

Report of Evaluation Committee for Cruise Shipbuilding Business

October 18, 2016

Mitsubishi Heavy Industries, LTD

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Reference: Overall reform of structure and organization of the commercial shipbuilding business

1. Background

- 1) Several years after deliveries of “Diamond Princess” and “Sapphire Princess” in 2004, the Shipbuilding Division resumed marketing activities for cruise ships based on the notion that, among commercial ships, cruise ships are the most valuable. The assessment at that time was that although cruise ships are highly difficult to build, it would be able to manage given its experience with similar sized passenger ships. Following the resumption of these activities, however, a series of business talks were deferred for later consideration or were lost to competing shipbuilders.
- 2) After receiving the order for cruise ships from AIDA Cruises in 2011, the Shipbuilding Division and others all concluded that ship’s construction was making steady progress.
- 3) Around mid-2013, however, it became clear that construction was in a critical condition, and there was no clear view of when the ships’ basic design would be completed.
- 4) In response to this problem, countermeasures were implemented swiftly, supported by the entire MHI Group, including the appointment of project management specialists. However, the underlying issues (which are outlined below) turned out to be more serious than had been estimated. Ultimately the construction of the cruise ships for AIDA resulted in huge financial losses¹.



- 5) Recognizing that the project turned out to be unexpectedly difficult, and was an urgent and serious matter, an Evaluation Committee² charged with conducting analysis and reevaluation tasks (described on the next page) was established. The committee was to be led by internal experts who were not involved in the Shipbuilding Division. In addition, in order to make the reform successful and sustainable, some younger and mid-level employees from the Shipbuilding Division were also invited to join discussions on this issue.

Note 1: Profit/loss through FY2015 (ship #1 and #2, collectively)

FY2011	- ¥ 9.3 billion	Operating loss (construction orders)
FY2012	+ ¥ 6.0 billion	Operating profit (forex revisions, etc.)
FY2013-1H	- ¥ 0.1 billion	Operating loss (forex revisions, etc.)
FY2013-2H	- ¥ 64.1 billion	Extraordinary loss
FY2014	- ¥ 69.5 billion	Extraordinary loss
FY2015	- ¥ 103.9 billion	Extraordinary loss
Total losses	- ¥ 240.8 billion	

Note 2: Committee members

Chair	: Executive Vice President Kazuaki Kimura
Members	: 5 experienced employees from departments other than the Shipbuilding Division, and 5 experienced employees from the Shipbuilding Division
Discussion participants	: 14 younger and mid-level employees from the Shipbuilding Division
Secretariat	: Strategy Planning Department, Business Strategy Office

2. Objectives

1) Analysis of the causes of financial losses on AIDA cruise ship project

(see Chapter II, Pages 4-8)

2) Comprehensive review of AIDA cruise ship project

➤ Evaluation of decision-making process and project management

(see Chapter III, Page 9)

3) Re-Evaluation of the viability of the cruise shipbuilding business

(see Chapter IV, Page 10)

4) Future approaches for the cruise shipbuilding business

➤ Synergy with car ferry building business in Shimonoseki Shipyard

➤ Future business plan/policy

(see Chapter V, Pages 11-12)

Outcomes and learnings to be reflected in the risk management practices (Refer to the materials provided separately)

II. Analysis of the causes of financial losses on AIDA cruise ship project

1. Unique Features of AIDA cruise ship project

(comparison with previous projects – Diamond Princess)

Comparison between AIDA cruise ships and Diamond Princess

[Similarities]

- 1) General characteristics, such as dimensions, engines and propulsion systems etc. are similar. (See table at right)

[Differences]

- 2) The essential difference in design and construction work for AIDA cruise ships (Prototype) and Diamond Princess (Semi-Prototype) are described in more detail on Page 5.
- 3) AIDA cruise ships have a 23% more passenger cabins, but the crew number is 27% less. Savings in manpower are realized through widespread adoption of automated equipment, monitoring devices, etc.
- 4) AIDA cruise ships have new features not incorporated into the Diamond Princess (for example Wi-Fi in all cabins and beer brewing facilities).

Main Dimensions		AIDAprima 1st ship, delivered in 2016	Diamond Princess Delivered in 2004
Length overall	m	300.0	288.3
Width	m	37.6	37.5
Draft	m	8.00	8.05
Gross tonnage(GT)	ton	125,000	115,900
Propulsion system		Electric (POD System)x2	Electricx2
Main engine		Dieselsx3,36MW Dual fuelx1,10.8MW	Dieselsx4,35.7MW Gas turbinex1,25MW
Speed	kn	21.4	22.1

Quantitative ratios (AIDAprima vs. Diamond Princess = 1.0)

Steel weight		1.1	1.0
Welding length		1.0	1.0
Pipe length		1.2	1.0
Duct length		1.1	1.0
Cable length		1.3	1.0
Interior area		1.1	1.0

Cabin and crew

Number of passenger cabins	rooms	1,643	23% increase	1,339
Number of Crew	people	900	27% decrease	1,238

