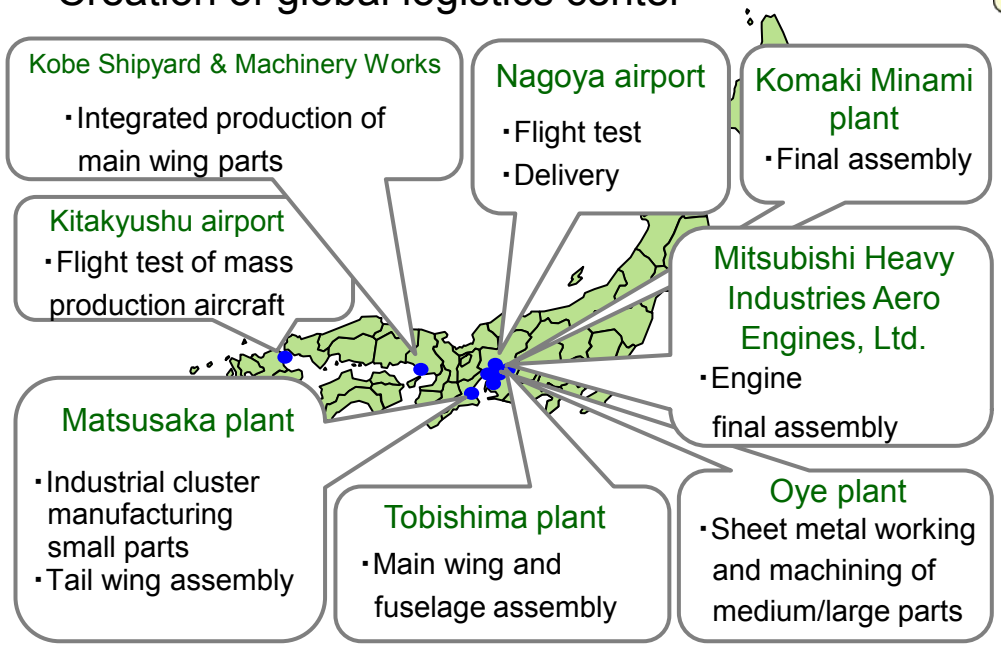
Article		CY2015				CY2016				CY2017		
MRJ90	Roles	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q
Milestone		First Flight				New Komaki Minami Plant Come Online / Preparation of CS system				First Delivery		
Static Test Aircraft	・Static Tests	Static Strength Testing										
Fatigue Test Aircraft	・Fatigue Tests	Assembly	Fatigue Strength Testing									
Flight Test Aircraft No.1	・First Flight ・Flight Envelope Expansion ・System Test	Ground Test				Flight Test (Japan)				Flight Test (USA)		
Flight Test Aircraft No.2	・Functional Tests ・Performance Tests	Assembly	Ground Test			Flight Test (Japan)				Flight Test (USA)		
Flight Test Aircraft No.3	・Flight Characteristics Tests ・Avionics Tests	Assembly	Ground Test			Flight Test (Japan)				Flight Test (USA)		
Flight Test Aircraft No.4	・Interior Tests ・Noise Tests ・Anti-Ice Tests	Assembly	Ground Test			Flight Test (Japan)				Flight Test (USA)		
Flight Test Aircraft No.5	・Auto-Pilot Tests	Assembly	Ground Test			Flight Test (Japan)				※Flight Test Aircraft No.5 to be only tested in Japan		
						Timely provision of flight test data						
Customer Support Structure Building		Building of CS Structure				Reflect Flight Test data Preparation of Manual/Engineering Support/Spare Parts, etc.				Continued/ Revised Support etc.		
		IT System Development				IT System in Operation						

More frequent flight tests

TC：Type Certification,　CS：Customer Support

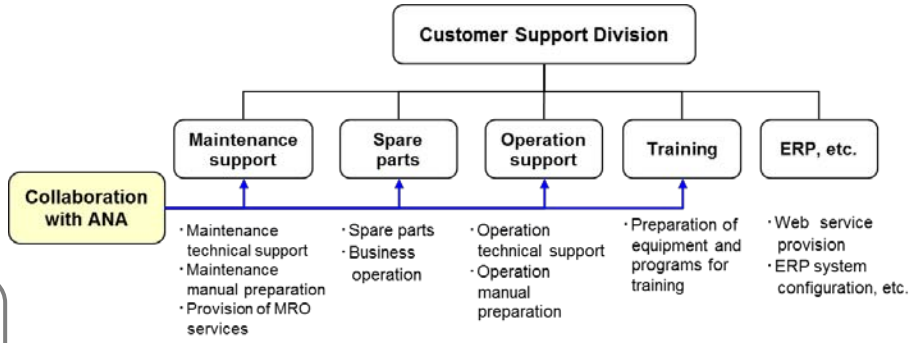
Mass Production Structure

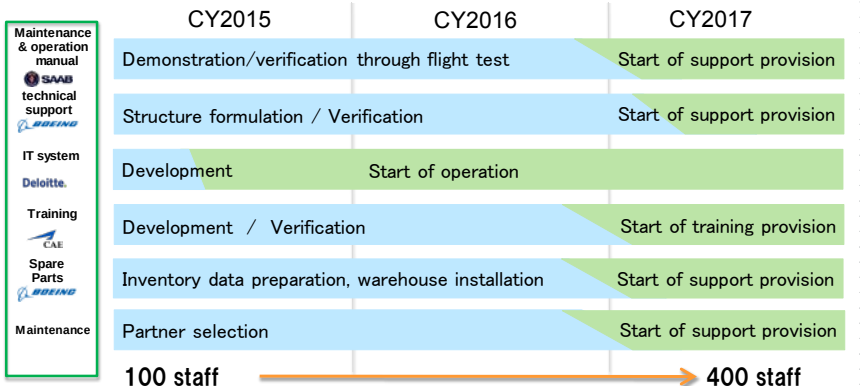
- Mass production plant will start sequentially from early 2016
  - Utilization and preparation of in-house factories
  - Participation of partner enterprises such as Matsusaka Industrial Cluster
- Maximum production rate: 10 units/month.
  - Production workers to be shifted by reforming production processes at Nagoya Aerospace Systems Works
- Creation of global logistics center



