

Development and Application of an Integrated Planned Maintenance System (iPMS) for Research Vessels

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01 Requirements and Challenges

- Planned Maintenance System (**PMS**) -- a critical component in the marine industry, a key tool to maintain the operational reliability and safety of vessels;
 - a software system that allows shipowners and operators to plan, perform and document vessel maintenance at intervals complying with Class and manufacturer requirements.
 - different ways to achieve, depending on the size and complexity of the shipping company and the types of vessels in operation.
 - based on risk assessment and begins with the establishment of a complete database of machinery, equipment and fittings.
- PMS is a **mandatory** requirement under the International Safety Management (**ISM**) Code. If you apply safety management system(SMS) to your vessel, you need a PMS in routine operations;
- It is estimated that globally ~ 50-80% of cargo ships use a PMS, with higher rates among newer and larger vessels, also vary with industry adoption, ship types and regions.

01 Requirements and Challenges

Challenge: fragmented software modules, unfit for research vessels

- **No standardized management:** Unfit for the **workflows** of research institutions and ship manager, secondary customization difficult.
- **Opaque procurement:** some still using Excel/spreadsheets; paper hard-copy; through emails to approve; weak oversight & traceability;
- **Insufficient inventory control:** lack of support for **science spare** part management;
- **Incomplete SMS:** No document system; outdated SMS, crew turnover → document loss, failed inspections, cruise delays
- **Slow software service response:** Delayed troubleshooting → excessive software O&M expenses

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02 iPMS for RV

Software Development Objectives

Adaptable, scalable, RV-oriented software

Standardized management

comply to regulatory requirements (shipowner, & ship manager)

1

Life-cycle procurement monitoring

prevent duplicate purchasing.

2

Tracing dynamically

real-time alerts for maintenance, daily tasks & inventory

3

4

Integrated vessel systems

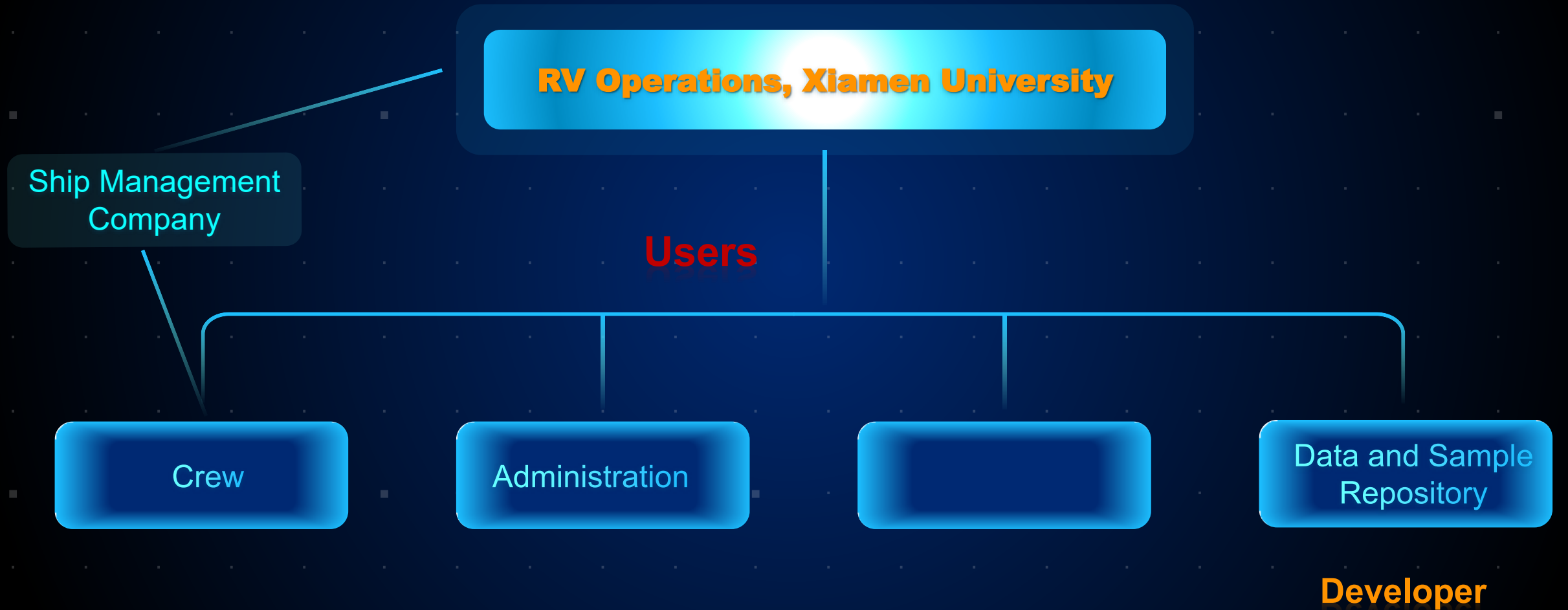
Ship-shore comm.; centralized management and decision-making