II. Analysis of the causes of financial losses on AIDA cruise ship project

1. Unique Features of AIDA cruise ship project (comparison with previous projects – Diamond Princess)

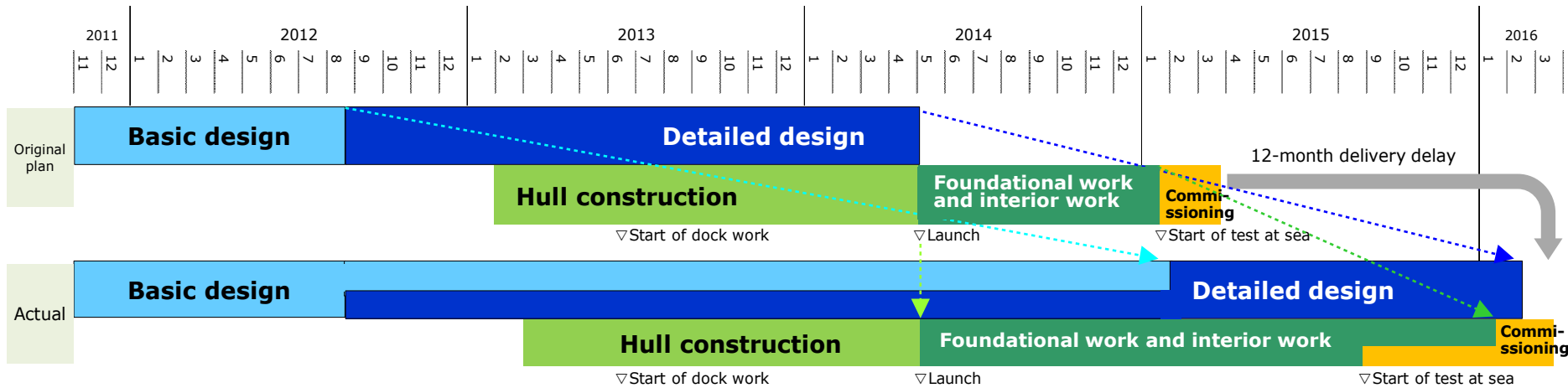
- Work on the prototype vessel, 1st Ship “AIDAprima”, required special expertise, a great deal of time and experienced human resources in all processes from concept design to basic planning, procurement (selection of suppliers), detailed design, etc. In almost every respect, the work differed from that of the Diamond Princess (Semi-Prototype), whose prototype vessel existed already and design and construction work could proceed based on the existing prototype.
- **Due to the lack of relevant experience and a lack of recognition of this factor among those involved when the order was received, the construction process of “AIDAprima” encountered extreme difficulties (as indicated on the following page).**

No.	Item	Prototype AIDAprima	Semi-Prototype Diamond Princess	Remarks (experience with Diamond Princess)
(1)	Concept design	○	× Passenger facilities △ Ship functions	Passenger facilities were based on the concept for this vessel's prototype: the Italian-built Grand Princess. The hull design engine layout were specially designed by the specific request of the customer.
(2)	Definition of required specifications	○	× Passenger facilities △ Ship functions	Passenger facilities were modeled on those of the Grand Princess (fully reflected in the concept specifications).
(3)	Determination of basic specifications / Basic plan	○	× Passenger facilities △ Ship functions	The hull design and main engine plant were specially designed. The Grand Princess was considered for other specifications.
(4)	Selection of suppliers	○	△ ~ ×	Fundamentally, the suppliers chosen for the Grand Princess were selected. In cases where the same suppliers were selected, the design concept in principle was unchanged.
(5)	Finalizing the detailed specifications / Detailed design	○	△	Based on the confirmed specifications of the Grand Princess, revisions were made to accommodate our own facilities. The detailed drawings and work drawings were specially prepared based on the Grand Princess's system drawings.
(6)	Establishment of project execution principle	○	△	The principle was specially prepared, although it differed in scope from that of the prototype (with respect to structural organization, management, construction method, etc.).
(7)	Preparation of work implementation practice and manufacturing practice(including fabrication sequence)	○	○	These practices specially prepared in consideration of differences in facilities, construction methods, etc.
(8)	Preparation of commissioning plan	○	○	The plan was specially prepared.

Requisite capability : ○ ; Required, △ ; Partially required (partial possible), × ; Not required (duplication possible)

For 2nd ship, duplication from 1st ship experience was possible in all respects.

2. Delays of Work (overview and causes)



Main Causes

- 1) Design personnel who could take appropriate actions in the process (1)-(6) mentioned on page 5, namely the difficulties of the prototype vessel, were inadequate in quantity and quality. It took a much longer time to understand the required specifications of the customer, thus resulting in a significant delay in obtaining the customer’s approval for the basic design drawings.
- 2) To keep to the delivery schedule, design work, procurement of materials and construction work proceeded simultaneously without approval of the basic design. This led to a ‘vicious cycle’ of re-ordering or changes in procurement sources due to subsequent changes in design.
- 3) In particular, the advanced outfitting work¹ was limited due to delay of design approval. This meant that the following foundational and interior work became rush work, resulting in additional costs in conjunction with large amounts of redone work and idle stand-by.