Customer Support Structure

- Collaboration with ANA (launch customer) toward targeted quality level
- Configuration of 400 staff structure at 1st unit delivery

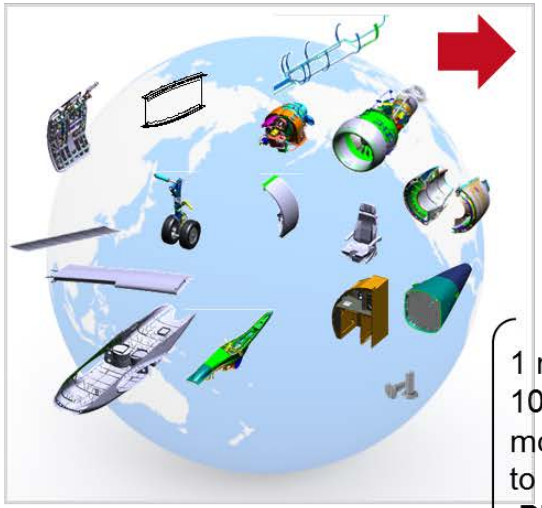




Mass Production Structure

- Configuration of global supplier & real time networks

Parts Production/ Procurement



Logistic Center

Track & Manage Global Logistics Status

1 million.parts per A/C X 10 A/Cs manufactured per month＝10mil. parts/month to be supplied to assembly Plant, JUST-IN-TIME

Direct Delivery to Plants

A/C: Aircraft

Component Assembly

Tobishima Plant

Main Wings and Fuselage

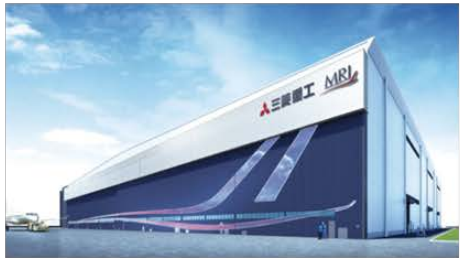
Mitsubishi Heavy Industries Aero Engines, Ltd.

Engine

Tail wing

Matsusaka plant

Final Assembly



New Komaki Minami Plant

4-3. Transportation System

Market Environment

＜Market scale＞

Annual growth: 2-3%. Current scale: 22 trillion yen/year. Regions and business areas we can enter are limited.

＜Market trends by area＞

- North America
  Many airports have APM projects and/or high-speed railway plans.
- South America
  Urban traffic congestion in Brazil is becoming a political issue. Intercity transport projects have emerged.
- Middle East
  Specific large-scale urban transportation projects exist, and realization of plans is likely.
- South-Eastern Asia
  Traffic congestion is increasingly serious. High-speed railway plans are moving forward.

MHI's Position

- Entry into accessible market areas with total solutions business based on MHI's strengths in system integration and AGT systems.

APM：Automated People Mover, AGT：Automated Guideway Transit

Business Strategies

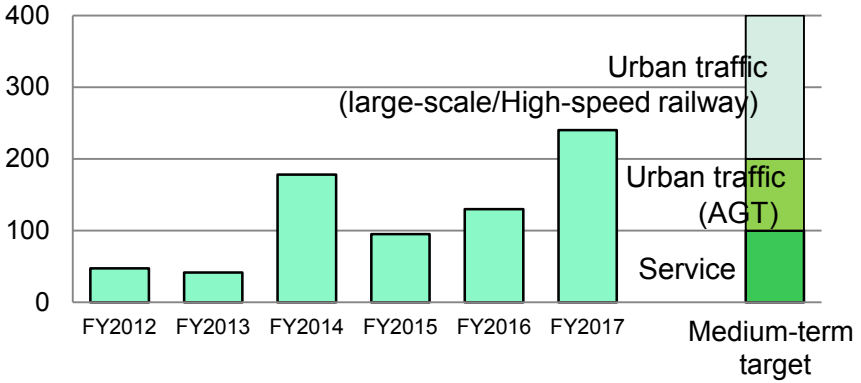
Basic Policy

Secure orders for large-scale urban transportation systems in accessible market areas.

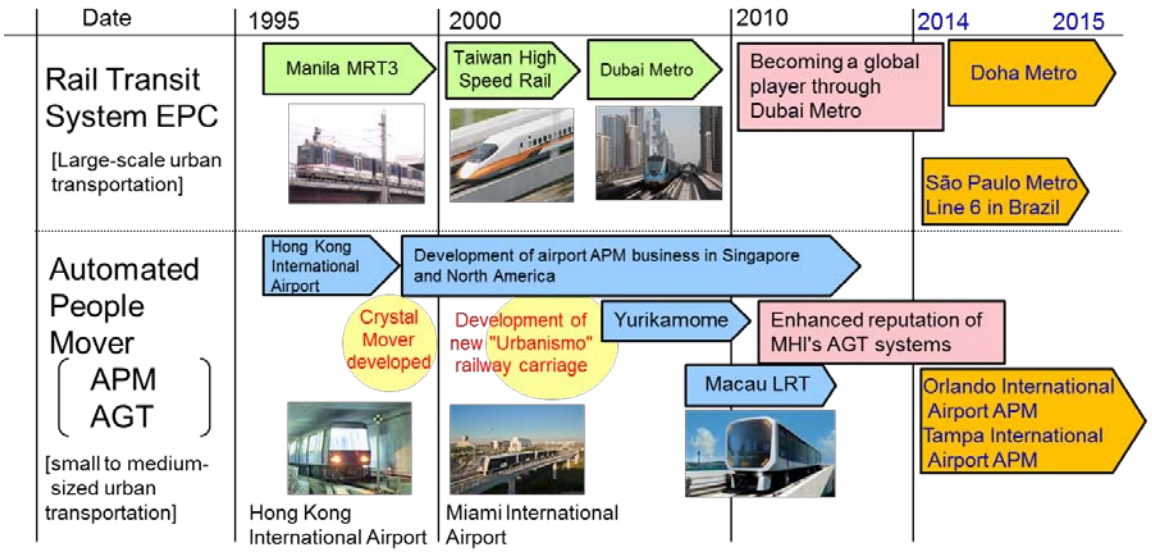
Measures

(1) Optimal introduction of superior technologies and products
(2) Development of total solutions business
(3) Expansion of lifecycle management and services business

