▶ **CTO Message**
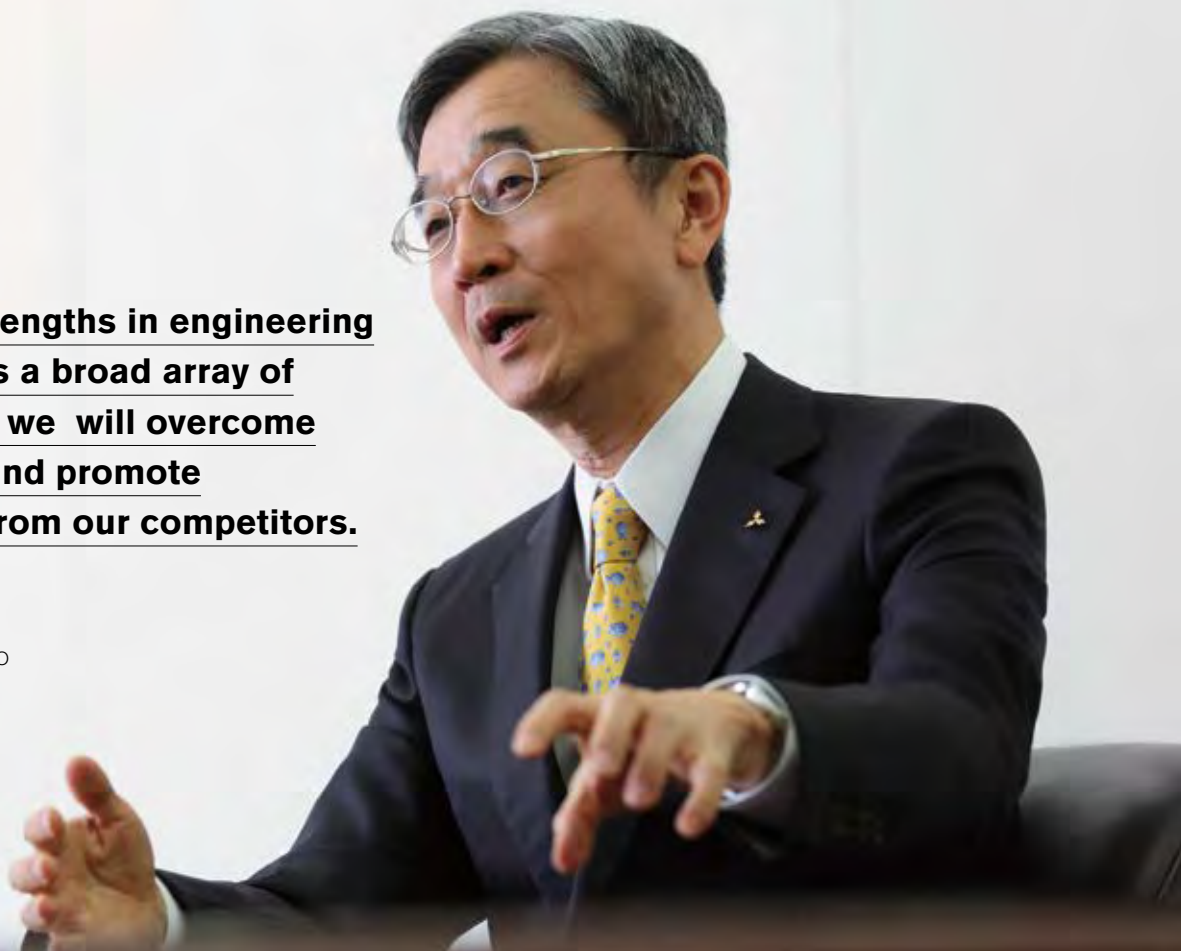
Applying our strengths in engineering spanning across a broad array of business areas, we will overcome current issues and promote differentiation from our competitors.

Michisuke Nayama
Executive Vice President and CTO

Core Functions of the Chief Technology Officer (CTO)

In recent years the MHI Group has progressively spun off its various businesses to enable them to operate autonomously and resiliently with full authority and responsibility. The business corporations and independently managed joint ventures (JVs) that have evolved out of this initiative have each devised their own growth strategies and are pursuing scale expansion, and as a result their autonomy from MHI —the parent company—has steadily grown. Inherently, having a business scale of a certain size is of significance to the MHI Group as a whole in several ways, not only in terms of corporate trustworthiness and financial clout but also, above all, with respect to comprehensive technological capability. For this reason, as a countermeasure to the spin-off trend, it is imperative for MHI to strengthen its unifying force and share a wide spectrum of technologies throughout the entire Group, including independently managed JVs.

The core function performed by the CTO is to serve as leader in gathering together the technological strengths of these various businesses and directing the transfer or provision of their technologies throughout the MHI Group. Another important function is to allocate resources into technology development from a groupwide perspective. In April 2016, the authority and scope of responsibility held by the CTO were expanded with the inauguration of a shared technology framework under the CTO's direct oversight. The launch of this framework has enabled expanded support of fundamental core technologies and further advancement of our corporate aspiration to become "an innovative and agile organization that leverages our dedication to technological advancement and engineering excellence."

