

# CHIRO<sup>®</sup>

## HULL CARE TOTAL SOLUTION

### Why SLM?

#### SLM FOCUSES ON COMPACT AND PRACTICAL USE

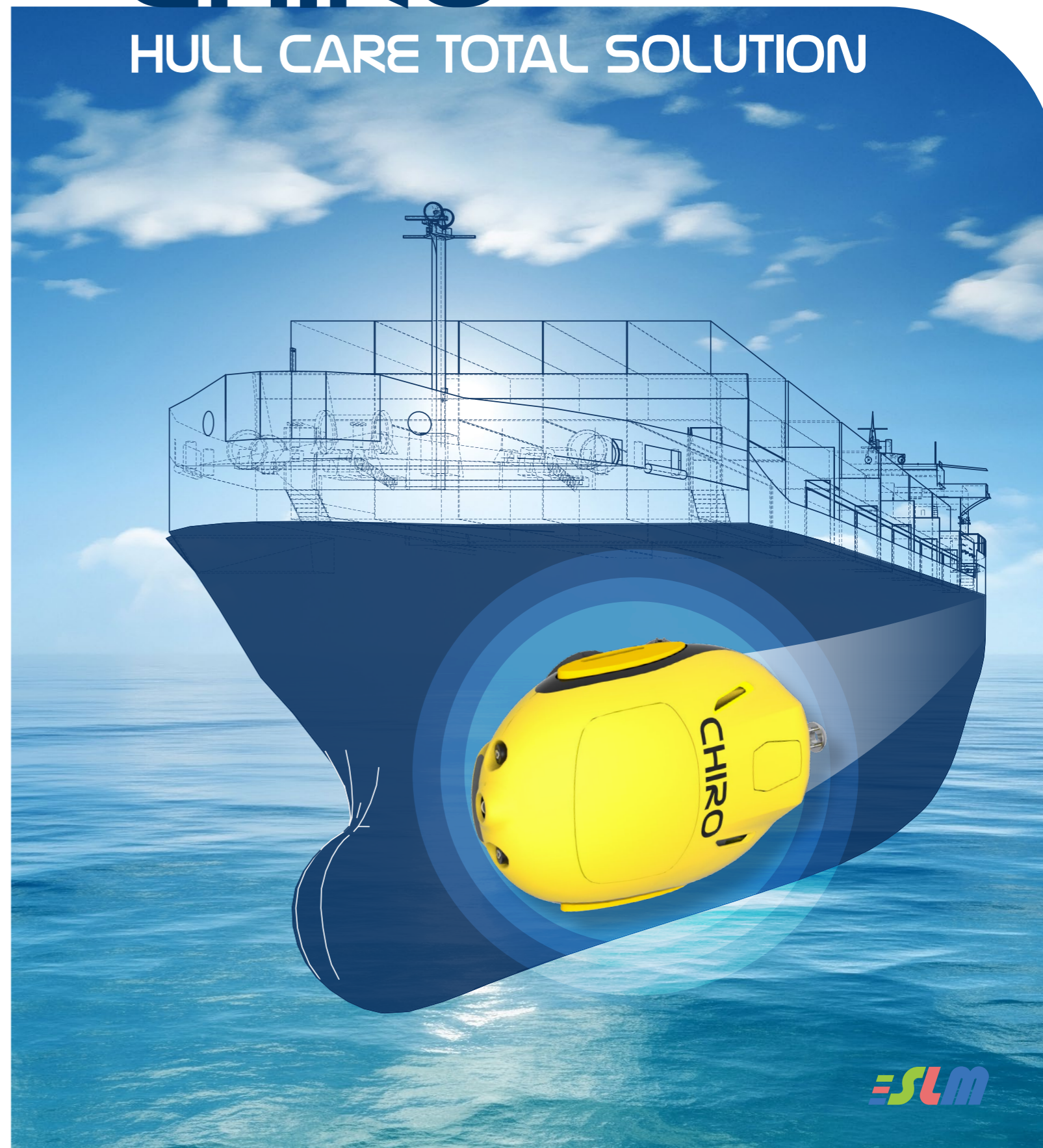
We are committed to introduce human-robot collaboration technology, under or above water.



Homepage



Brochure







# Mechatronics Technology for Human & Nature

Based on High Technology & Manpower, SLM Global develops the eco-friendly product & service to contribute Safety of people & environment.



## SLM Global Hull Cleaning Robot System

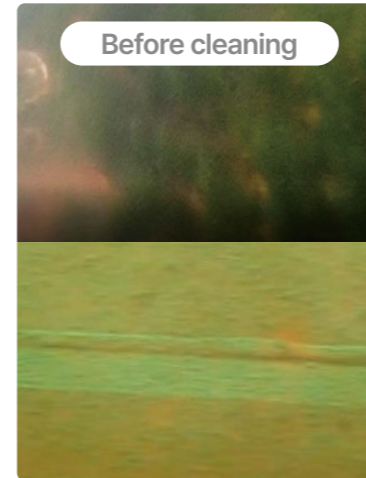
SLM Global is pursuing eco-friendly solutions that benefit people and the environment. We are dedicated to create green solutions and services.

We believe that our hull cleaning robot system CHIRO is one of the most feasible and eco friendly alternatives for "Green" shipping CHIRO provides great performance to meet the requirements of marine businesses.