5

Smart SMS:

online operation with ship-shore synchronization.

02 iPMS for RV



02 iPMS for RV

Features expected

Modules	PMS for Cargo Ships		iPMS for Research Vessels
	Basic	Comprehensive	
Machinery maintenance	✓	✓	✓
Scientific Instrument maintenance	/	/	✓
e-Procurement management	/	✓	✓
Inventory - general (ship spare parts, materials & fuel)	/	✓	✓
Inventory – scientific parts	/	/	✓
SMS for ships	/	✓	✓
SMS for scientific operations	/	/	✓
Asset management	/	✓	✓
Cruise management (applicable to research vessels)	/	/	✓

02 iPMS for RV

Application Case I

Science instrument maintenance

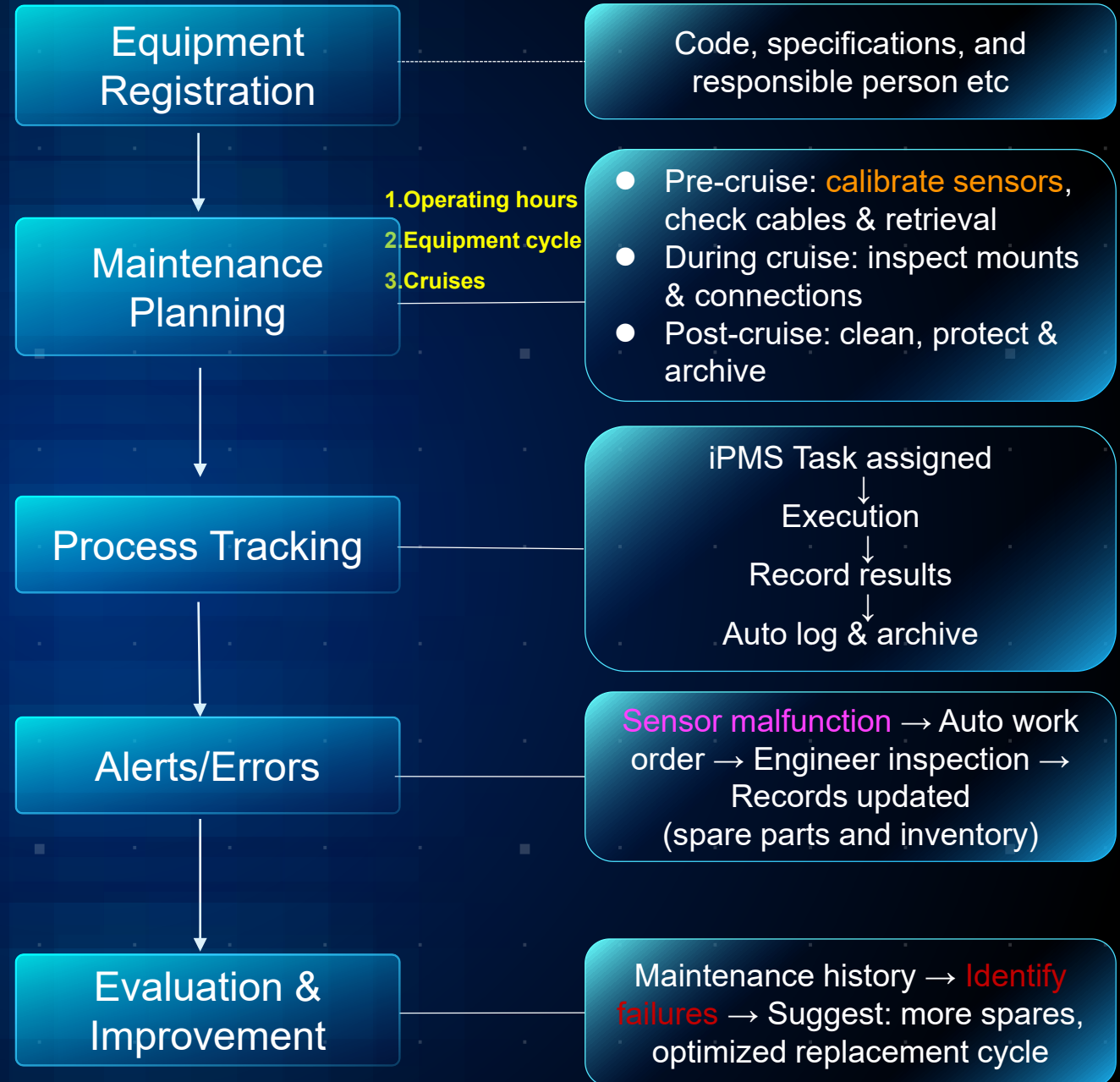
□ Full traceability:

- maintenance planning
- execution
- malfunction handling
- archive

□ Minimizes critical

equipment failures to ensure mission success.

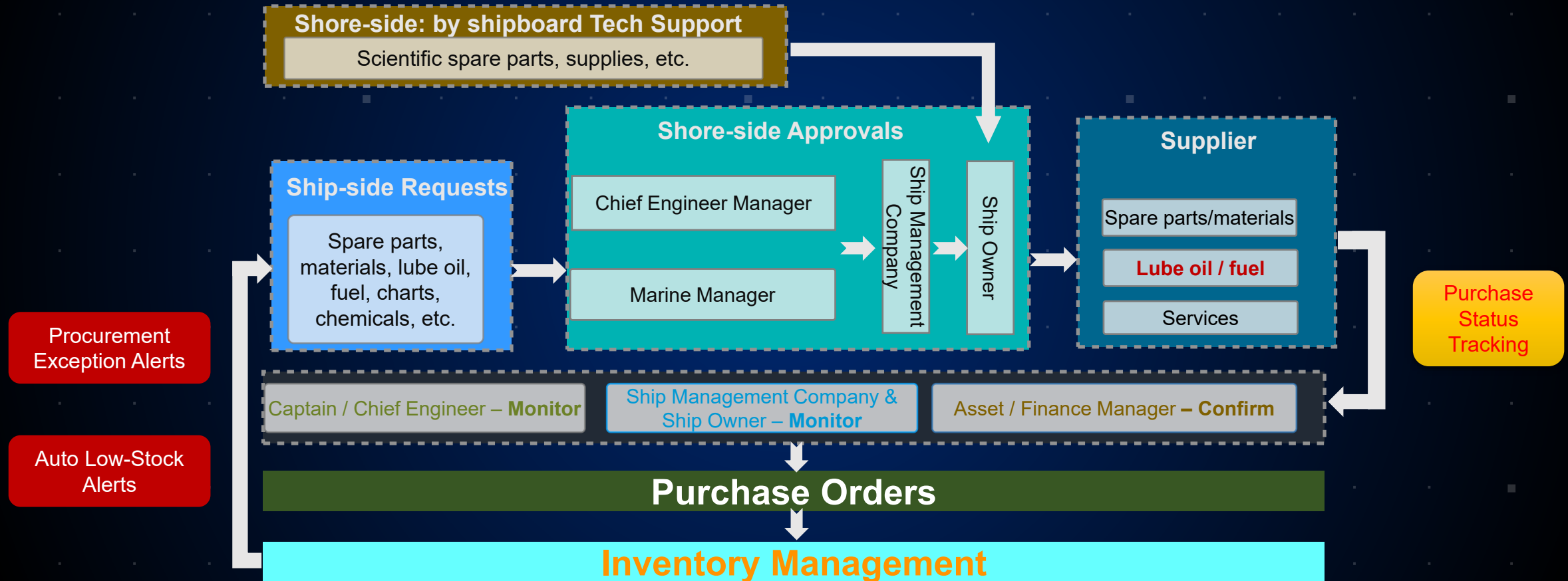
e.g. SBE 911plus CTD



02 iPMS for RV

Application Case II

Paperless Procurement (ERP-like)



- ✓ Unified tool for daily operations & research needs.
- ✓ Full traceability & transparent workflow.
