

Taking on Challenge of “Hardtech” Innovation through New Co-Creation Space



Business Intelligence & Innovation
Department, Head Office Technology
Strategy Office, Mitsubishi Heavy
Industries, Ltd.

There has been growing importance of innovation for solving various social issues, while markets and technologies are changing at a speed and on a scale greater than we have ever seen. This report will introduce a new co-creation space for working on “Hardtech” innovation emergence called Yokohama Hardtech Hub (YHH), which Mitsubishi Heavy Industries (MHI) Group launched in April 2020. Hardtech is a technology field that will be the center of future mechanical system evolution, combining digital technology innovations such as AI (Artificial Intelligence) and IoT (Internet of Things) with physical technology innovations such as quantum technology, material design, micromachining and biotechnology, where repeated prototyping and verification are critical for actual implementation in society.

1. Background the foundation of YHH

MHI Group has, since its establishment, contributed to social progress through the manufacturing of the mechanical systems that constitute social infrastructure. Meanwhile, the recent needs and values surrounding social infrastructure have been changing in an uncertain and discontinuous manner due to increasingly complex social issues, the diversifying values of people, various technological innovations (i.e., digital, biotech, etc.) combined with people’s behavioral changes associated with the coronavirus pandemic.

MHI Group will continue to be a mechanical system manufacturer contributing to society, but in order to offer value to the stakeholders surrounding our group to continue our contribution, it is necessary to illustrate the state of future society that we aim to achieve, to recognize once again what role our group is expected to play and to keep working on the required transformation to make it happen. Accordingly, we have organized the activity called MHI FUTURE STREAM (MFS), which is an activity designed to provide a panoramic view of changes in the politics, economics, society and technology surrounding our group over the mid- and long-term and to discover the direction in which our group’s business should go based on multiple possible scenarios (**Figure 1**). MFS consists of three actions. “Mega Scan” creates business opportunities by providing a panoramic view of future society in 10 to 20 years and plans multiple scenarios of changes considering a wide range of possibilities related to markets and technologies. “Shift the Path” forms an innovation hypothesis on markets and technologies based on the insights and prospects provided by “Mega Scan” and to explore the newly discovered business opportunities. “Technology Scouting” is undertaken from the following two technological aspects. One is disruptive technology that could potentially have a significant impact on the mid- and long-term insights and prospects provided by “Mega Scan”. The other is the technologies required to realize the innovation hypothesis proposed by “Shift the Path” based on co-creation with our external associates.

MFS activities enhance the agile prototyping and trial framework where a small team of people work proactively through discussions with various stakeholders in MHI Group and experts in different industries. Meeting ever-changing social needs requires continuous transformation. In order to do so, it is necessary not only to “deepen” conventional efficiency, reliability and probability, but also to “explore” through prototyping and trials based on a wide range of

knowledge, insight and the hypotheses formed thereby, from a panoramic or long-term viewpoint. For intensifying this exploratory innovation, we have launched YHH in the MHI Honmoku Plant of Yokohama Dockyard & Machinery Works, Naka-ku, Yokohama, as a space for various talents and technologies from many different fields unrelated to our group businesses to get together and co-create new value.

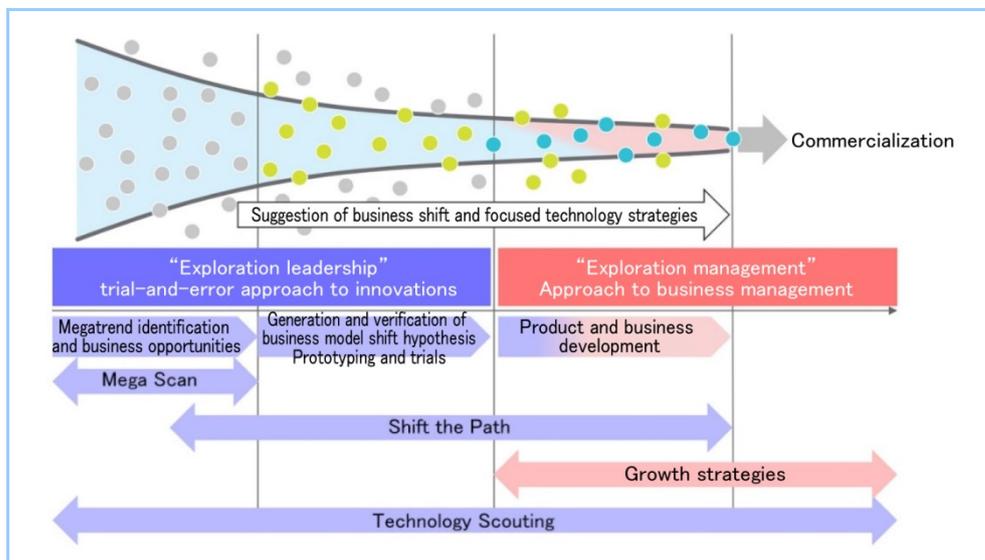


Figure 1 From MFS, business model shift/new business conception to development of growth strategy
(Blue: Led by Shared Technology Function, Red: Led by Business Function)