＜Business scale＞



History



Success factors: superior technologies and products

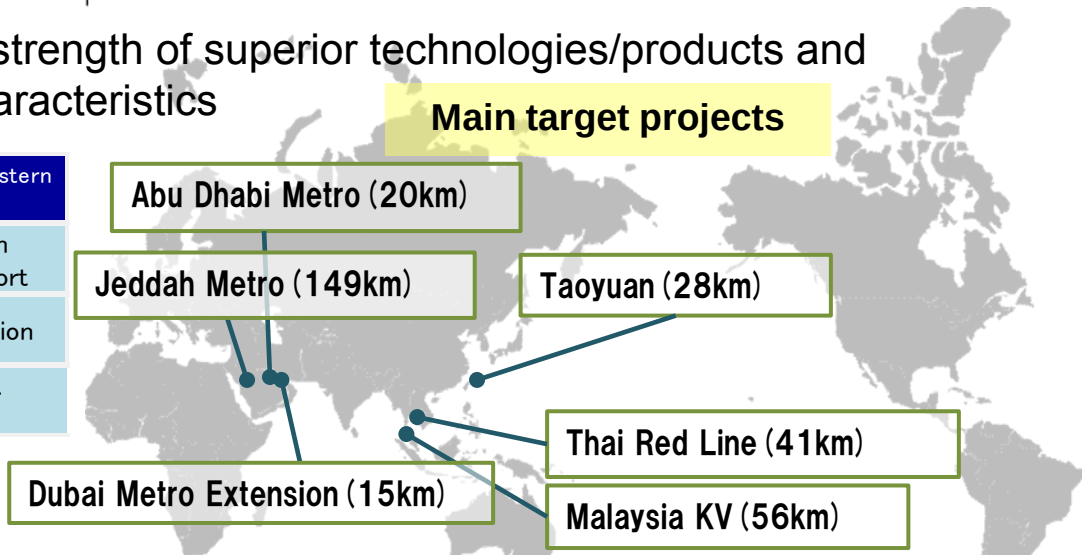
System integration strength
Team formation matching local situations
Reputation of Dubai Metro
Government support

Rubber tire AGT
Localization

Winning of large-scale project orders on strength of superior technologies/products and project team formation matching local characteristics

	North America	South America	Middle East	South-Eastern Asia
Target market	Airport APM	Urban transport	Large-scale urban transport	Urban transport
MHI stage	Status up	New market entry	Expansion	Expansion
System	APM	Rail Transit System EPC	Rail Transit System EPC	AGT

Main target projects



EPC: Engineering Procurement Construction , MRT: Mass Rail Transit
APM: Automated People Mover, AGT: Automated Guideway Transit, LRT: Light Rail Transit

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Development of business solution, collaborating with industrial/academic/government sectors and utilizing MIHARA Test Center

【Challenge in cities】

- Population concentration
- Traffic jam
- Noise problem
- Aerial pollution/CO2
- Accessibility

【Industry-academia-government collaboration】

- Traffic engineering
- Traffic economics
- Safety certification

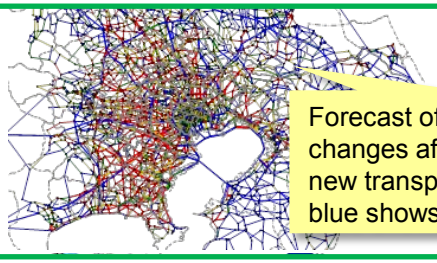
【Transport solutions】

- Life cycle management
- EPC engineering
- AGT vehicles, air brakes

【Testing & Verification】

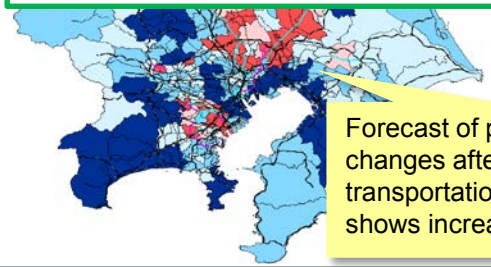
- MIHARA Test Center

【 Traffic engineering 】
Multi-mode transportation simulator



Forecast of road traffic volume changes after introduction of new transportation system: blue shows decrease

【 Traffic economics 】CUE model



Forecast of population changes after introduction of transportation system: red shows increase

High-speed AGT

METRO

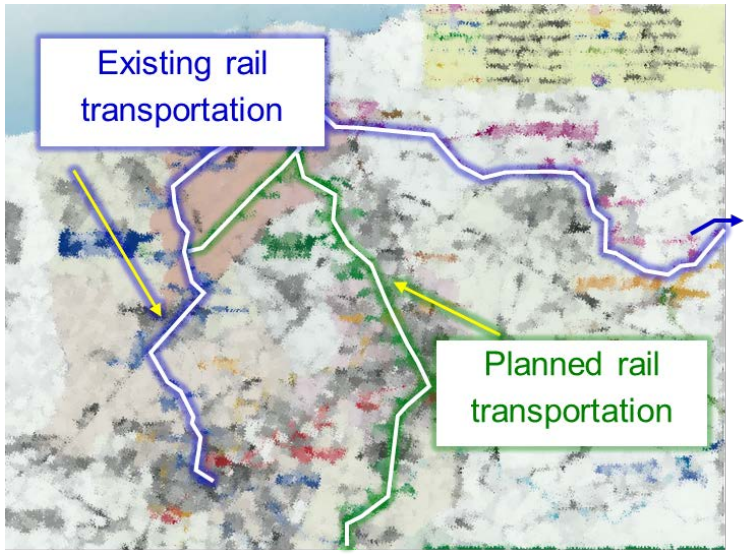
MIHARA Test Center

Accommodates testing, technology development, safety evaluation, specification verification and training for train operators, manufacturers, consultants and clients