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                                                                       Value Creation through Our Business   Value Creation

Need for Full Cognizance of All Risks

In recent years a number of issues have arisen relating to our power plant and cruise ship construction projects, but in my view these issues are by no means an indication of deterioration in our technologies themselves. In the case of the damaged steam turbines at units 3 and 5 of The Kansai Electric Power Co., Inc.'s Himeji No. 2 Power Station, glitches occurred in steam turbines incorporating state-of-the-art technology. We deeply regret the significant inconvenience those problems caused for the utility itself and all other affected parties, but these incidents must not keep us from continuing to pursue the development of new products at the technological forefront in order to grow globally. We firmly believe we were not mistaken in taking up such a challenge in the case of our advanced steam turbines.
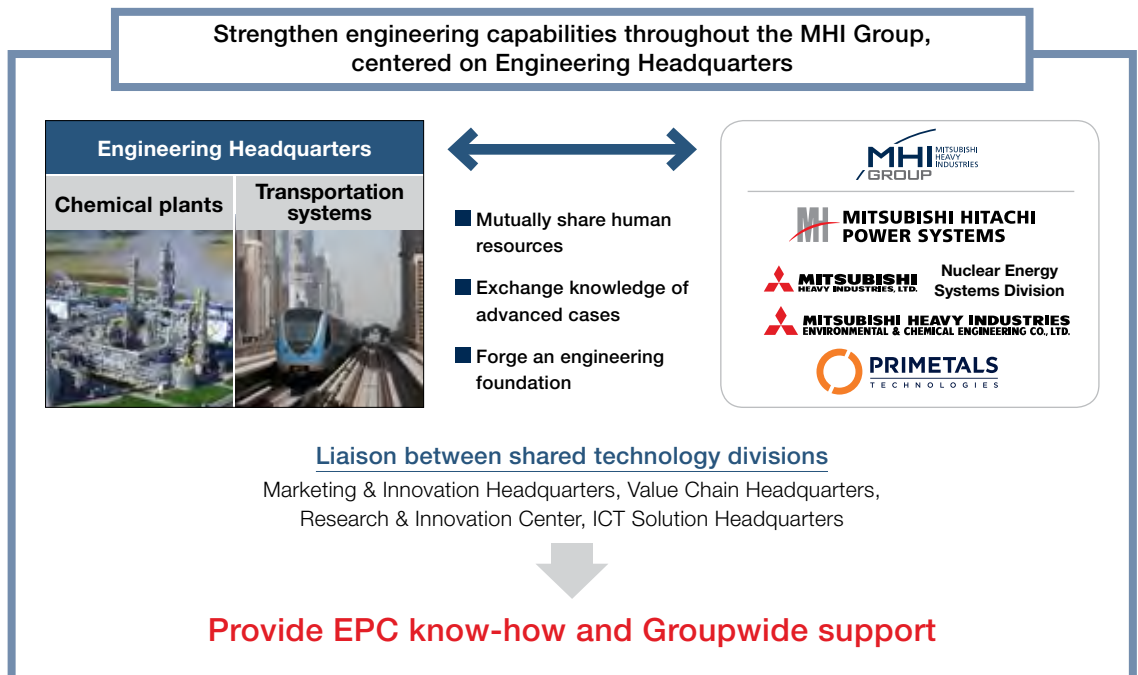
The case of the delays in constructing the two large cruise ships ordered by AIDA Cruises, a unit of the U.S.-based Carnival Corporation & plc, involves issues different from those relating to the Himeji No. 2 Power Station's turbines. The cruise ships on order demanded construction on an extremely high, cutting-edge technological level with respect to fuel efficiency, speed and other parameters of their basic performance, and from the outset we were fully aware of the potential risks and managed them. Ultimately, however, we failed to recognize fully perhaps the most crucial risk of all: whether we would be able, based on our previous experience in standard shipbuilding, to successfully carry out a project to build large-scale cruise ships—a product incorporating myriad types of equipment and heavily weighted toward engineering elements. In retrospect, we must reflect seriously on our failure to judge in full what risks we might have incurred and the importance of devising measures to deal with such risks when taking on a new challenge of such dimension.

Targeting Strong Engineering Capabilities as a Risk-Reducing Method and Differentiation Strategy

In the case of the cruise ship problems, I acknowledge that there were also issues with project management. The management demanded in this instance essentially equates to engineering capabilities of the type called for in engineering, procurement and construction (EPC) when constructing a plant. With plant engineering, project execution requires a quantitative grasp of quality, cost, delivery (QCD); in the cruise ship project, this engineering approach was inadequately applied, and project execution management matching the needs of cruise ship construction was lacking. At MHI, engineering strengths vary between our

Strengthen engineering capabilities throughout the MHI Group, centered on Engineering Headquarters

Engineering Headquarters

| Chemical plants | Transportation systems |

■ Mutually share human resources

■ Exchange knowledge of advanced cases

■ Forge an engineering foundation

MHI GROUP MITSUBISHI HEAVY INDUSTRIES

MITSUBISHI HITACHI POWER SYSTEMS

MITSUBISHI HEAVY INDUSTRIES, LTD. Nuclear Energy Systems Division

MITSUBISHI HEAVY INDUSTRIES ENVIRONMENTAL & CHEMICAL ENGINEERING CO., LTD.