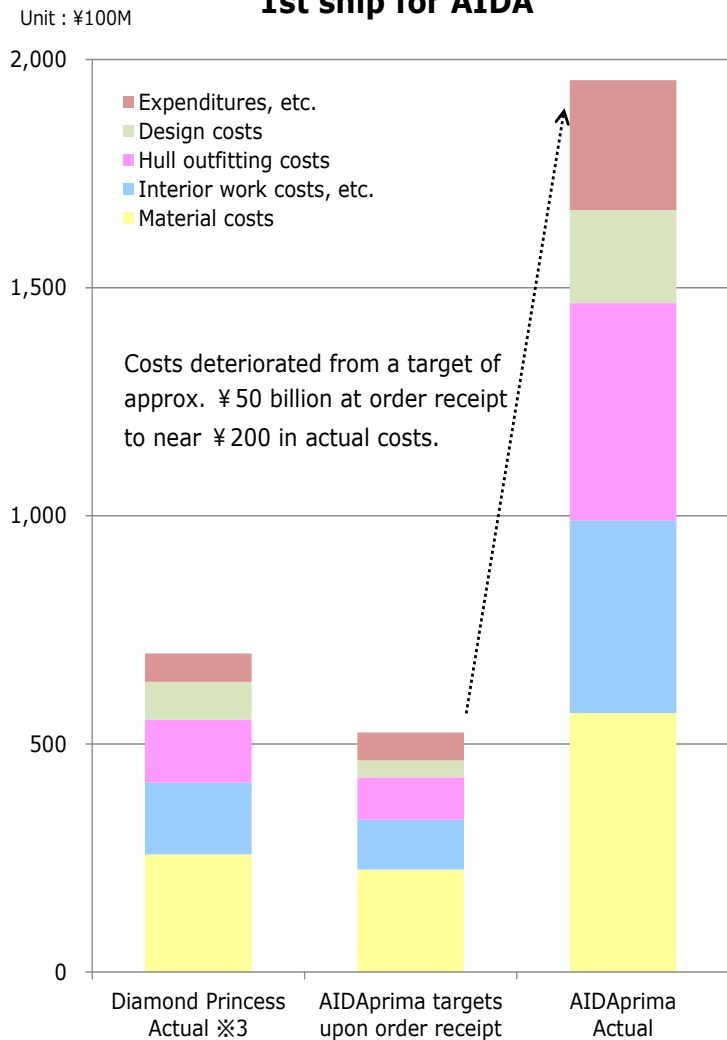
Note 1: Advanced outfitting work refers to work targeted at improving efficiency by increasing the amount of work performed in a downward direction in an open space. This applies to installation of piping etc. before the hull structure is fully assembled and while it is still in separate blocks.

Additional Factor

Due to the customer’s demands during inspections of the final interiors of public rooms and other onboard facilities/equipment etc., a large volume of work had to be redone.

3. Status of Cost Overruns

Comparison of target costs upon order receipt and actual costs of the 1st ship for AIDA



Note3: Design costs are the aggregate of costs incurred for the Diamond Princess and Sapphire Princess.

Comparison of AIDA cruise ships and Diamond Princess

As indicated in the table below, the number of man-hours¹ spent in building the 1st ship of AIDA was significantly higher than that of the Diamond Princess. Especially noteworthy is the number of man-hours required for outfitting² in the AIDA ship: more than five times greater than the Diamond Princess. This disparity is attributable to the substantial delay in finalizing the ship's design, with only about 1/10th the amount of advanced outfitting achieved before the ship's launching. This delay in outfitting processes also led to redoing of interior work and idle stand-by.

Note 1: Man-hours: number of workers x number of hours at work

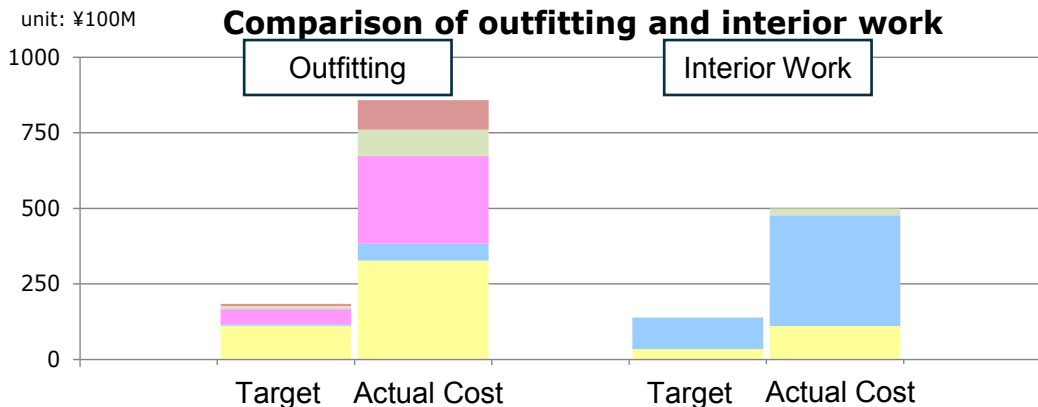
Note 2: Outfitting: installation of pipes, air-conditioning ducts, wiring, etc.