2. YHH's mission/vision and services

YHH aims to create new mechanical systems that can meet future social needs by focusing on venture businesses that take on the challenge of “Hardtech”, a technical field, combining digital technology innovations such as AI and IoT with physical technology innovations such as quantum technology, material design, micromachining and biotechnology, where repeated prototyping and verification are critical, that will become the center of future mechanical system evolution. YHH classifies the target areas, which will form future social infrastructure, into the following 4 categories; “Environment & Energy,” “Next-Generation Mobility,” “Intelligent Machine & Electrification” and “Next-Generation Food & Agriculture” (Figure 2) and builds a platform for supporting seed and early-stage venture businesses and their co-creation (Figure 3). YHH does not base its activities on collaboration with MHI Group, which is only involved in planning and operation. When participating, MHI Group does so simply as one of the venture businesses joining YHH.



Figure 2 YHH's target areas

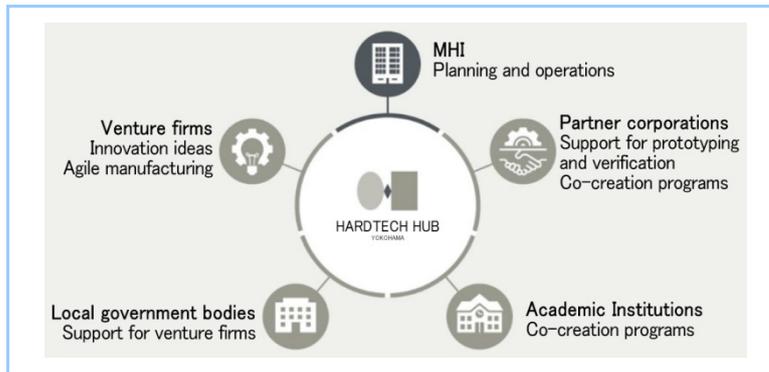


Figure 3 YHH's Stakeholders

Upon undertaking the above activities, YHH's mission and vision are set as follows.

Mission:

YHH contribute to accelerate solutions on social challenges and regional development by providing technology-orientated support for the creation and emergence of new innovations, and also increase the corporate value of MHI Group

Visions:

1. "A space where innovative ideas for solving social issues are created with various talents from around the world"
2. "A space that provides support for the implementation of new innovative ideas, taking advantage of the existing manufacturing base"
3. "A space where various innovators from around the world get together and bring about new industries and cultures to Yokohama"

In light of its mission and visions, YHH will provide the following four services; 1. Construction of the Hardtech co-creation network, 2. Planning and hosting co-creation activities and events, 3. Prototyping and verification in a large-scale open space and 4. Utilization of City of Yokohama's start-up support (**Figure 4**).

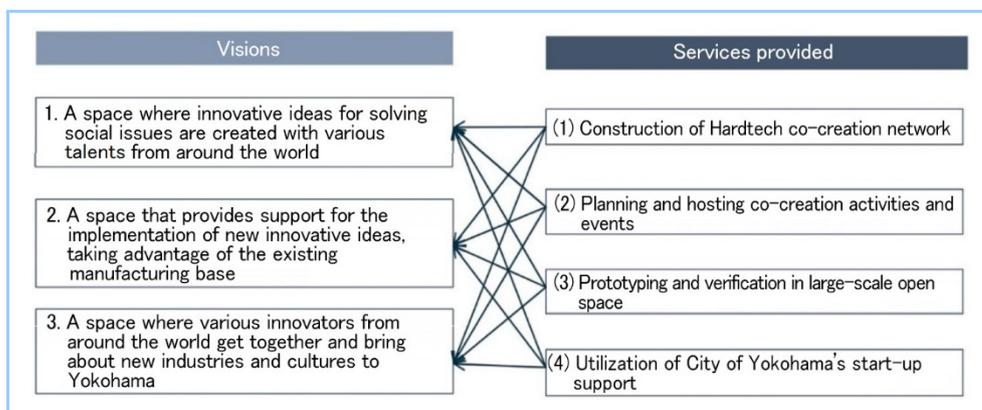


Figure 4 YHH's visions and services

3. Features of YHH's services

Regarding YHH's services as described above, the progress in the first year of its launch and details of future undertakings are explained below.