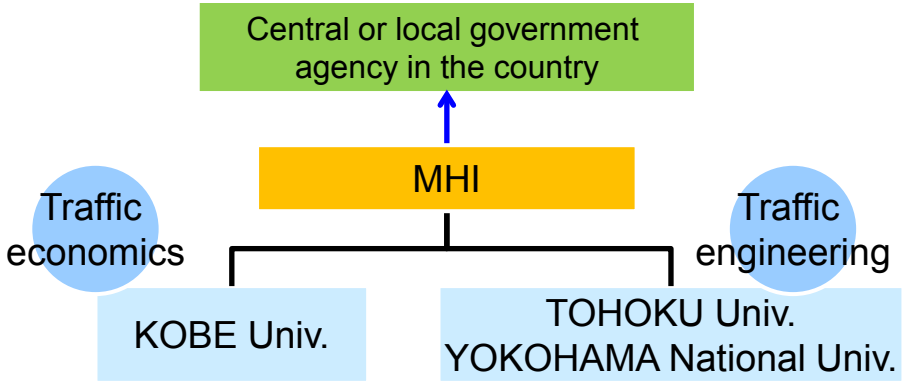
CUE：Computable Urban Economic, AGT：Automated Guideway Transit

Evaluating the impact of the introduction of new transportation system on a city in Southeast Asia

■ Target: urban area of Southeast Asia

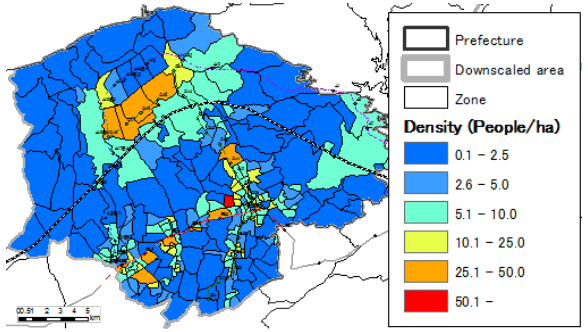


■ Collaboration with academic sector



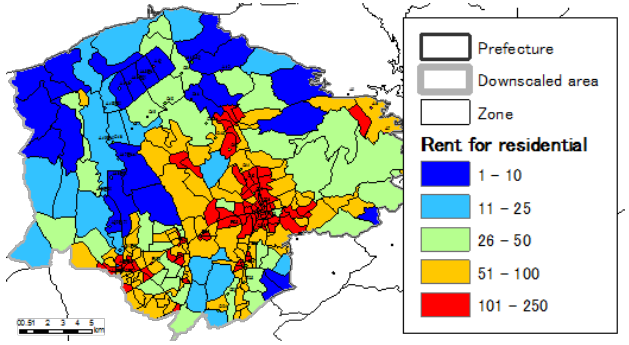
■ Evaluation results

① Changes in population density after the introduction of the planned rail transportation



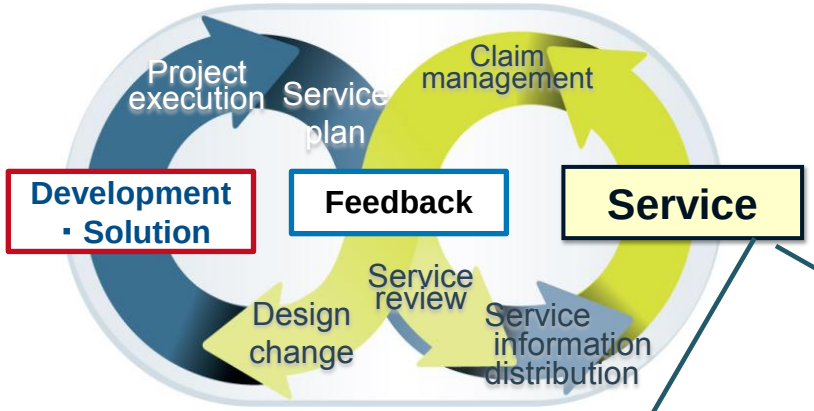
Population density increases along the planned rail transportation line

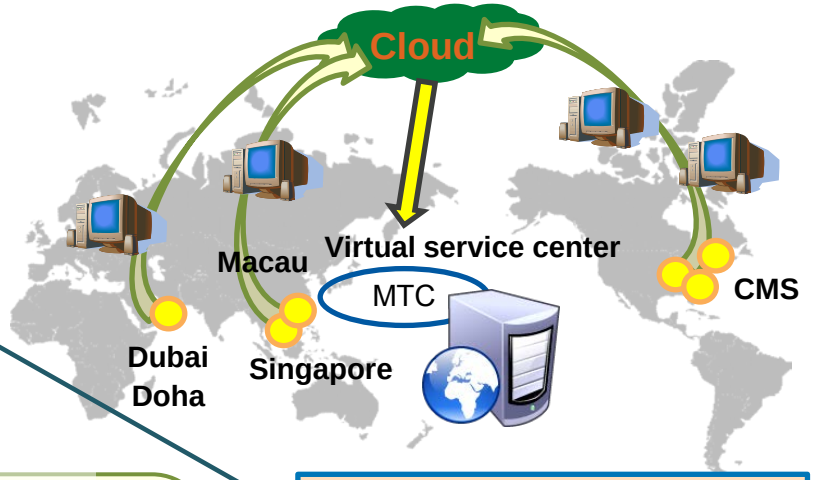
② Changes in land value after the introduction of the planned rail transportation



Increased land value centering on the planned rail transportation line to the suburbs

Global operation monitoring and maintenance networks





O&M

【Operation】

- Big data processing of operational information
- Enhanced availability and safety
- New developments and solutions

- ・Application of domestic railway operators' knowledge and experience
- ・Use of MTC as training center for overseas operators
- ・Feedback from CMS (North America) expertise

【Maintenance】

- Optimize repair timing and parts supply
- Presentation of maintenance menu based on status diagnosis

- ・Global network by IoT
- ・Establishment of global platform enabling remote monitoring and big data usage
- ・Parts factories → Promotion of local industries

Parts・Components

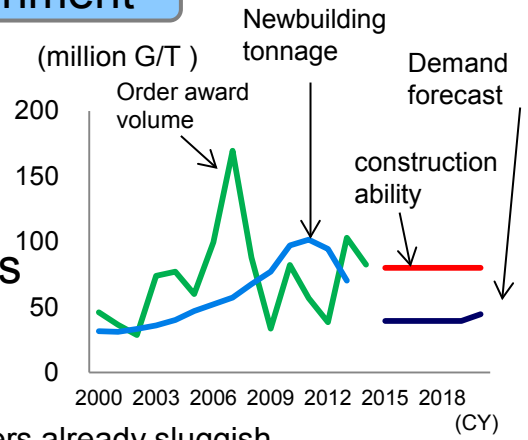
- ・Feedback of AGT development knowhow; development of maintenance parts (machinery/equipment unification, use of general-purpose machinery/equipment, etc.)
- ・Collaboration with parts manufacturers
- ・Certification of standards, Verification using demonstration rolling stock at MTC