Comparison of actual man-hours

		AIDAprima 1st ship, delivered in 2016	Diamond Princess Delivered in 2004
Design	※4	2.7	1.0 ※5
Hull Production	※4	2.0	1.0
Outfitting	※4	5.7	1.0
Advanced outfitting ratio	%	8%	70%

Note4: Ratio of man-hours required for AIDAprima vs. Diamond Princess (= 1.0)

Note5: Aggregate man-hours required in designing the Diamond Princess and Sapphire Prince



II. Analysis of the causes of financial losses on AIDA cruise ship project

4. Overview of order timeline

	Year	Related events	Main points
	2004	Delivery of Diamond Princess Delivery of Sapphire Princess	
Progress of business talks	2008	Discussions with Company A about 130,000 GT class ship	Global financial crisis: Plan abandoned at customer's discretion
	2009	Discussions with Company B about 130,000 GT class ship	Order lost: Customer placed order with other shipyard.
	2010	Discussions with Company A about 105,000 GT class ship	Plan postponed at customer's discretion
	January 2011	Discussions with Company A about 142,000 GT class ship	Order lost: Customer placed order with other shipyard. (Target cost: Cost estimate for 105,000 GT class ship scale-adjusted to 142,000 GT class vessel + specification differences)
Business talks with AIDA	February 2011	Start of talks about 121,000 GT class cruise ships for AIDA	Although Shipbuilding Division recognized that AIDA's concept differed from its previous specification, ① Management decided that, after the successive failure to win orders described above, it should respond flexibly with highest priority accorded to winning this order. ② Management optimistically believed that, based on its past record and previous experience, the order could be handled as an extension of those precedents. ③ Management assumed that, although the price under discussion was extremely severe, anticipated successive orders would improve profitability.
	March 2011	Indication offer	(Target cost: Cost estimate for 105,000 GT class ship scale-adjusted to 121,000 GT class vessel + specification differences)
	June 2011	Firm offer	The target cost was set using an approach of sliding and adjusting the actual cost of the Diamond Princess.
	October 2011	Order receipt	The order amount was reviewed to reflect forex fluctuations, etc. vis-à-vis the firm offer target cost.

III. Comprehensive review of AIDA cruise ship project

(Evaluation of decision-making process and project management)

Direct causes of losses

- Insufficient recognition by the Shipbuilding Division of the difficulties in the prototype vessel. Optimistic and hasty decision-making following successive failures to win orders. Inadequate project management capability; and general confusion in carrying out the construction work resulting from all of the above (details as shown on pages 4-8)

Recognition of shortcomings by top management and corporate departments

- Decision-making relating to individual business negotiations and technology development was initiated by the business segment concerned. In short, the Company retained its old management practice of having corporate departments perform individual functional checks only if needed, followed by confirmation from top management.

Other points for improvement

- The Shipbuilding Division had a mindset not suited to project management nor to development of new products and technologies: for example, an ingrained reluctance to seek help from other segments and a top-down culture.
- From the early phase of project execution, the corporate departments failed to perform adequate monitoring of work progress and costs. (excessive dependency on the business segment in charge)
- Improvements were also needed with respect to the method and accuracy of cost estimates made by the Shipbuilding Division.

Management reforms going forward

1. Strengthening of risk management

Recognizing this matter as a group-wide issue, improvements will be made to how decisions are reached within the conduct of business activities, and risk resilience will be strengthened (please refer to attached materials).

2. Commercial shipbuilding business reforms

- 1) To learn from the mistakes made and apply that knowledge to rehabilitate and develop the commercial shipbuilding business, including cruise ships, all company-wide resources will be directed into carrying out overall reforms of this business's structure and systems (see pages 13-14).
- 2) To carry out those reforms successfully, the active participation of all persons involved in this business, including younger and mid-level employees, will be indispensable. Reforms of the business and corporate culture will be accelerated, led by a committee charged with reforming commercial shipbuilding at Nagasaki.*

* Launched in late 2015, involving younger employees in Nagasaki, after the unsatisfaction of meeting specification requirements was found out in the commercial shipbuilding division.

Market (cruise lines) and trends

- The industry structure of cruise lines (the operators of cruise ships) is as follows:
 - 1) The three major operators¹ account for nearly 80% of market share;
 - 2) Clear business models have been established;
 - 3) As the global population of cruise passengers steadily increases, all three companies are registering operating margins above 10%.
- The cruise business is expected to expand further, fueled by growth of the Chinese market in the medium to long term.

Structure and trends of the cruise shipbuilding business

- The three leading European cruise shipbuilding companies² collectively account for a greater than 90% market share, but their operating margins are only a few percent. Two reasons are thought to be responsible: 1) the consortium-like business ties between the shipbuilders and the parties that supply them with interior designs and procured items (entertainment facilities, etc.), which account of a high percentage of their overall costs; 2) the power relationship between shipbuilders and cruise lines.
- Meanwhile Chinese operators are beginning to overtake state-owned shipbuilders and European shipbuilders, generating concern around construction overcapacity in the future.