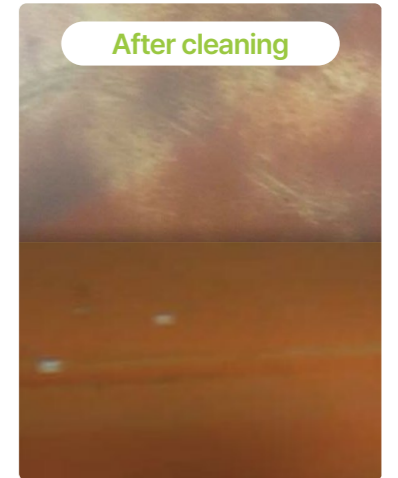
We are striving to be the most competent and reliable partner to our customers.

## Paradigm change

# Hull Clean to Hull Care



Before cleaning



After cleaning

- Cleaning is recommended at every 3 months
- Leave AF coating intact by gentle brushing
- Quick cleaning operation (typ. 8 hours)
- Minimum loss of paint film and the performance of AF paint is maintained
- Minimum paint powder is generated and mostly captured instantly
- The later the hull is cleaned, the shorter AF paint life can be

## Problems Caused by Hull Fouling

**Hull fouling** is a phenomenon that occurs when a ship is exposed to seawater. Marine organisms adhere to the hull, forming colonies, and growing along the hull.



Damage to the Marine Environment



Challenges for Divers



Increased drags, fuels and emissions

## SLM : History

### 2018

- Established SLM Global Co., Ltd
- Technology Use Contract (Hull Cleaning Robot Technology, Samsung Heavy Industries)
- Venture Business Certification

### 2019

- ISO9001 certified
- Prototype of CHIRO completed
- **Successful Sea-trial**
- External investment attraction and selection for TIPS program
- Established Busan service factory

### 2020

- **Commercial HC service** commenced
- Supply of CHIRO system to Korean Navy
- Pacific Ocean Marine Industries Co., Ltd. Hull cleaning robot supply contract
- CE certified

### 2021

- KC certified
- 2 years Hull Cleaning contract with S\*\* shipyard
- Supply contract cleaning robot for GNTF
- Accepted as a member of IMO GIA (Global Industry Alliance) Partners

### 2022

- Export to **Indonesia**

### 2023

- Export to **Singapore**
- Possesses 20 technical patents and 2 brands





# CHIRO® - Cleaning Hull Intelligent ROBot

## Performance and Specifications

- Dimension** : 1600 × 900 × 600(mm)
- Weight** : 250kg
- Cleaning Speed** : 1 knots (@0.5m/sec)
- Power Consumption** : 12kw (driven by net power)
- Time Required** : 8 hours (at the fouling rate of 30 or less)
- Cleanable Area** : at least 90% of the underwater surface of a ship (Up to 2m of RC (radius of curvature))
- Brush** : controls torque and pressure precisely
- Prevention of Pollution** : pump sucks cleaned dust/debris and collects it through an internal filter.
- Navigation Assistance** : depth-contour autonomous straight driving and free rotation in 360 degrees
- Maximum Depth** : 50m
- Operation Personnel** : 2~3 people (driving is easy to learn)



### STABLE

- Automated moving and cleaning
- Safe and fast operation
- Streamlined shell
- Highly available under 3 knots currents
- Staying still under powercut



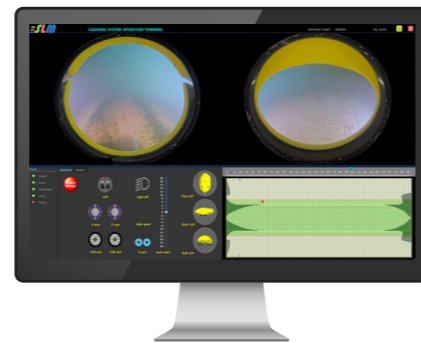
### CONVENIENT

- Easy to control - instinctive car-like vehicle driving
- Vision based real-time remote control
- Full electric within a rugged body
- Extra torque cancellation

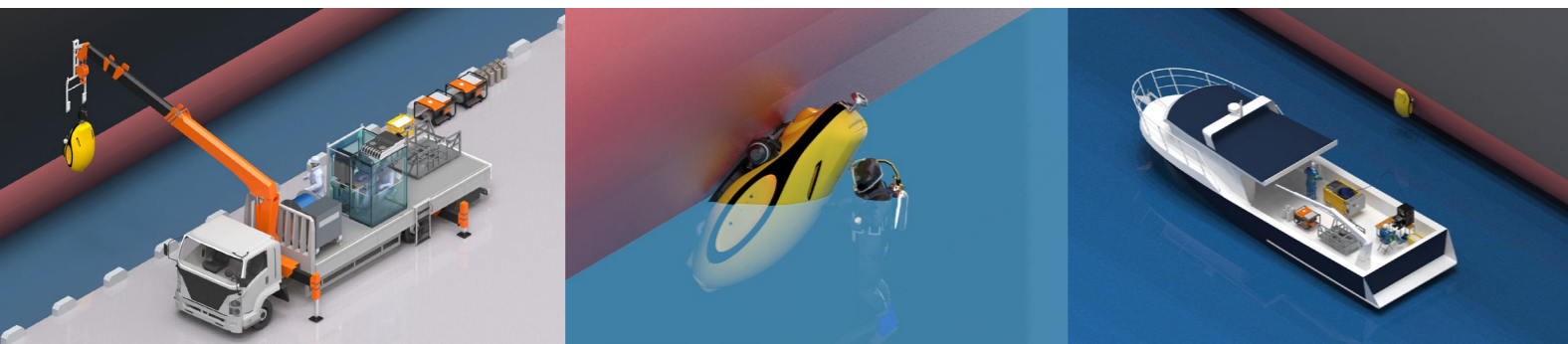


### EFFICIENT

- Needed only 2 operators
- OPEX reduction
- Scalable on demand
- Modular systems - easy to maintenance