MTC：Mihara Test Center, CMS：Crystal Mover Services
IoT：Internet of Things, AGT：Automated Guideway Transit

4-4. Commercial Ship

Market Environment

Supply/demand gap expected to remain wide, with overall drops in order volume and prices



- Bulk carriers: New orders already sluggish
- Container ships: Robust growth projected to continue
- Cruise ships: Steady growth; market relatively immune to fluctuations
- Gas carriers: After shale gas development projects in North America, projects in east Africa and Canadian west coast to emerge, along with demand for LNG carrier replacements
- Domestic: Existing demand for domestic ferry replacements; demand to emerge 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

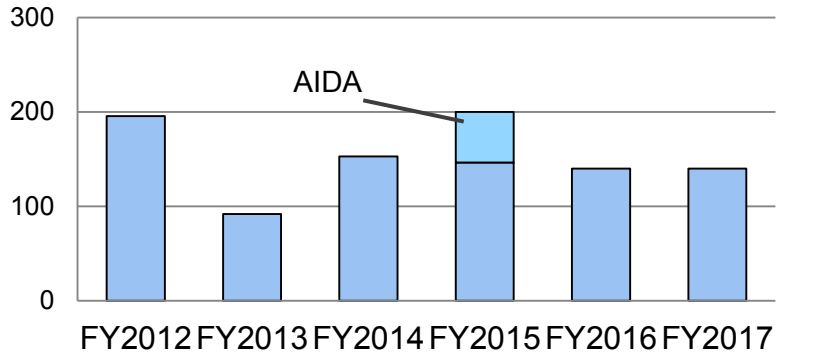
Promotion of structural reforms of commercial ships business; restructuring of cruise ships business.

Measures

(1) Formation of new shipbuilding business scheme
(2) Structural reform of business in Nagasaki district
(3) Creation of new cruise ships business model

<Business Scale>

(In billion yen)



4-4. (1) Formation of new shipbuilding business scheme

Formation of shipbuilding business focused on ship construction engineering, and not exclusively dependent on in-house construction

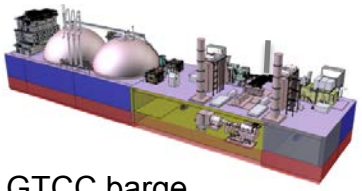
Overview of MHI's shipbuilding business

Engineering

Manufacturing

Oil & Gas

Energy & Environment domain



Offshore system

GTCC barge

GTCC : Gas Turbine Combined Cycle

Leisure

Commercial Aviation & Transportation Systems engineering organization

Cruise ship

Shipbuilding engineering organization

Technology development, basic design, advanced design, analysis

Special high-performance ships; national projects

Commercial ships in Shimonoseki

- Energy savings; high-speed/high-performance design and construction technologies
- Response to national science projects, etc. on system integration strength

Hankyu Ferry " IZUMI "

JAMSTEC for Wide-area Seabed Research Vessel "KAIMEI"

Energy logistics

Ship construction company in Nagasaki

Hull block manufacturing company in Nagasaki

"Sayaendo" New-generation LNG Carrier

Other shipyards

- Engineering
- Design cooperation
- Construction consignment
- Hull block

4-4. (2) Structural reform of business in Nagasaki district

Basic Policy

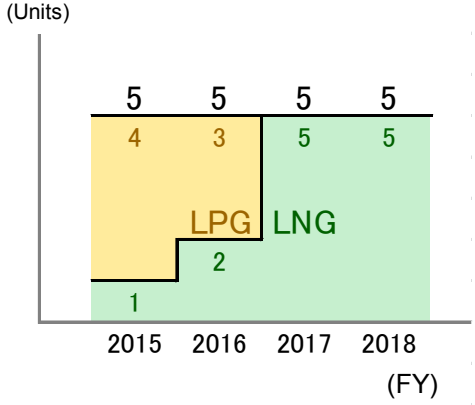
◇Focus on superior ship types and technology areas

- Energy and logistics fields (LNG/LPG carriers, etc.)
- Large-scale hull block manufacturing capability

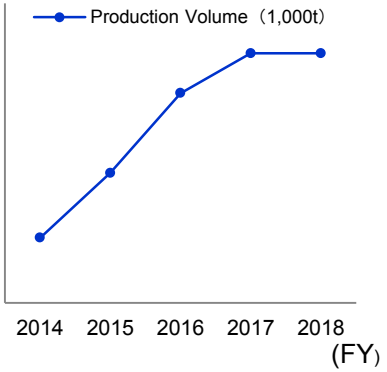
◇Formation of resilient organization and strengthening of cost structure

- Streamlined organization
- Organization downsizing
- Manufacturing process reforms

Production of LNG/LPG carriers

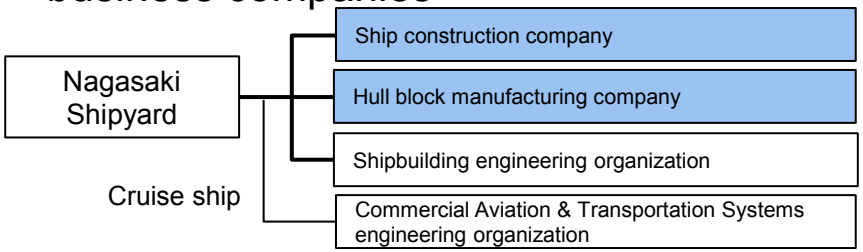


Production of hull brock



Measures

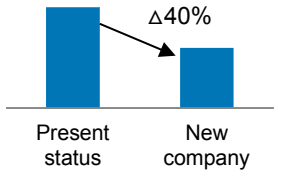
◇Organizational reforms, transition to business companies



◇Streamlining; reforms of manufacturing processes

- Through successive construction of 13 LNG carriers, improvement of management structure and achievement of stable profit structure
- Streamlining through business spinoffs
- Expansion of order of hull block work and production rationalization
- Radical review of operational management system

