

Strengthening Our Technological Infrastructure

Our knowledge of the full potential of machinery uniquely positions us to contribute to solutions for social issues

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Forecasting the Future and Achieving Innovation

MHI Group has contributed to the progress of society by providing various mechanical systems. At the same time, as illustrated by SDGs, social issues and human values are diversifying and technological innovation is accelerating, all of which requires a shift in business.

Making this shift in business will require a new trial and error “exploratory process” that takes a bird’s-eye view of the future, and formulates hypotheses for innovation in business and technology. We will undertake the challenge of innovating our business and technology from a medium- to long-term perspective without being bound by the constraints of current business. These activities constitute MHI FUTURE STREAM (MFS) and are led by our Shared Technology Framework*1.

We will share the business ideas we obtain with the Growth Promotion Office and organically connect them to our existing business foundation and organizational culture as a companywide growth strategy. This includes business ideas that require new organizations.

MFS consists of three activities. The first of these is “Mega Scan,” which explores business opportunities for MHI Group based on social mapping far into the future. We are analyzing more than 100 mega-

trends in technology, politics, society and economics. Next, with “Shift the Path,” we are considering measures for medium- to long-term conversion of businesses, and to accomplish this goal, we are using “Technology Scouting” to seek and co-create necessary technologies.

For example, we expect the values of our customers and investors to change and decarbonization to accelerate. In response, we will work to achieve carbon recycling by engaging in conversion to low-carbon in our existing businesses, creating carbon-free new businesses—as well as hydrogen power and stored energy—and achieve those goals from a variety of perspectives.

In addition, with the evolution of machinery systems, we are focusing on electrification and intelligent systems. MHI Group has many of the world’s leading hardware and control technologies. By incorporating more electrification and intelligent systems into these technologies, we can create new value.

First, in electrification, we are developing products in anticipation of future power semiconductors. Power semiconductors are devices that alter electrical frequency, and the latest models have higher output density. Furthermore, converting conventional motorized machinery to electric drive delivers a variety of

advantages, such as better efficiency, size and weight reduction, as well as easier automated control.

In intelligent systems, for many years now, MHI Group has been commercializing technologies that make use of deep learning and other forms of AI and has been applying them to uses such as autonomous driving. By combining these efforts with recent advances in digital, communication and control technologies, we can achieve optimal operation by linking multiple machines as if they were one.

For example, in the growth fields of thermal and logistics, we are working on intelligence, automation and a significant improvement in performance. We are also working to expand services by improving inspection technology using AI.

With markets and technologies changing at an unprecedented speed and scale, it is essential to incorporate external knowledge and create innovation. We are carrying out initiatives for the co-creation of innovation by collaborating with nearly 200 universities and companies and flexibly combining innovative technologies and business ideas.

*1 The Shared Technology Framework encompasses the Technology Strategy Office, Research & Innovation Center, ICT Solution Headquarters and Value Chain Headquarters.

New Initiatives to Achieve Innovation

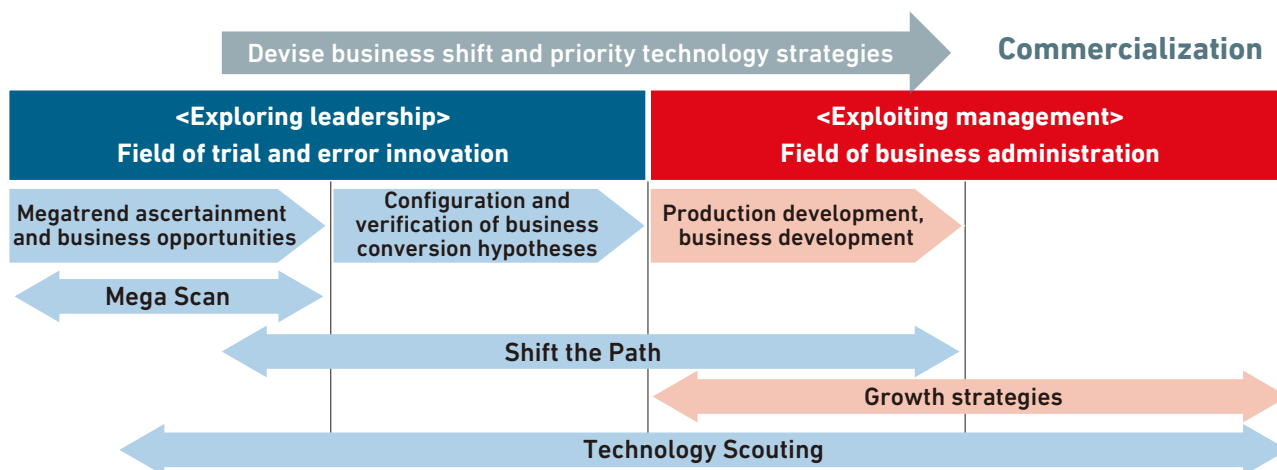
Here we would like to present three examples of new initiatives to achieve innovation through our MFS efforts.