PRIMETALS TECHNOLOGIES

Liaison between shared technology divisions
Marketing & Innovation Headquarters, Value Chain Headquarters, Research & Innovation Center, ICT Solution Headquarters

Provide EPC know-how and Groupwide support

various business operations while on the one hand we possess highly advanced, comprehensive engineering capabilities in areas such as the Energy & Environment domain, on the other hand we carry out business in the manufacture of individual products. To close the gap between these two levels, we launched an Engineering Headquarters.

The Engineering Headquarters integrates the EPC execution functions of the Energy & Environment domain's businesses in chemical plants and social infrastructure and those of the Commercial Aviation & Transportation Systems domain's engineering operations. The underlying notion here is that, by sharing the methodologies and resources cultivated in a wide array of business areas—chemical plants and transportation systems, etc.—project management capabilities can be elevated to new levels of sophistication and efficiency. Raising the level of our strengths in engineering throughout the Company will, I believe, not only reduce overall

project risks but also drive profit growth in all businesses.

Through the years, in its diverse engineering operations the MHI Group has not only delivered equipment to customers; we have also been involved in related construction work. Among our major overseas competitors there are companies that are striving to shift to a business model in which they supply the same type of system to customers of all business formats and make a selling point not of hardware but of information processing itself. We, by contrast, have consistently stressed EPC as one of our core business areas. Listening to the requirements of our customers and the views of our business partners, and then overseeing and coordinating an entire project, has become firmly rooted as the very essence of our business. Going forward, further honing and strengthening of this special capability will be an important strategy.

Shared Technology Framework Vision

Our shared technology framework encompasses the Engineering Headquarters, the newly introduced Marketing & Innovation Headquarters and Value Chain Headquarters, and the pre-existing ICT Solution Headquarters and Research & Innovation Center. Previously, only the Technology & Innovation Headquarters—which had oversight of the Intellectual Property Department and the Monozukuri Innovation Planning Department, etc. – was in a position to apply resources common to the Company's various businesses. Now, under the shared technology

framework, in addition to such technological support, the objective is to raise the level of the value chain as a whole, including productivity enhancement and the optimization of supply chain management. Particularly in the Marketing & Innovation Headquarters, through customer account management, market trends are monitored from a companywide perspective, based on which the headquarters considers, what types of technologies should be developed going forward, what enterprises possessing what kind of technologies should be chosen as future partners in collaboration, etc. Then, within the shared technology framework as a whole, planning is undertaken of new business frameworks and product/service frameworks—the latter including design work, procurement, develop-ment, information and communication technology (ICT)—and leadership in technological aspects is provided to the entire Group. This is our vision for the shared technology framework.

Given that have made our Group companies independent in order to promote their autonomous management, corporate functions of this nature may perhaps seem unnecessary. But it is precisely for that reason that the shared technology framework must create value in the various business segments, providing information or services, etc. based on inte-grated knowledge and resources. Since the ability of the MHI Group as a whole to manifest its

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comprehensive strengths depends on how well the shared technology framework functions, sharing the approaches devised not only by me as CTO but by the rotating ranks of employees transferred from the various segments, I am addressing this task with a strong sense of mission.

In this context, I wish to refer to the Research & Innovation Center. More than 80% of the Center's budget derives from orders received from the various business segments, i.e, this is an organization conducting "virtual management." Because it becomes necessary to reduce costs, for example, by trimming the workforce, if orders flag due to poor quality of provided services or research results, improvements are spontaneously carried out. Of course, since proactive upfront investments are needed in R&D, approximately 20% of the budget is furnished from the corporate divisions in order to keep a proper balance. I aim to implement this same type of management scheme within our shared technology framework.

For details about the Engineering Headquarters and shared technology framework, please see the Technological Base section on page 52.

Active Use of AI and Global Technology Sharing Are Issues for the Longer Term

Looking toward future growth beyond the near term, artificial intelligence (AI) in particular is a disruptive technology that can engender huge breakthroughs, and we cannot ignore it. However, AI is a topic of research conducted all over the world , and rather than giving birth to new technologies through in-house development, our intention is to incorporate, ahead of other companies, new technologies developed externally and put them to use at MHI. In the area of AI technologies, we are focusing not only on applying such technologies to the "control systems" incorporated into products but also expanded applications in the business process. It is conceivable that AI may come to serve not only in the back office but also replace work performed at design and manufacturing worksites, and MHI is undertaking research into how to apply AI. In the future we hope to introduce AI into engineering, the realm in which we excel, and by seeking to further raise productivity and reduce risks, we aim to boost our competitive strength.

Compared to companies whose business is focused on the domestic market, companies doing business primarily overseas typically lag in sharing technology, and here I feel there is great room for us to improve going forward. As open innovation in tie-ups with overseas universities is steadily increasing, promoting active sharing of domestic and overseas technology resources within the MHI Group is a topic we will clearly address as we move forward.

Leveraging the Internet of Things (IoT) and AI