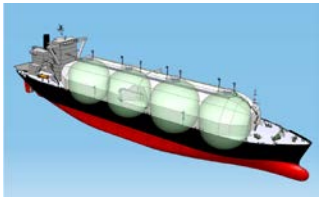
Ship construction business firm (Number of personnel)



◇Strengthening of relatively superior technologies

Promotion linked with shipbuilding engineering organization

"Sayaringo" LNG carrier for shale gas, accommodating new Panamax needs



4-4. (3) Creation of new cruise ships business model

Completion of AIDA project construction

◇Completion of AIDA ships No.1 and No.2
- Completion of ship No.1 applying all means available
- Thorough improvement for ship No.2

◇Review of shortcomings of AIDA ship No.1
- Activities to prototype construction
  → Inadequate basic design owing to insufficient knowledge
- Vast quantity of materials; work volume management
  → Insufficiency of shipbuilding production management
- Cutting-edge technology; demand for compacting
  → Unprecedented density, complex systems
- Inadequate global SCM development
  → Bottleneck from insistence on in-house reliance

SCM: Supply Chain Management

Acquired knowledge and direction

Design/manufacturing improvements; understanding of cost structure

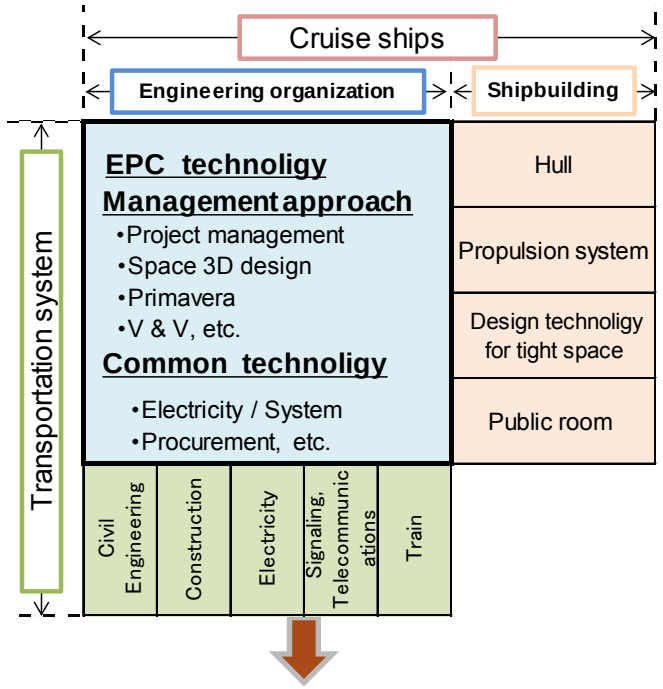
EPC engineering, design management method

Engineering design technology for tight space

Departure from in-house reliance; globalization

Formation of new cruise ships business model

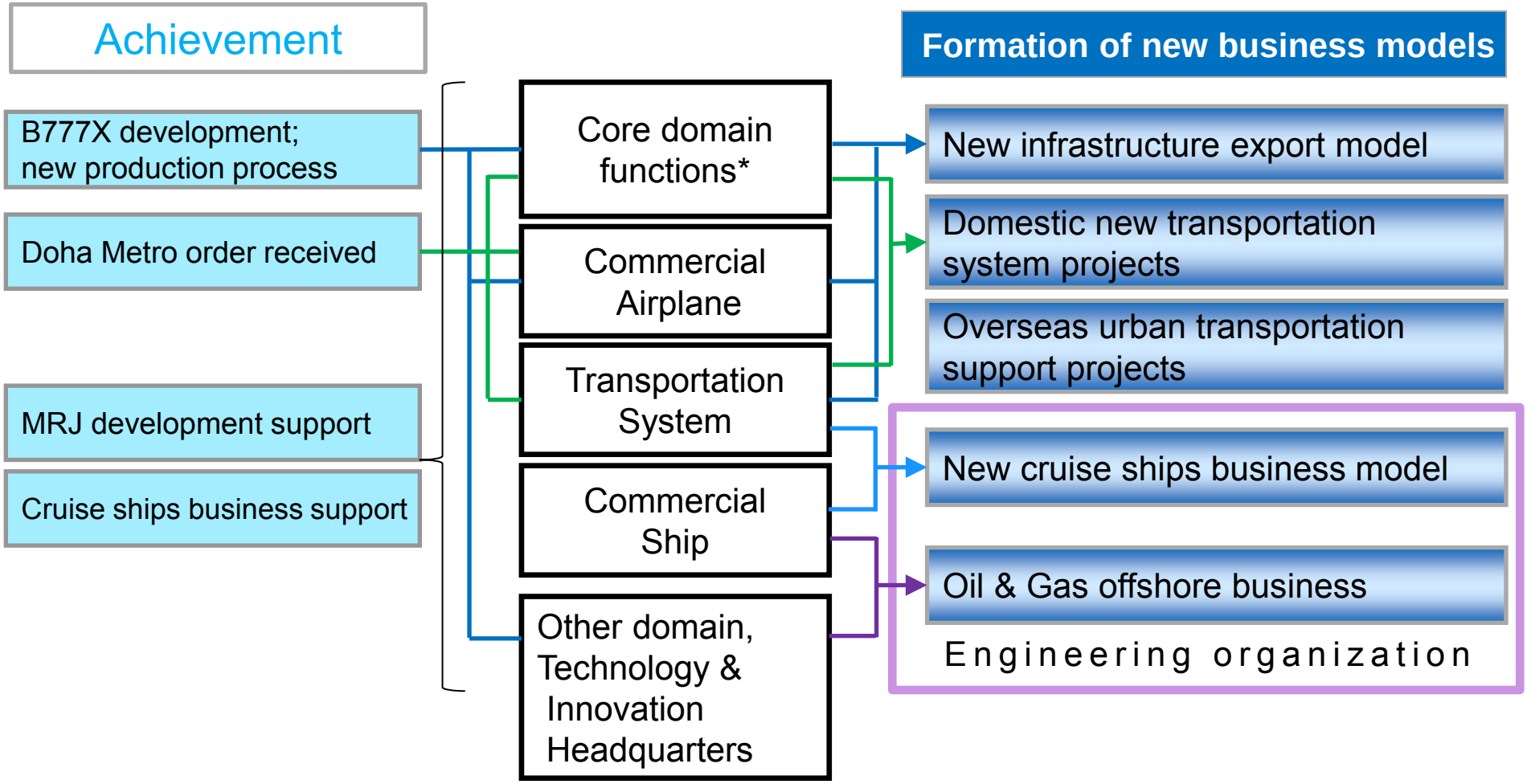
◇Correspond with scheme fusing EPC and shipbuilding