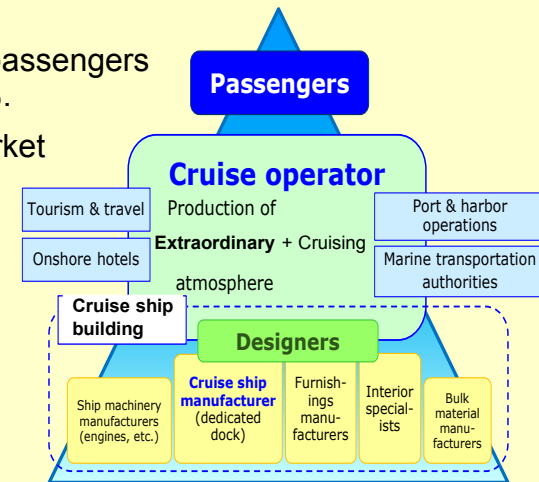
Note 1: Carnival Group (U.S., U.K.), Royal Caribbean Group (U.S.), Norwegian Group (U.S.; Hong Kong capital)

Note2: Meyer (Germany), Fincantieri (Italy), STX France (France; French-Korean joint venture)

Characteristics of the cruise shipbuilding business as a whole

- In the West, and particularly in Europe, “cruise ship clusters” centered around ship operators (cruise lines) are being formed to meet the need for continuous construction of large cruise ships. No such clusters exist in Japan or its vicinity, however. This is putting Japanese cruise ship builders at a disadvantage against their European competitors in terms of costs and delivery schedules.

Structure of cluster in Western cruise industry



- ✓ Barring any major changes in the above operating structure and environment, no initiatives should be taken with respect to continuous building of large cruise ships for the American and European markets.
- ✓ The Company should pursue a business model focused on posting stable earnings by taking full advantage of the MHI Group’s differentiated technologies and equipment³, which were highly evaluated on the cruise ships built for AIDA, and its comprehensive engineering capabilities reflecting the lessons learned from this matter.

Note 3: Development of eco-ship body design, Mitsubishi Air Lubrication System (MALS), air-conditioning system making use of waste heat, LNG fuel supply system, etc.

1. Synergy with car ferry building in Shimonoseki Shipyard

Car ferry building business at MHI Shimonoseki Shipyard

Ranks No.1 worldwide in terms of car ferry building record to date. It established interior work methods for car ferries*, and it is pursuing further improvement and sophistication.

- 1) Although differing from cruise ships in terms of size, etc., a “car ferry cluster” incorporating local suppliers has been successfully created.

* Ferries that serve to transport both vehicles and passengers. In the U.S. and Europe, such ships are referred to as “RoPax ferries,” a term derived from “roll-on/roll-off” (ships for transporting wheeled vehicles) and “passenger.”

	Shimonoseki Shipyard's areas of expertise		Trends in the Japanese car ferry market
	Conventional car ferry	Cruise ferry	Cruise ship
Service pattern	Regular (scheduled)	Regular (scheduled)	Irregular (tramp)
Navigation time	Several hours to 3 days	Several hours to 3 days	3 to 100+ days
Purpose	Transportation of cargo, passenger cars, & passengers	Transportation of cargo, passenger cars, passengers & leisure	- Passenger leisure (on board & sightseeing)
Main source of earnings	Transportation of cargo vehicles	Transportation of cargo vehicles, passenger fees, duty free shop	Passenger fees

Features of cruise ferries and cruise ships

- Abundant public spaces for enjoyment by numerous passengers (grade of interior facilities varies between ships)
- Require advanced designs to enable large interior spaces and higher-density outfitting configurations
- Require “smart city” type approach to enable large numbers of passengers and increased energy consumption

Trends in the Japanese car ferry market and Synergy with Cruise ship

- Cruise ferries have come into service, both in Japan and overseas (especially Europe), in recent years. Demand requires that they be able to accommodate large numbers of passengers as well as restaurants, shops, theaters, duty free shops and a variety of entertainment facilities. The trend toward cruise-like car ferries taking place in Europe is expected to occur in Japan also.
- If Shimonoseki Shipyard’s capabilities in car ferry design and construction are integrated with Nagasaki Shipyard’s expertise in large-scale interior work and entertainment facilities (derived from its construction of cruise ships), and with company-wide capabilities in project management, synergies can be created. Orders for cruise ferries may supersede car ferry and cruise shipbuilding, within a given scope.

2. Future business plan/policy

Cruise shipbuilding business enabling synergies with car ferry building at Shimonoseki Shipyard will be promoted within the scope defined below. Further additional measures described in 2) and 3) will also be implemented simultaneously.

1) Future business negotiations concerning cruise shipbuilding will be limited in scope based on the two criteria - (a) and (b) - listed below. Individual negotiations will be entered only after the Business Risk Management Division has thoroughly investigated issues such as profits, delivery schedule, and securement of major suppliers.

(a) Cruise ships (cruise ferry or small/medium-sized vessel) manageable in size and specifications utilizing the currently available resources.

(b) Cruise ships for which the concept design is jointly developed with the customer, and which is achievable utilizing a supply chain centered around Japan.

The appropriate construction site shall be decided taking into account synergies with car ferry operations.