## CHIRO Operation Concept



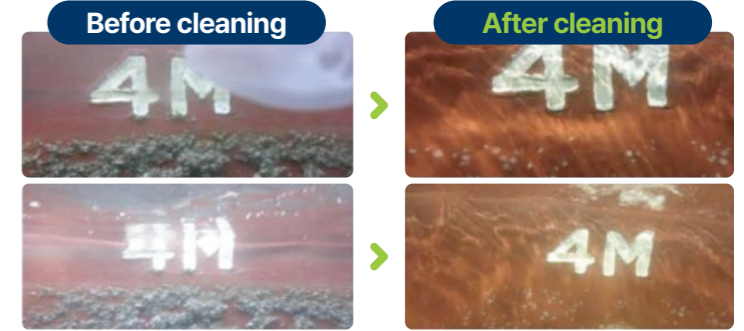
- Using Crane, LARS, and Auto shackle, robot loading & unloading.
- Operation Room Available

- CHIRO can adjust buoyancy, so diver can attach & separate CHIRO easily.

- With compacting component, CHIRO can operate in the ship on the marine area.

## Minimum Paint Wear-Out

- Brush module can move up & down automatically.
- Adjustable brushing pressure and rotation speed



### Brushes for coating area

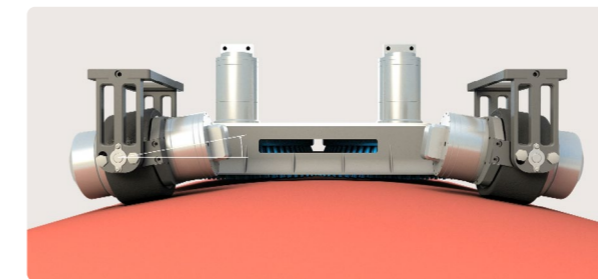
5um

### Less damaging surface paint

- Tested and approved by paint manufacturers

## Smooth Movement & Coverage wide area

- Tiltable Magnetic-Driving-Wheel
- In-Wheel Motor Type



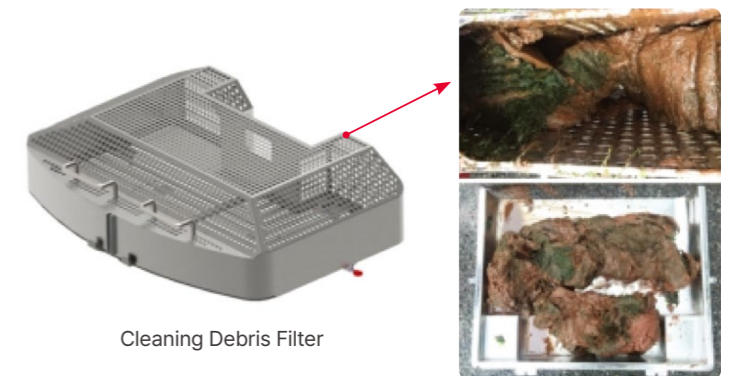
> 90%

### Drivable area of the entire hull surface (cleaning area)

## Debris suction and built-in storage

### Cleaning Debris Filter

- Brushing and vacuuming take place simultaneously and collect debris swiftly



Cleaning Debris Filter

## Brushing

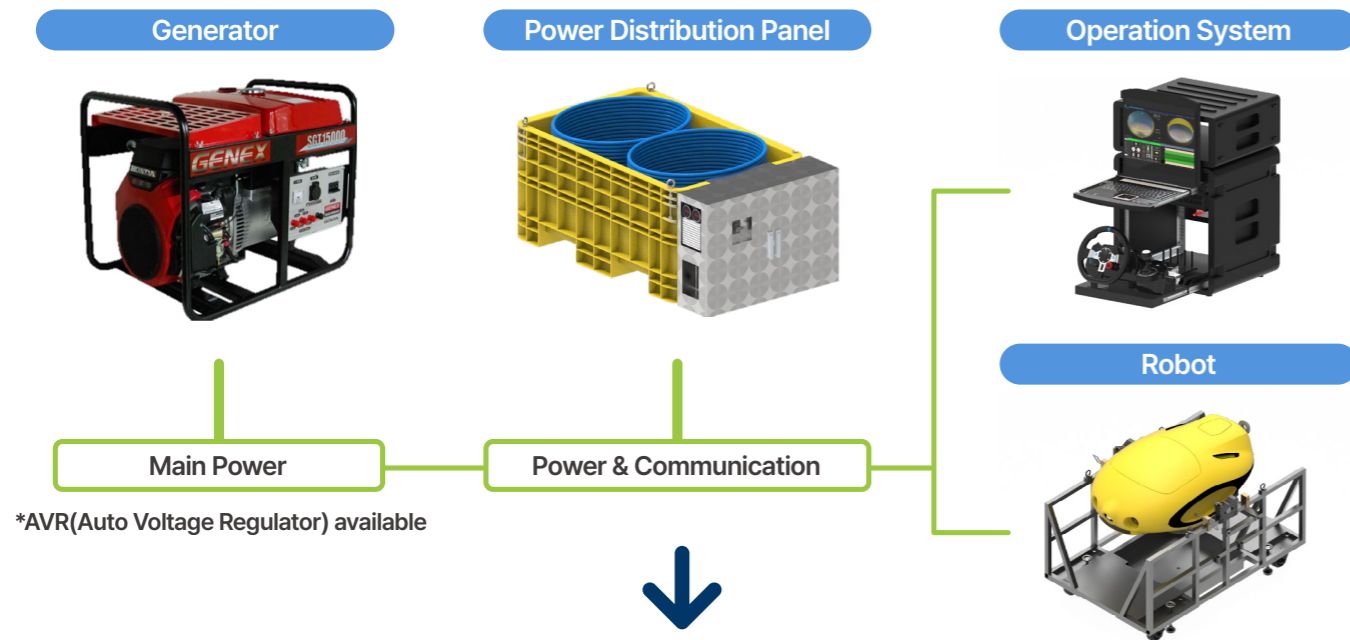
- Easy replacement of brush disks for best result.
  - Plate Size : ø350 Circle Type / ø370 / ø380 Circle Type
  - Brush Hair Type : ø0.5, ø0.8, ø1.2 ø1.5 (P.P)
  - Hybrid (ø1.2 + Grinding Stone)
  - Flexible Panel (P.P)