- ✓ Budget control and cost-saving.

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Application Case III

Inventory Alert:

Intelligent reorder triggers and **min/max** stock thresholds

Mobile Access:

Stock in/out checking by **hand-held equipment**

Categorization:

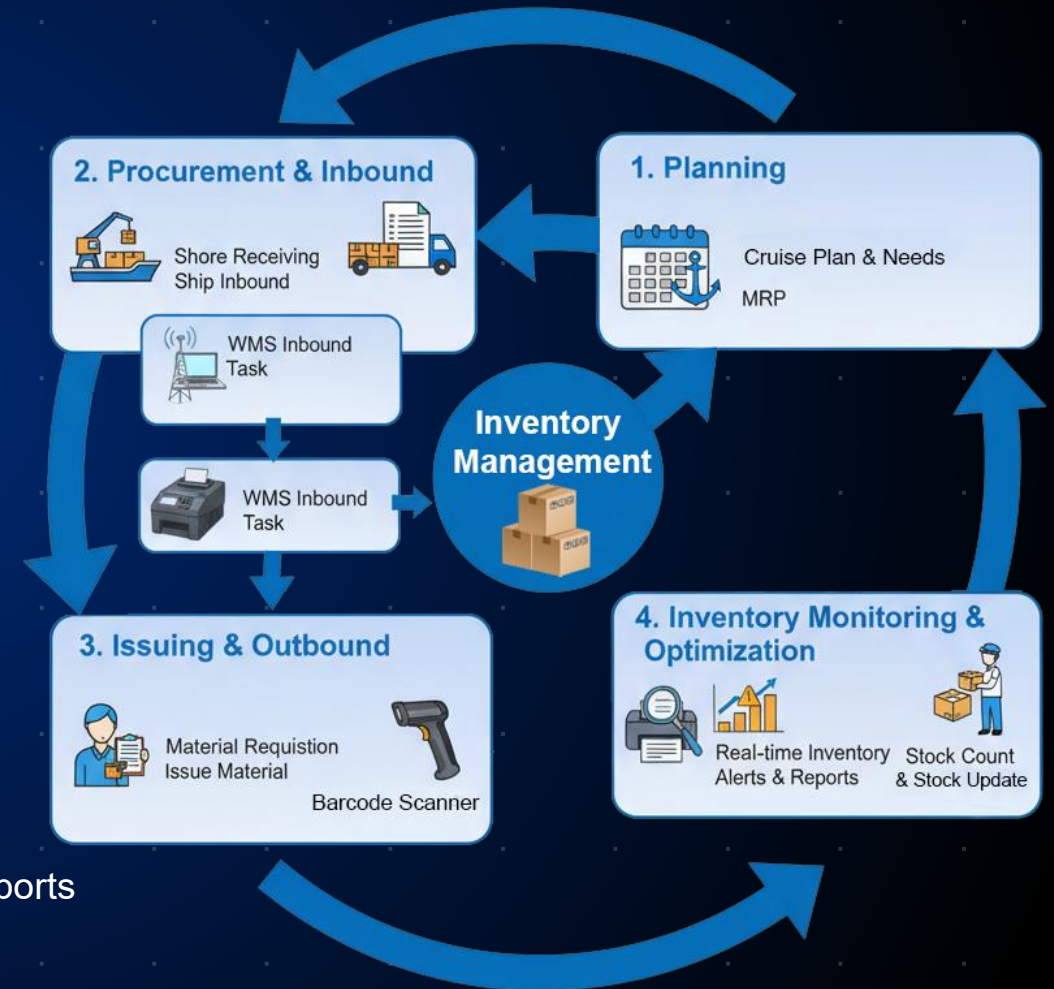
Precisely classify categorize high-value spares and low-value supplies.