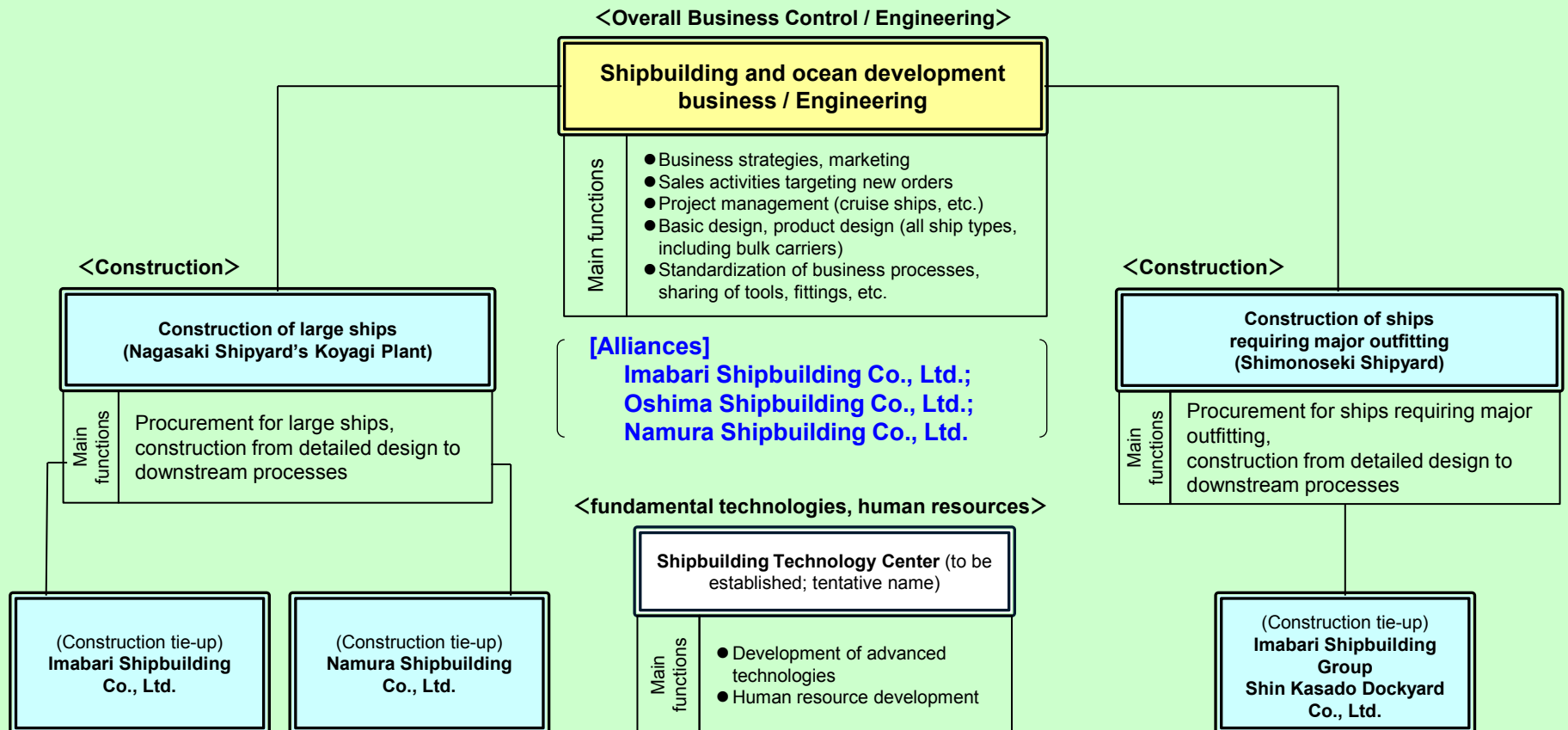
2) For improved viability of the cruise ship and car ferry building businesses, alliances with other companies shall be considered that will generate mutual benefits in terms of construction capabilities and supply chains. Such alliances will be incorporated into the overall reform of the commercial shipbuilding business, and further strengthened going forward.

3) Establishing the differentiated technologies out of the experience of “complexity ship engineering” in AIDA cruise ship project.