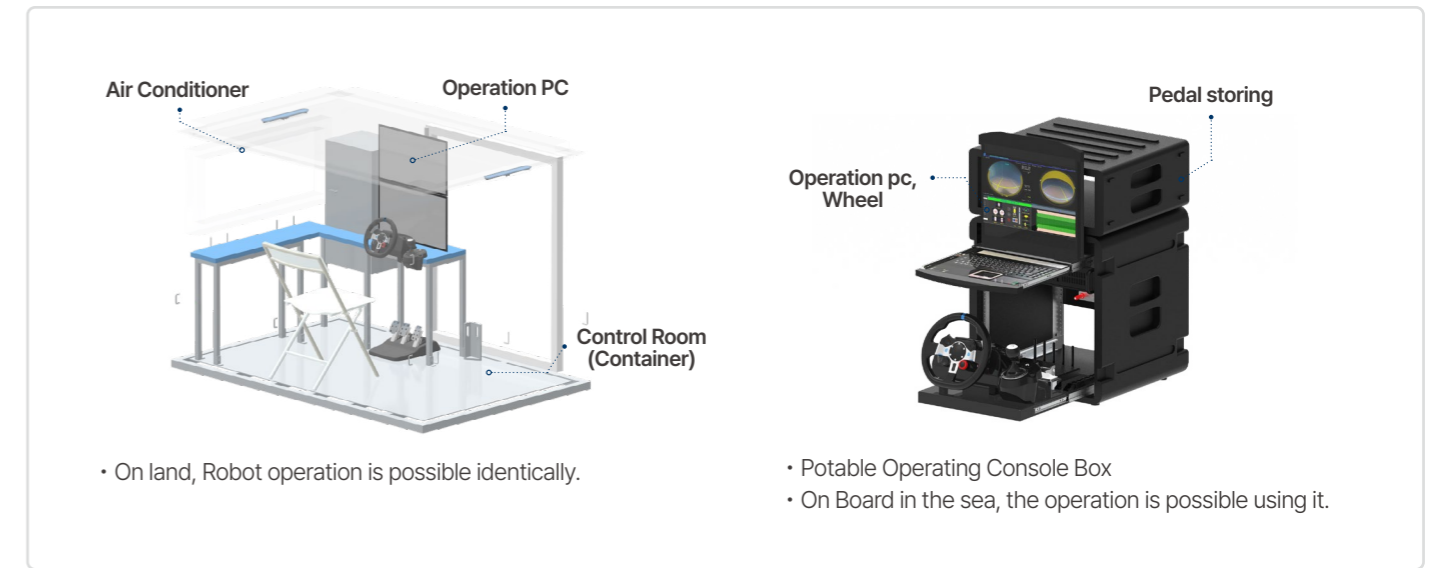


# Selection of CHIRO Combination

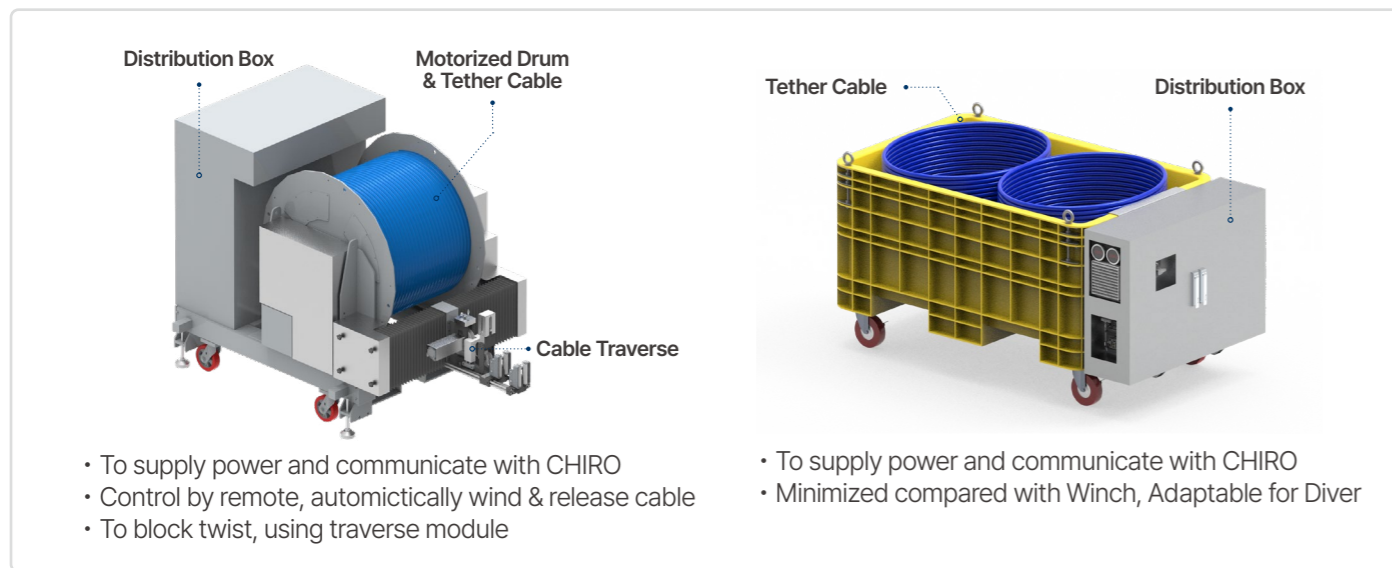
## CHIRO Configuration (Basic)