The first of these is the MHI Innovation Accelerator, which we established in 2018. This organization works to discover new knowledge from the most advanced technologies and research fields and carry out research and development of technologies that rewrite conventional wisdom on products and business. The organization conducts R&D on ambitious innovative technologies that, if achieved, will have a great impact on society and industry. Many themes start with essential verification of the basic principles, but we are steadily improving our technical readiness. The number of themes is also increasing, and with young in-house researchers on board from the initial stage, we will accelerate future commercialization.

Furthermore, in 2020, we will establish "co-creation centers" to achieve the new ideas of venture businesses. These centers are equipped with laboratories and infrastructure for trial and error of prototypes and actual implementation and are operated with a focus on hard technologies. Several venture companies have already commenced activities, and we will accelerate commercialization by adding MHI Group technologies, equipment and human resources.

► Deployment of Growth Strategy from MHI FUTURE STREAM

(Blue: Led by the Shared Technology Framework, Red: Led by our Business Divisions)



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These centers also enable MHI Group employees to become creative, active innovators.

Another example is the acceleration of R&D and the expansion of scope in the Shared Technology Framework. We have introduced a new scheme, focused on our Research & Innovation Center, for researchers to freely come up with and verify hypotheses. This is conditioned on being able to write down ideas and business scenarios that contribute to society in their own words and being able to subdivide issues and break them down into elemental technologies. In the first few months, we received more than 100 proposals. They made up a mixed bag of ideas ranging from those at the embryonic stage to those that were quite well developed. Throughout this process, we say, "It is alright to fail." Even failed ideas help accumulate excellent data on hypothesis testing. We could see people take their own original ideas to the aforementioned "co-creation centers" and come into their own as entrepreneurs.

Moreover, new business and product ideas that are close to commercialization are also emerging from MFS. Often, there is a need for Group-spanning projects facilitated through the collaboration of multiple SBUs*², and we therefore operate a scheme to have SBU designers and Shared Technology Framework researchers handle development jointly.

*2 SBU: Strategic Business Unit

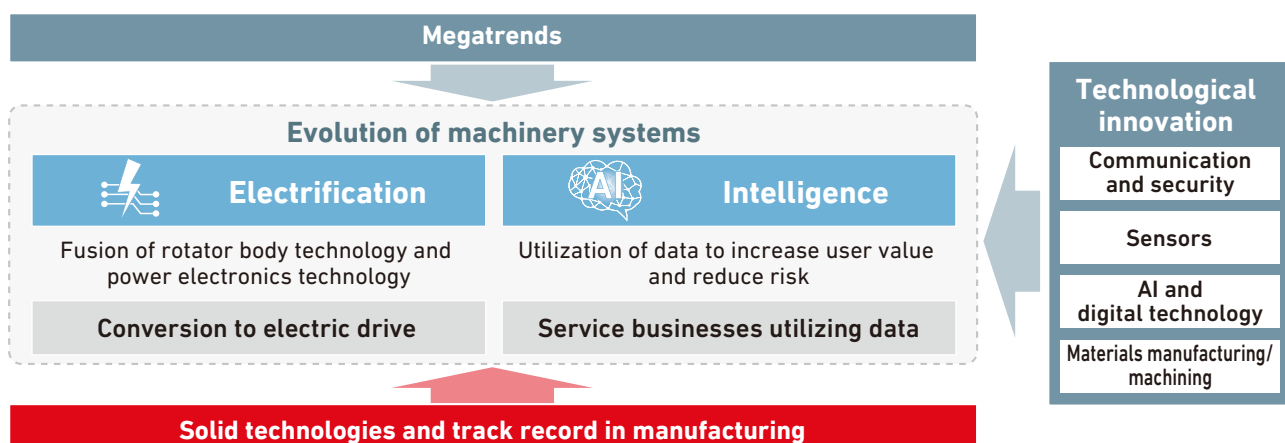
Adding a New Form to MHI Group

Operating complex and high-performance machines with high precision, while also providing reliability: That is the strength of MHI Group. We will evolve by adding electrification and intelligent systems, and that is the direction we will take in the months and years ahead.