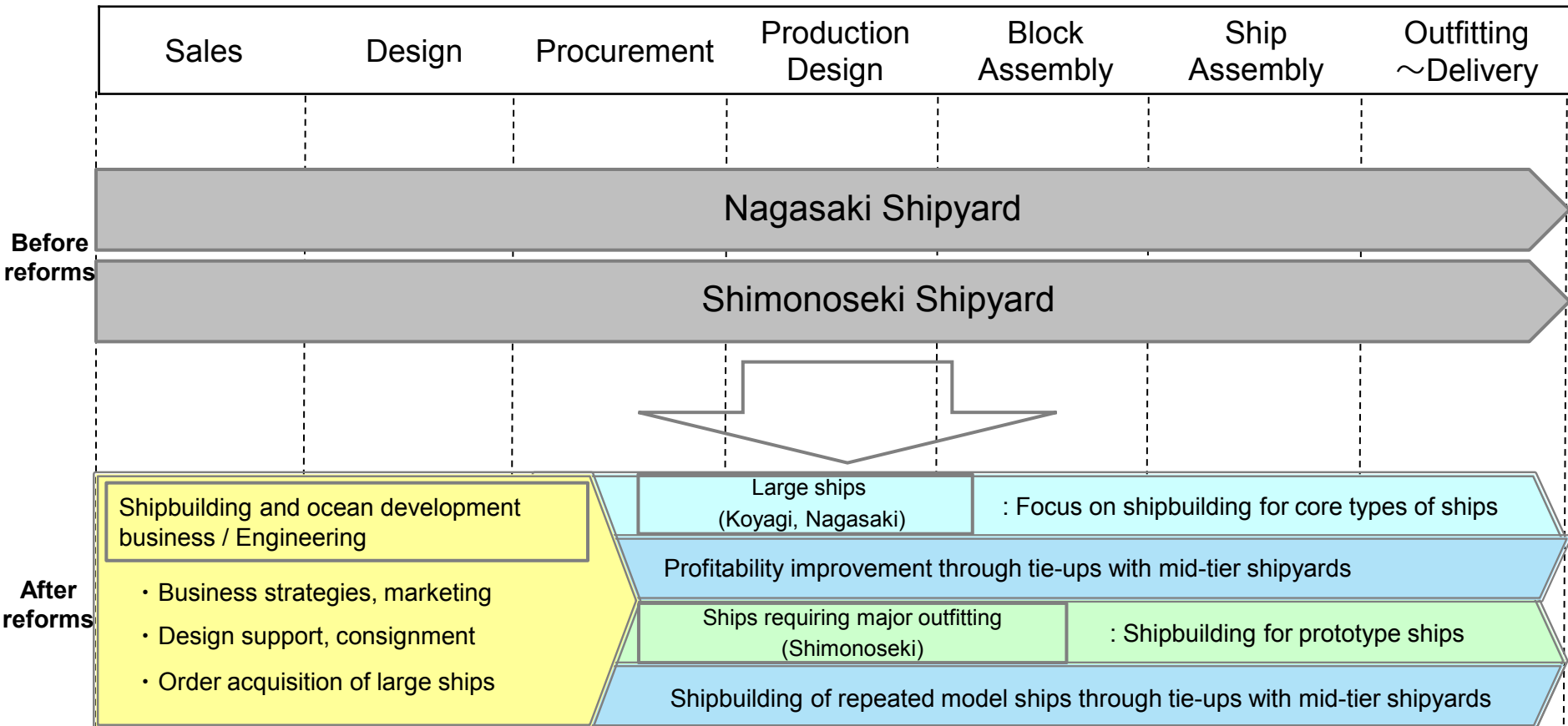
Reference: Overall reform of structure and organization of the commercial shipbuilding business (1)

[Fundamental concept]

1. Aim to enter tie-ups with mid-tier shipyards that offer mutually complementary relationships, putting MHI's shipbuilding and ocean development engineering at the core. (Consideration given to establishing a specialized shipbuilding entity via a company split)
2. Aim to reduce costs and strengthen competitiveness by standardizing product design and business processes, and sharing tools, fittings, etc.
3. Pursue tie-ups in receiving order, design, supply chain management and construction with mid-tier shipyards that can be expected to offer mutually complementary relationships for specific types of ships.
4. Establish a Shipbuilding Technology Center (tentative name) – together with affiliated shipbuilders, maritime transport companies and other maritime entities – that provides programs for advanced technology development, shipbuilding technologies and skills, in order to develop core technologies and skilled human resources.



Comparison of work sharing etc. before and after reforms



**MITSUBISHI
HEAVY
INDUSTRIES
GROUP**

NEW SHIPBUILDING BUSINESS MODEL
Nagasaki × Shimonoseki × Partners

MOVE THE WORLD FORWARD

Similarities between large cruise ships and LNG carriers

As can be seen from the table on the right, there is no significant difference between large cruise ships and LNG carriers with respect to steel weight (hull part), Hull size and propulsive functions

Differences between large cruise ships and LNG carriers

Large cruise ships differ significantly from LNG carriers with respect to their upper-hull outfitting* and interior works, demanding “compact & smart city” type installations. As indicated in the lower section of the table, large cruise ships require over 10 times more equipment than LNG carriers in terms of duct length, wiring length and interior work area.