## Operation Room / Operating Console (OP Box)



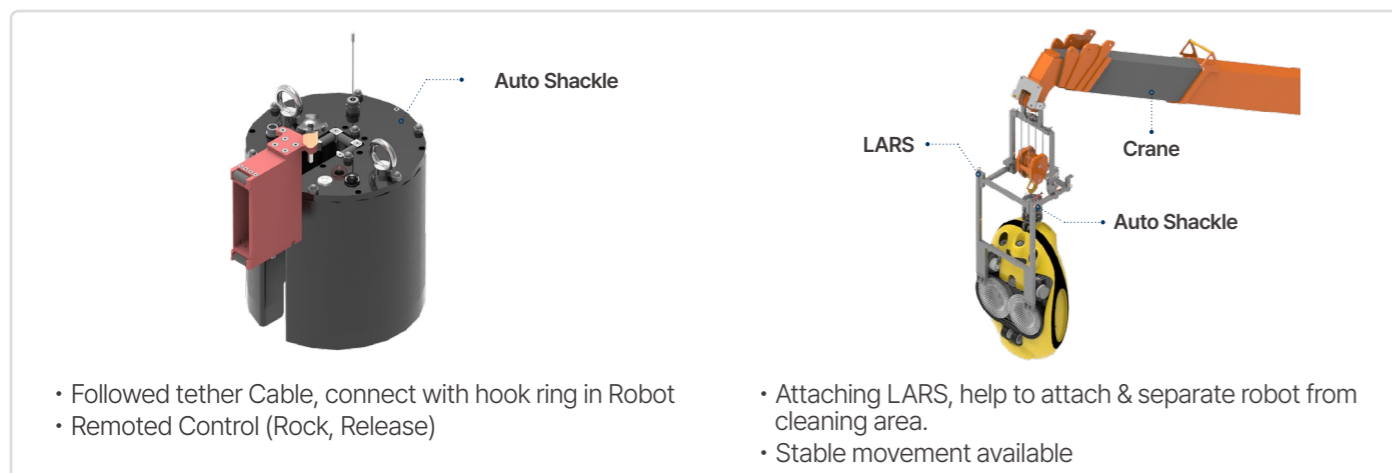
## Power Winch / Potable Power & Tether Cable