Towards new business model of cruise shipbuilding through further advances in management and design methods

EPC: Engineering Procurement Construction
V&V: Verification and Validation

Formation of new business models integrating 3 business areas and core domain functions



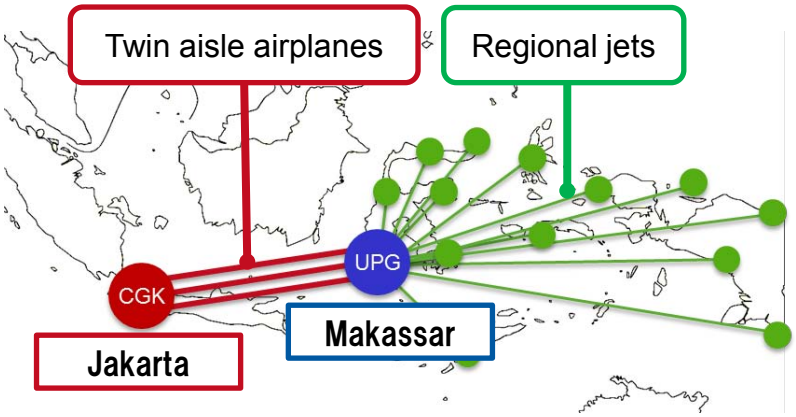
* Financing, technical oversight, operational oversight, cooperation between industrial/academic/government sectors

New business model for infrastructure export

Example: Indonesia air traffic network in Eastern Indonesia = Broad-Band/Regional-Hub（BB/RH）

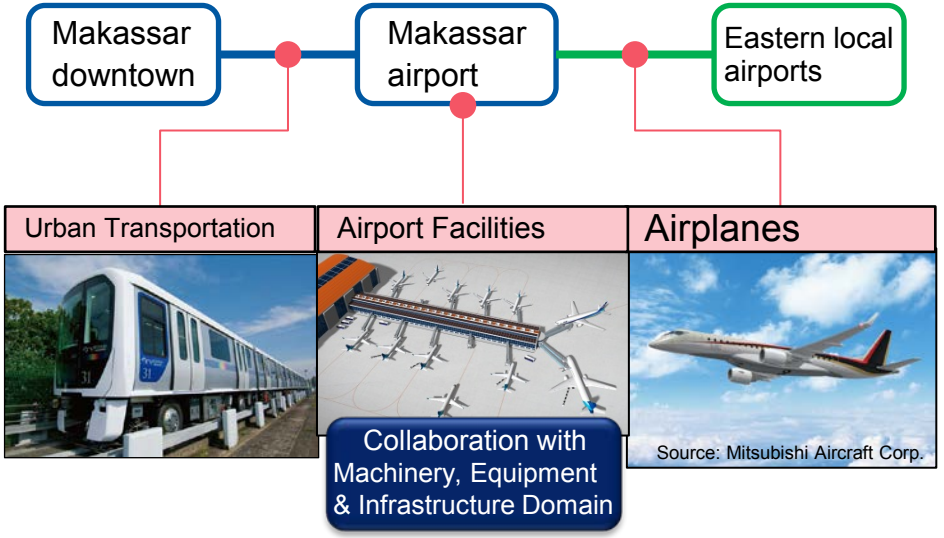
＜Concept＞

New air traffic network (BB/RH) combining
Twin aisle airplanes and regional jets (MRJ)
- Alleviate Jakarta airport congestion
- Promote eastern development



＜New infrastructure projects＞

- Makassar airport development as a regional-hub airport
- Infrastructure exports bundling airport facilities, airplanes and urban transportation
- Collaboration with industrial/academic/government sectors (METI, MLIT, Tokyo Tech, etc.)