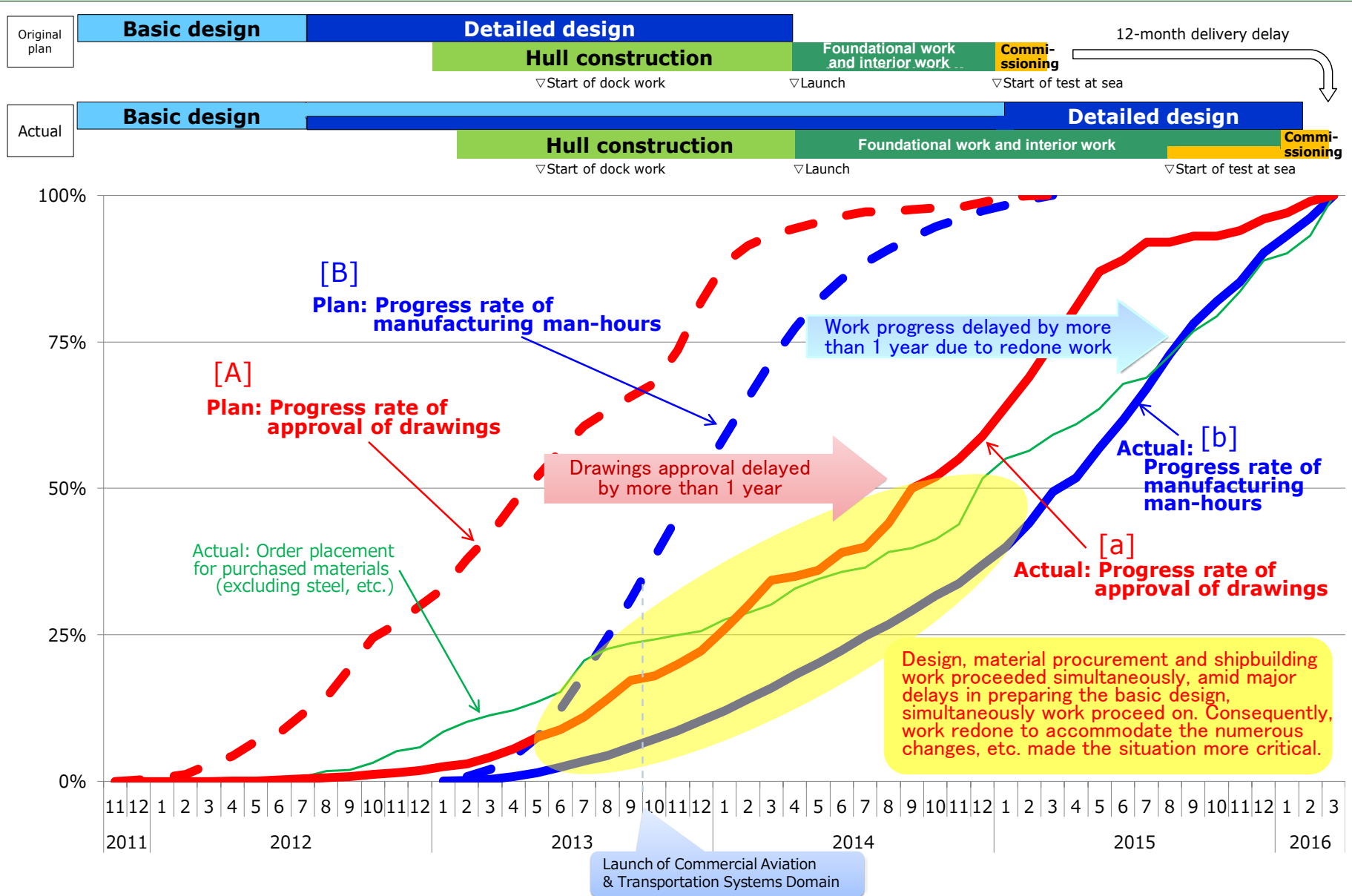
* Outfitting: installation of pipes, air-conditioning ducts, wiring, etc.

Main Dimensions		AIDAprima 1st ship, delivered in 2016	LNG carrier Delivered in 2008
Length overall	m	300.0	288.0
Width	m	37.6	49.0
Draft	m	8.00	11.27
Gross tonnage (GT)	ton	125,000	122,361
Number of cabins	rooms	1,643	-
Crew size	people	900	44
Propulsion system		Electric (POD System) x2	Steam turbine x1
Main engine		Diesel x3, 36MW Dual fuel x1, 10.8MW	Steam turbine, 22.9MW
Speed	kn	21.4	19.5

Quantitative ratios (AIDAprima vs. LNG carrier = 1.0)

Steel weight	0.9	1.0
Welding length	2.8	1.0
Pipe length	4.7	1.0
Duct length	71.0	1.0
Cable length	16.8	1.0
Interior area	21.3	1.0

Supplement #2: Comparison of planned and actual work progress



Supplement #3: Comparison of car ferries, cruise ferries and medium-size cruise ships

	Ishikari (for Taiheiyo Ferry)	Viking Grace	Crystal Harmony (now, Asuka II)
Shipyard	MHI Shimonoseki Shipyard	Meyer Turku	MHI Nagasaki Shipyard
Features	Largest car ferry in Japan	Newest cruise ferry	Largest cruise ship registered in Japan
Length overall	200 m	218 m	241 m
Width	27.0 m	32.4 m	29.6 m
Gross tonnage (GT)	35,028	57,565	48,621
Interior area	approx. 10,000m ²	approx. 30,000m ²	approx. 30,000m ²
Main public spaces	Restaurant ×1 Show lounge ×1 Entrance ×1 Large public bath ×1	Restaurants ×3 Cafe lounges ×4 Large duty free shop ×1 Conference area ×1 Spa ×1	Restaurants ×5 Cafe lounges ×5 Medium-size shop ×1 Show lounges / theaters ×4 Entrance ×1 Large public bath ×1 Spa / fitness centers ×2
Passenger capacity	783 people	2,800 people	1,110 people
Number of cabins	176 rooms	880 rooms	505 rooms