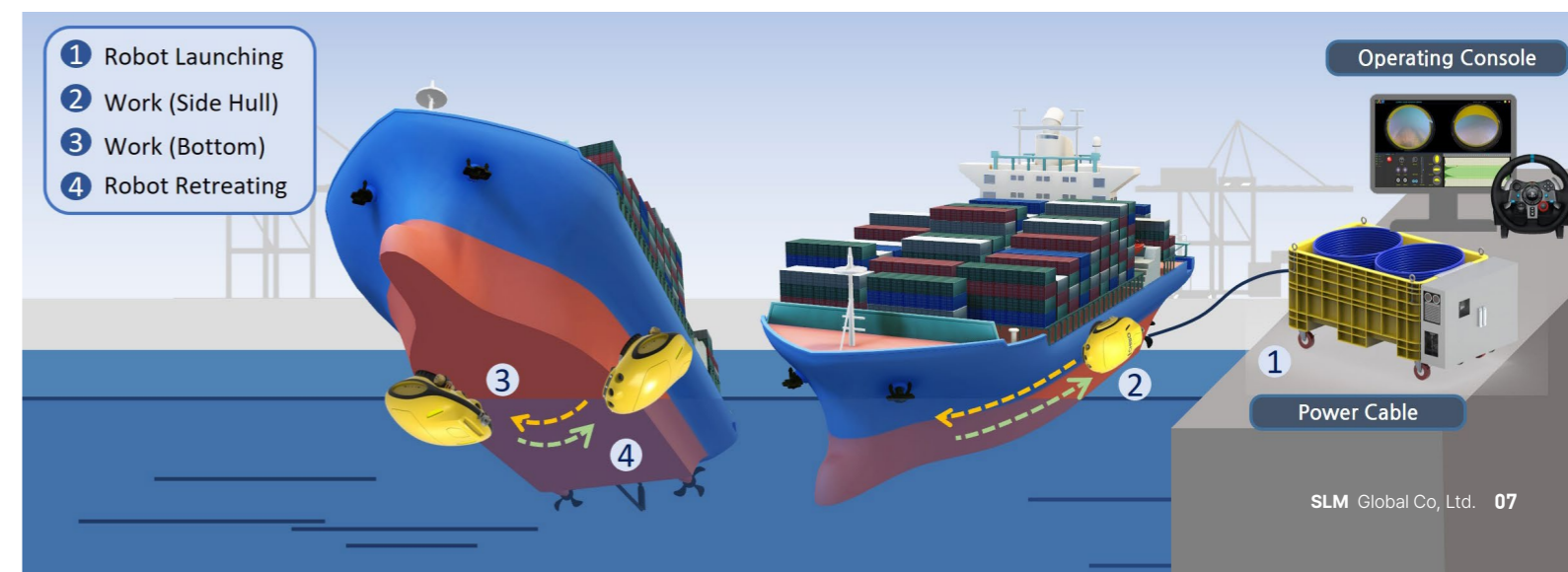
## CHIRO Driving & Operation Program UI



## Auto Shackle & LARS (Launching And Recovery System)



## Operation Concept of SLM CHIRO





# CHIFEX - CHIRO Filtering System EXcellence

## Performance and Specifications

**Dimension** : 2,200× 1,600× 2,000(mm)

**Weight** : 1.5ton

**Power** : 3Ph 220VAC, 10kW

**Consumable** : Diatomite. A few dozen kg for a vessel

**Processing Capability** : 10 ton/hr. (Max. 15 ton/hr.)

**Separation process** : 2-stage continuous processing

**1st Stage** : up to 500µm (Debris separation by shive screen)

**2nd Stage** : up to 5µm (Adjustable)

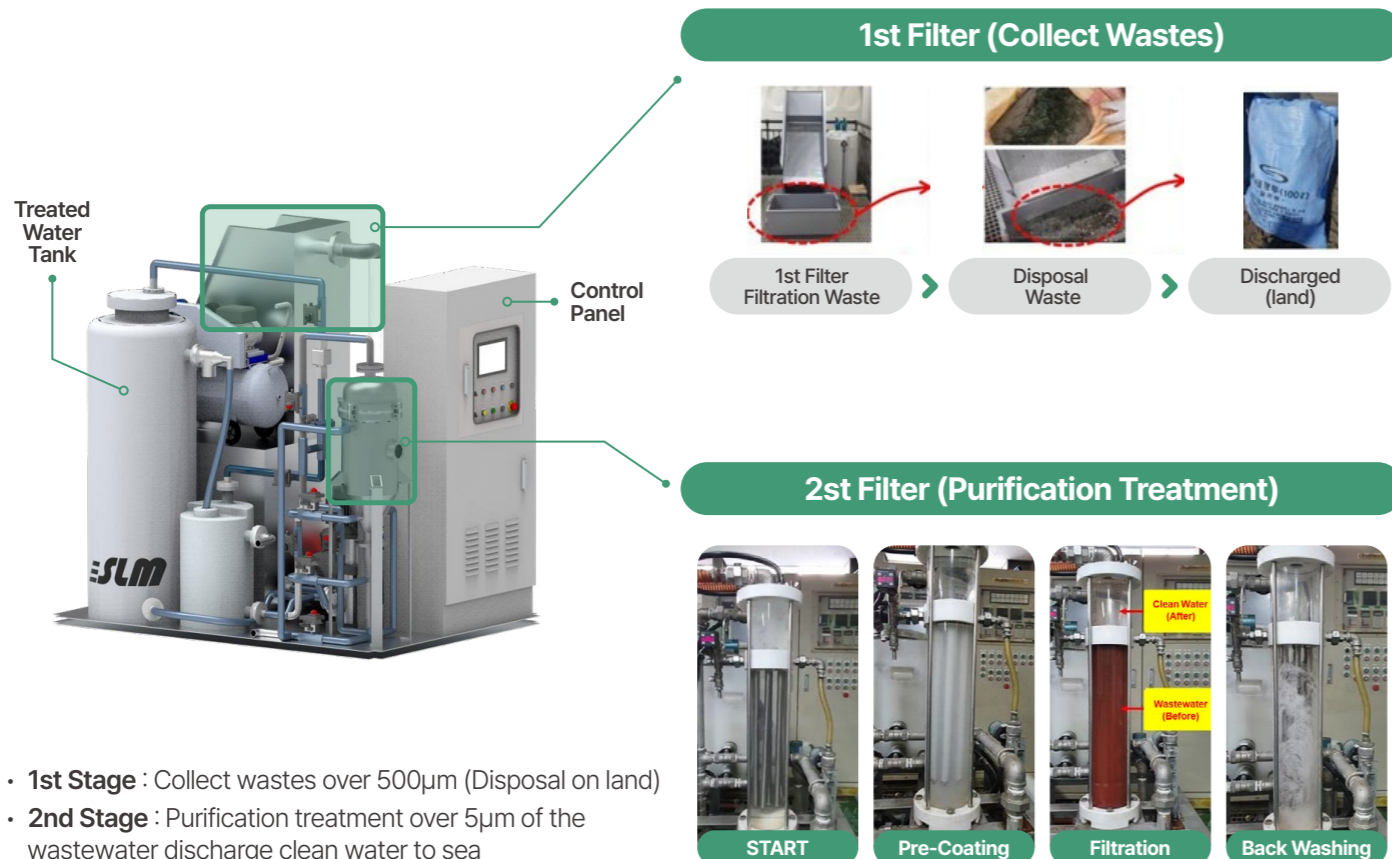
**Mesh cleansing** : Programmable backflush  
(No needs operation stopping)