(1) Construction of Hardtech co-creation network

YHH has been working on the construction of a broad network with various different organizations who understand and agree with YHH's visions, including ventures, manufacturing-related businesses (hardware/software makers, venture capital businesses, etc.), local governments (City of Yokohama and others), educational institutions (universities, technical colleges, etc.) and the like. Based on this network, YHH serves as a hub and supports the construction of a new network for promoting the creation of new ideas and facilitating prototyping/verification. For instance, it is possible not only to realize collaboration between the tenant firms, but also to facilitate discussions regarding technical development, prototyping

and manufacturing with different organizations including multiple metal-processing companies based in Yokohama or even a component procurement assistance consortium in the aerospace-related industry. It is also possible to receive a wide range of technical support or network assistance from MHI, depending on the actual contents of the project. In the future, YHH will further expand its network toward collaboration with educational institutions and incubation facilities mainly in the local City of Yokohama and the Tokyo metropolitan area, as well as toward co-creation, joint exploration, etc., in life science fields such as biotechnology and agriculture.

(2) Planning and hosting co-creation activities and events

YHH will host events useful for expanding its network, introducing its tenant firms and co-creation activities. The events focus on various challenges in each industrial field and those which are common across different fields as event themes, discussing the way to tackle the challenges and boosting the awareness of the importance of co-creation. In December 2020, YHH organized its first online event with the theme of “Reality of manufacturing in the space field and the value of co-creation.” Approximately 150 people remotely participated and shared awareness of the importance of personnel exchange and co-creation between different technical fields, which led to the forming of a new network with an aerospace-related component procurement assistance consortium with more than 100 member companies. YHH will continue to organize activities and events to increase exposure of our tenant firms, to provide business solutions and to promote co-creation with different businesses including ventures and small- and mid-sized companies, while taking the needs of the tenant firms and common challenges in Hardtech into account.

(3) Prototyping and verification in large-scale open space

YHH has 4 blocks of facility buildings on the site of MHI’s Yokohama Dockyard & Machinery Works, enabling various prototyping and verification works of any scale, leveraging various useful features such as the over-8-meter-high clearance and high floor bearing capacity, on top of basic utilities such as cranes and power supply. The buildings with a gross floor area of approximately 20,000m² have few partitions inside and the tenants can determine the size of the space they need flexibly depending on the stage of the project and the extent of its growth. There is also a multipurpose open space where events can be hosted, as well as other basic facilities necessary for business such as meeting rooms. The flat-rate rent, including lighting, 100V power supply, air-conditioning, wireless LAN, etc., is quite reasonable and attractive for the Tokyo metropolitan area. The tenancy period is basically for 3 years. Some partner companies who agree with YHH’s vision have already moved in, and have started installing devices for conducting various tests such as thermal vacuum tests and vibration tests on the premises and are offering the use of such devices at a low price. YHH is still inviting more partner companies to become tenants, which have the lineup of not only the available hardware such as test devices, but also software such as CAD/CAM/CAE (Computer Aided Design/Computer Aided Manufacturing/Computer Aided Engineering), depending on tenant needs. With help from partner companies, YHH will improve the environment so that it can facilitate tenants’ swift prototyping and verification (**Figure 5** and **Table 1**).

(4) Utilization of City of Yokohama’s start-up support

YHH participates in the City of Yokohama’s start-up support facility YOXO BOX as a co-sponsor, which makes YHH’s tenant firms eligible for YOXO BOX’s consultation services. YHH also plays a role as one of the places accepting ventures supported by Yokohama City. YHH will continue to work on its mission and promotion of the Hardtech industry in Yokohama, collaborating with Yokohama City/YOXO BOX.