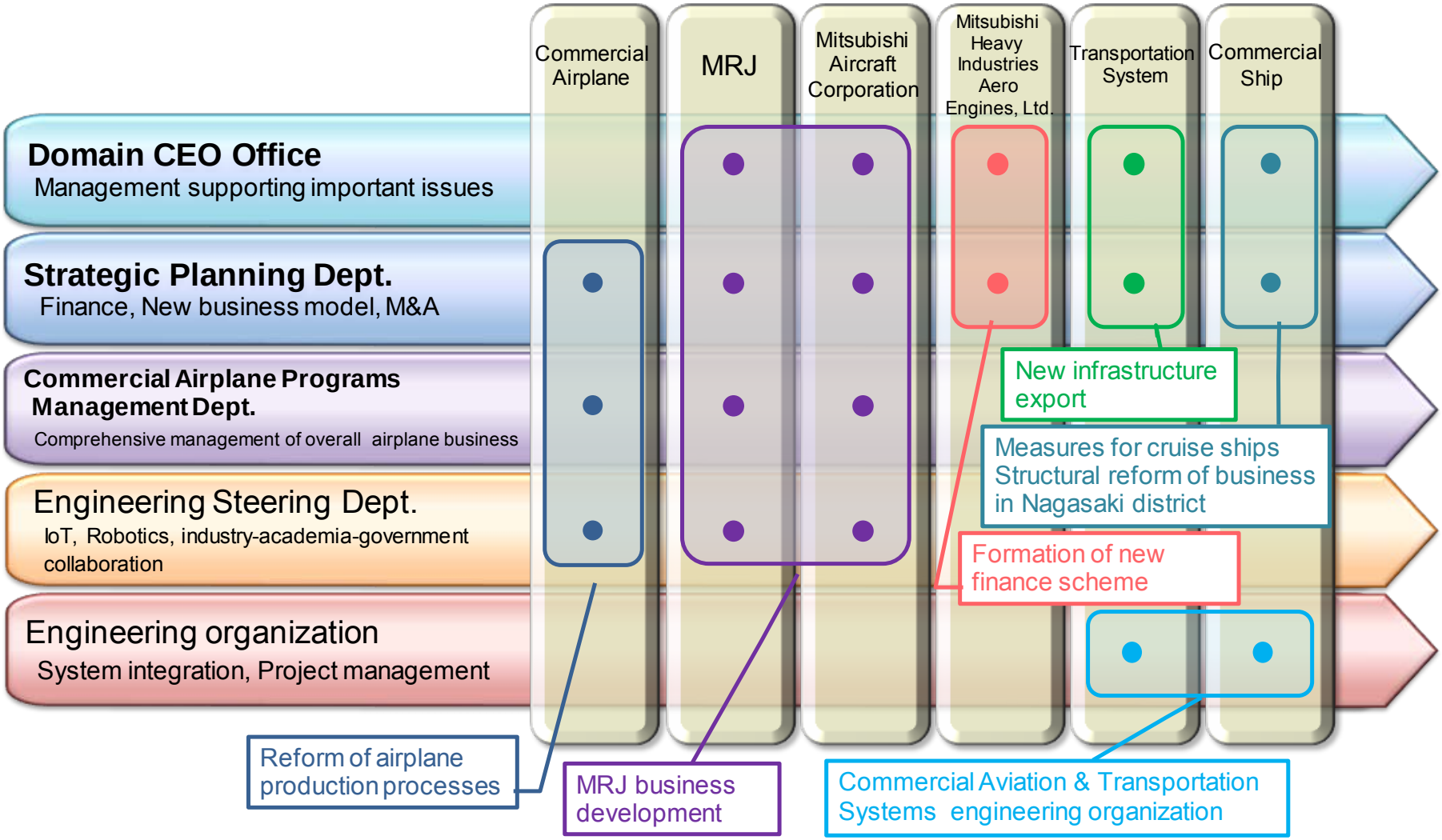


＜Roadmap (Assumption)＞

2014	2015	2016	2017	2018	2019	2020-2024	(FY)
METI Study on Economic Partnership Projects	JICA PPP F/S		☆ BB/RH Introduction			☆ BB/RH Execution	

JICA：Japan International Cooperation Agency, PPP：Public-Private Partnership, F/S：Feasibility Study

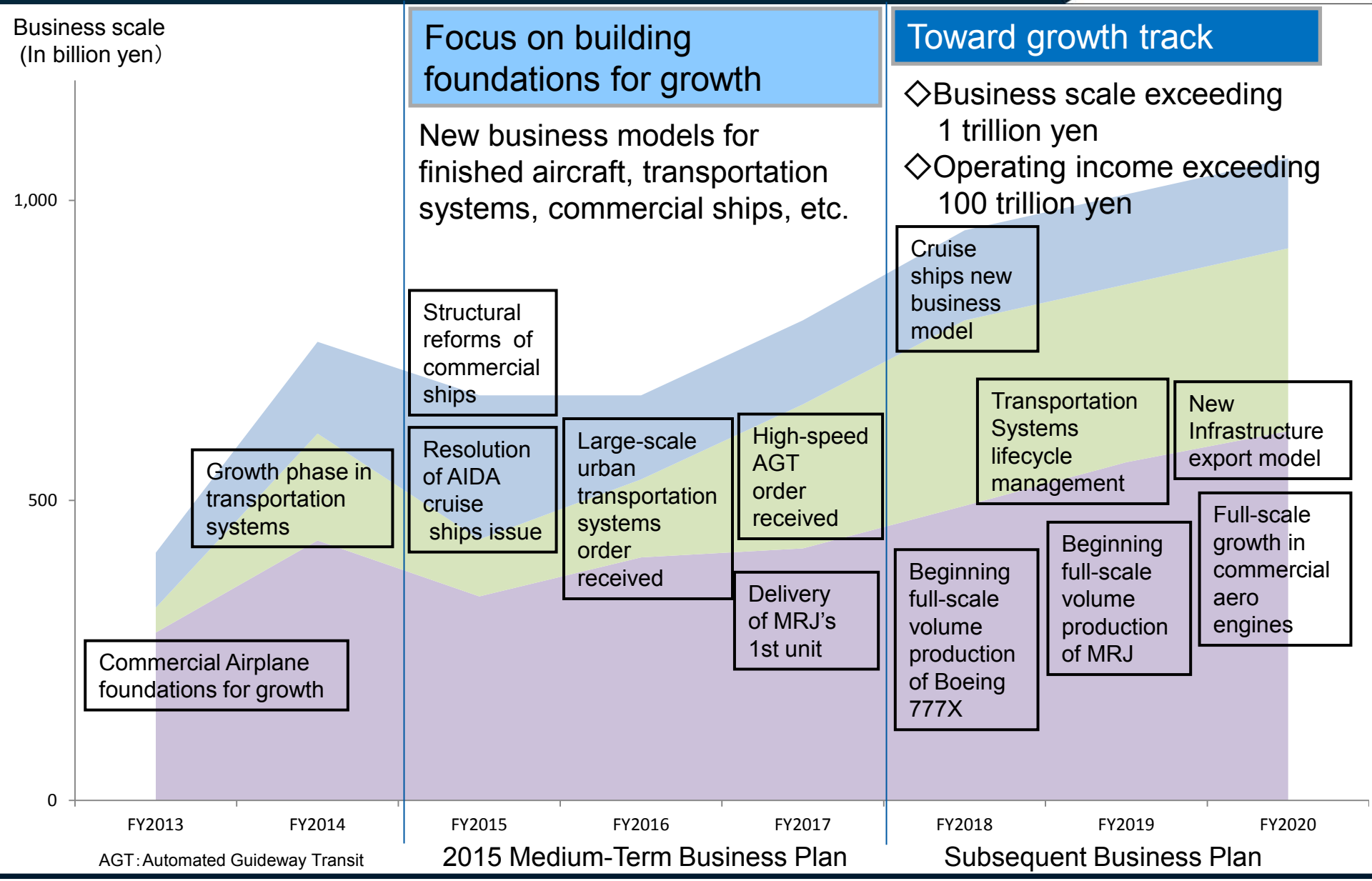
Application of domain horizontal functions to business entities; respond to important issues



M&A : Mergers and Acquisitions, IoT : Internet of Things

5. Summary

5. 2015 Medium-Term Business Plan: Overview & Outlook



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