**Filter replacing** : No need if not damaged

**Waste** : Watery mud of paint, bio and diatomite



## Configuration

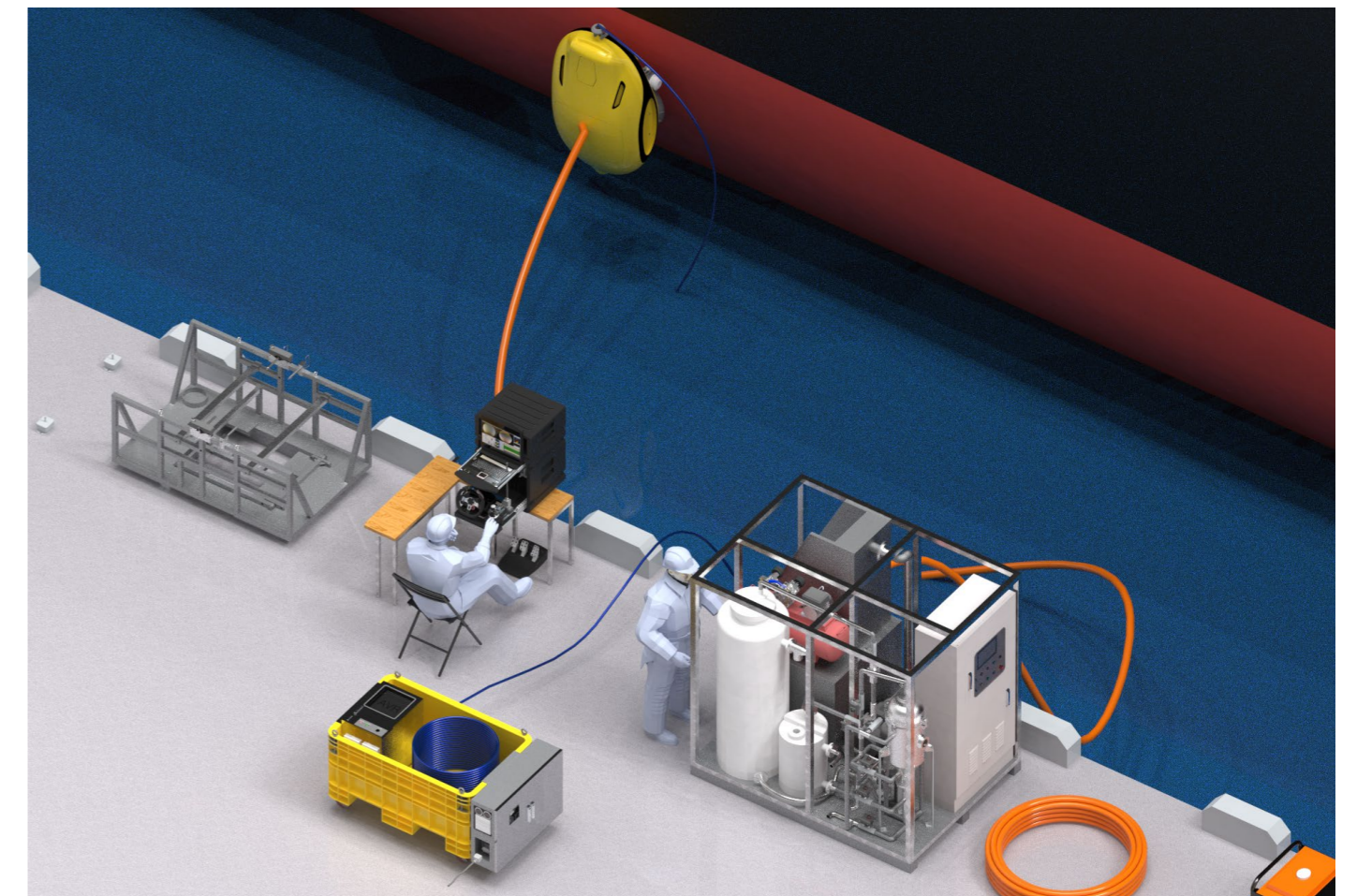


- **1st Stage** : Collect wastes over 500µm (Disposal on land)
- **2nd Stage** : Purification treatment over 5µm of the wastewater discharge clean water to sea

## Summary of Test

Test Item	Unit	Test Result			Removal rate	Test Method (Criteria)
		Contam'd Water	Treated Water	Raw Sea water		
Suspended Particulate Matter	mg/L	97.20	5.80	3.20	-94%	Standard methods for the examination of marine environment (seawater): 2021
TOC	mg/L	13.90	1.85	1.83	-87%	APHA Standard Methods: 2017
DOC	mg/L	1.09	1.64	1.49	50%	APHA Standard Methods: 2017
Cu	ug/L	25.30	7.37	1.05	-71%	APHA Standard Methods: 2017
Zn	ug/L	290.00	43.10	1.86	-85%	APHA Standard Methods: 2017
Fe	ug/L	0.58	0.69	0.31	19%	APHA Standard Methods: 2017
Mn	ug/L	3.47	1.81	0.29	-48%	APHA Standard Methods: 2017
Sb	ug/L	0.14	0.13	0.14	-7%	APHA Standard Methods: 2017
Sn	ug/L	1.50	1.50	1.22	0%	APHA Standard Methods: 2017