The name MHI tends to be associated with the manufacture of rockets and other large finished products, but going forward, we will increase opportunities to "make strong components (parts) and put them into more widespread use." While focusing on machinery that utilizes complex technologies, we will also provide new types of components incorporating electric and automated features. We will continue to create innovative components that are useful to society.

For example, in automotive thermal systems, by combining a motor into a conventional system for engine vehicles, we developed an electrical version for EV vehicles in an extremely short period of time.

In addition, high-performance power components are essential for the air taxis that are being developed around the world. Leveraging the top-class expertise in rotors that we have accumulated in turbines and related technology, we will build components that integrate fans with motors, and sell them to numerous air taxi manufacturers around the world, where they will be in widespread use. This



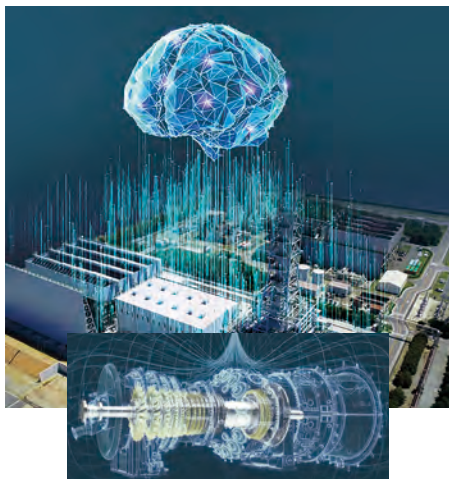
is a field where we can demonstrate our strengths since it requires the combination of difficult technological developments.

Control technology that soundly and efficiently operates complex machinery and plants is our important core competence. Above all, we lead the world in mission-critical control technologies such as social infrastructure and power plants.

In the field of intelligent systems, by attaching more sensors to equipment for monitoring, we carry out optimized operation of multiple systems. Our in-house power plants have already demonstrated technology that uses real-time data to determine optimal operation via edge computing and wireless networks. To analyze and utilize data, we are constantly improving various simulation technologies and AI technology platforms. By making full use of these technologies and platforms, we identify the signs of worn out parts that even seasoned experts may not notice and recommend their replacement. We will also increase remote control and autonomous driving.



Air taxis



Intelligent plants

We Will Continue to Provide Products and Services to Satisfy the Needs of our Customers

Some people wonder whether MHI Group has any more room left to grow, but I am convinced that we are precisely the kind of company that has the potential for future growth.

For example, electrification leads to smaller machinery that operates at higher RPMs, which presents various concerns, such as how to cool the heat generated and whether the machines are structurally sound. It also increases the need to accurately predict the timing of repair and replacement. However, when it comes to identifying the location and cause of a problem and determining the timing of repair or replacement, it is not enough to simply analyze operating data with AI. Only a company that has a deep understanding of the machine itself, has advanced design, development and manufacturing technologies, and is aware of boundaries such as operating limits and machinery lifespan can respond appropriately. Ultimately, that is where success or failure will be determined.

When it comes to advancing intelligent systems, one of the strengths of MHI Group, which is engaged in a wide range of applications for everything from defense to factories to air conditioners, is the ability to set appropriate security levels for the application in question. Diversity of technologies and breadth of practical experience are the pride of our Shared Technology Framework. This is unique to MHI Group, with our range of more than 500 products.

In the field of production, we are also working on work navigation systems and production scheduling technologies using AI technology. Basic technologies such as these can be used to transform business.

The credo of our Shared Technology Framework is to not be afraid to fail and to be faster than venture companies. By executing our MHI FUTURE STREAM, we will continue to evolve as a manufacturer of mechanical systems offering innovation to society.