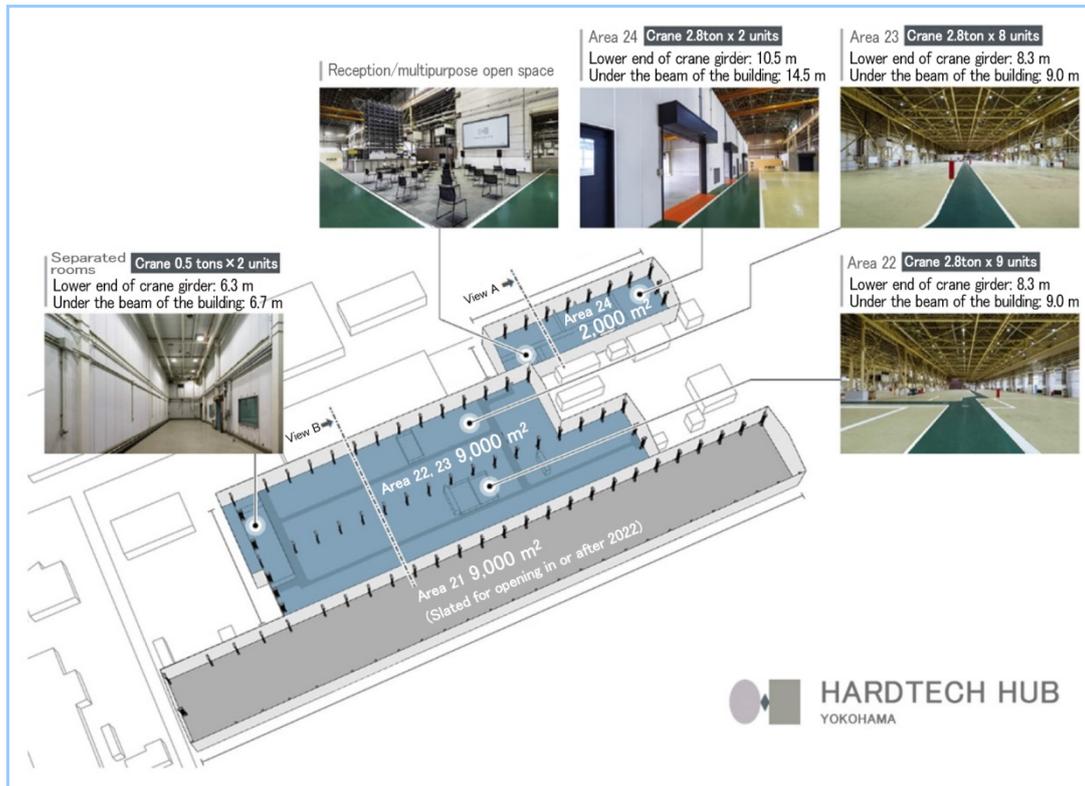


Figure 5 Bird's eye view of YHH

Table 1 Facility outline of YHH (as of January 2021)

Site area	20,000m ² (Area 24: 2,000m ² , Area 22 & 23: 9,000m ² , Area 21: 9,000m ²)
Construction	Reinforcing bar structure single-story construction (Seismic reinforcement measures have been taken.) Up to 450 mm thick concrete floor
Indoor ceiling height	14.5m to 19.5m
Indoor building	Gross floor area: Approx. 800m ²
Infrastructure equipment	Lighting, power supply (Single-phase 100V/200V, Three-phase 200v/400v) Compressed air, air conditioning, cold/hot water supply, etc.
Crane	Maximum load 0.49 tons to 2.8 tons Maximum lift 9.5m (Can be brought in by a trailer)
Shared facilities	Event square, Meeting rooms, Wireless LAN, Copy machines, pantry, etc.
Fee	Reasonable flat-rate rent despite being located in the Greater Tokyo area, including lighting/100V power supply, air conditioning, wireless LAN, vehicle parking, etc.
Tenancy period	Basically for 3 years
Test device (Partner companies)	Orbital Engineering Inc. <ul style="list-style-type: none"> • Thermal vacuum test device (Inside dimensions $\phi 1\text{m} \times 1\text{m}$ LN2 with shroud, Thermocouple approx. 80ch, High frequency 6 ch, Signal power source 40ch) • Temperature cycle tank (Thermotron S-8-8200, Temperature range -70°C to 180°C, Inside dimensions 61cm\times61cm\times61cm) • Clean booth (Class 10,000 with air shower, Size 3m\times5m) IMV Corporation <ul style="list-style-type: none"> • Small-size vibration test device for transportation tests m130LS (Vibration frequency range 2-1000 (Hz), Maximum speed 1.0 (m/s), Maximum displacement 51.0 (mmp-p), Maximum load volume 100 (kg), etc.)

4. Further development

In the future, through the enhancement of the individual services YHH provides, YHH will strive to contribute to solving social challenges and regional revitalization by facilitating collaboration between various different talents and facilities, as well as by creating an environment that supports the establishment of a value chain covering prototyping to mass-production, so that

idea creation, prototyping and verification are carried out quickly and smoothly. Furthermore, through its participation in YHH's activities, MHI Group will endeavor to become a better judge of business in terms of rapidly changing technological innovations and diversifying social needs, while also fostering talents with development management skills where failure and improvement are repeated in quick succession, a teambuilding ability that goes beyond the existing organizational framework and a spirit of entrepreneurship for the realization of a new society.