## Operation of CHIRO + CHIFEX

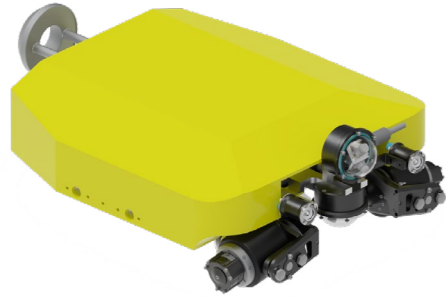




# Inspection Robot

**Purpose :** To manage the surface of ship and forecast cleaning timing properly

## Inspection Robot – on Boarding

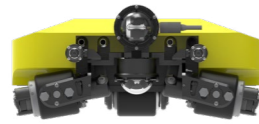


**Dimension :** 727 X 500 X 223(mm)  
**Weight :** 30kg (35kg with battery)  
**Speed :** 1 knots (@0.5m/sec)  
**Camera :** 2EA (Front-top & Bottom)  
**Operation Distance :** 250m (Installing Mid-Ship, inspection available up to 400m)  
 On-time inspection video, adding mapping, Automatic driving available

## Total Configuration of Inspection Robot



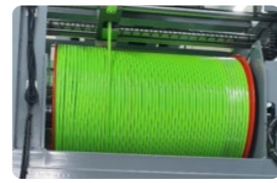
Internal



Front

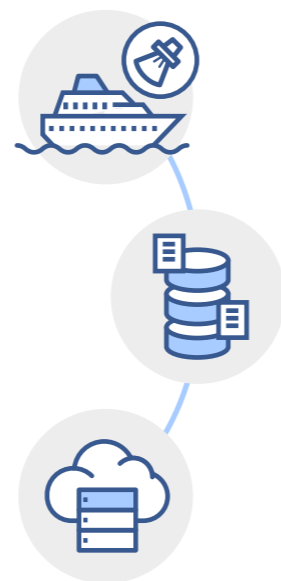
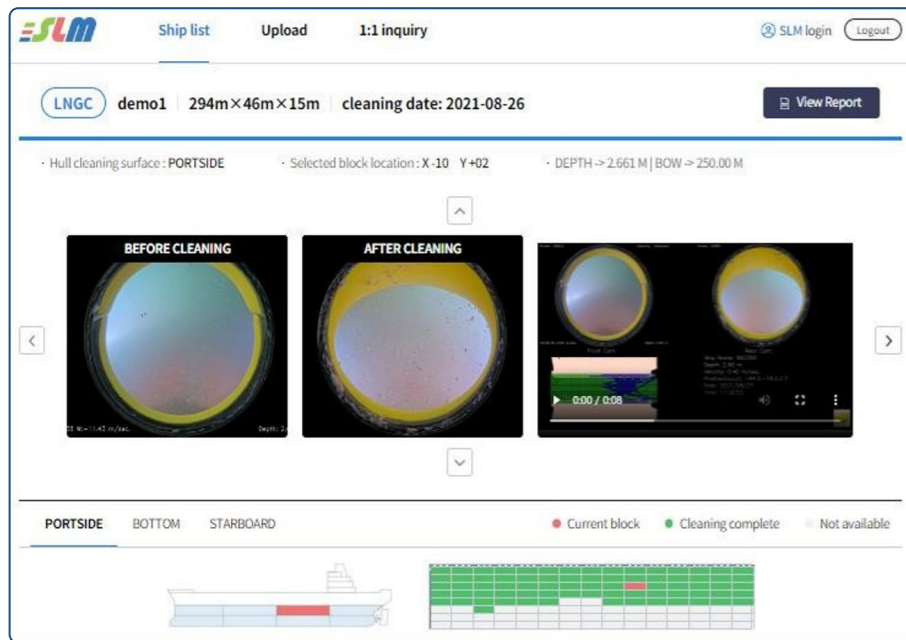


Operation Console



Tether Cable

# HULL CARE SYSTEM - HC database on cloud



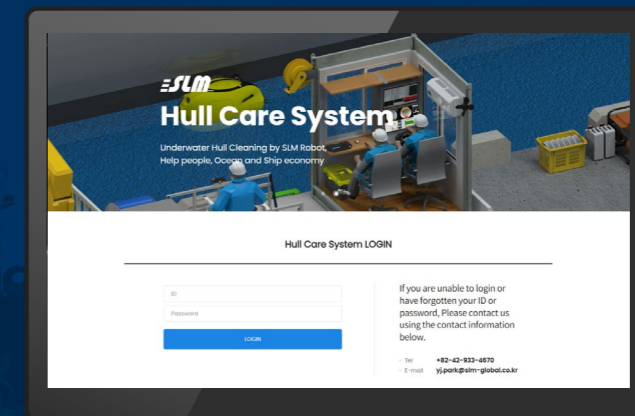
- Hull cleaning is viewed managed in online system (visit [hullcaresystem.com](http://hullcaresystem.com))
- Cleaning video is popping up at a click on the map
- Special online tool for each CHIRO service vessel

# Hull Care Total Solution

- Total solution of hull surface management system
- Keep the history of inspection & cleaning
- To forecast best timing of cleaning
- Detailed recording based on location(parts of ship), and management
- It can support additional special function based on paywall functions
- Additional Plan : Automation of inspection record, combined all of inspection result, etc.



## SLM Products



## Hull Care System



## Customer own System