Analysis & Reporting:

Spare part lifespan prediction with automated restocking & consumption reports

Inventory Management

Visualized stock & smart spare part allocation via WMS



02 iPMS for RV

Application Case IV

Safety & Compliance Management

- ❑ Dual coverage: Navigation & Sci-Ops.
- ❑ Guiding pre-/post-cruise safety inspections.
- ❑ Integration of IMO & research safety standards (e.g. Research Operation Standards, Lab Safety Rules, etc.)
- ❑ Ship–shore fusion: data, risks, and emergency.

Safety for “Vessel + Operations”

Practice onboard RV *TKK*

- Cruise Planning
- Loading & Offloading
- At-sea Operations
- Scientific Instrument
- HazMat
- Laboratories
- Cyber-security (coming ...)
-

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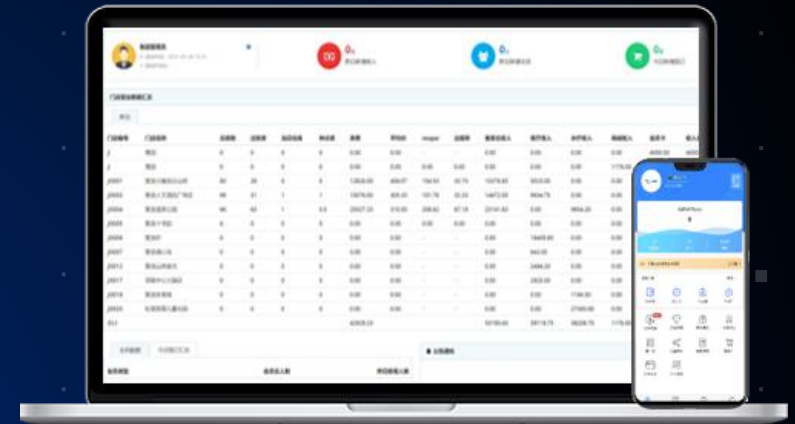
03 Outlook

➤ Ship–shore integration (Ongoing...)

Web Application (PC terminal) + **mobile APP**, enabling all users to access anytime / anywhere

➤ SMS with AI “flavor”

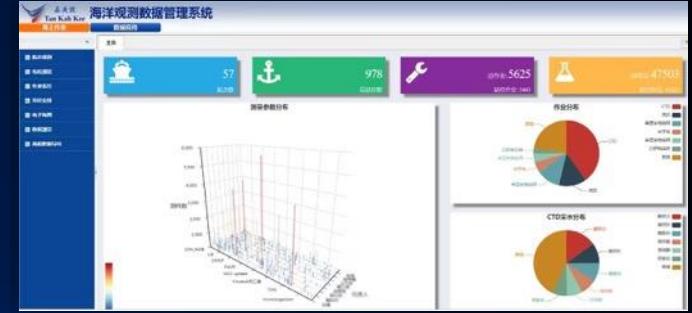
- ✓ Better SMS practice: prediction / prevention, emergency support;
- ✓ Data-driven enhancement: ship/science equipment,, personnel exchange, and cruise implementation;
- ✓ Decision-making: faster response, ship–shore coordination more precisely.



03 Outlook

- **O₂DMS**: Ocean Observation Data Management System
- **IVSO**: Integrated Visualization for Ship Operation

Cruise Scientific Data Archive & Management



O₂DMS

Real-time Monitoring



IVSO

One-Stop Ship Management System (SMS)



iPMS



03 Outlook

Smart Control · Standardized & Efficient · Ship-Shore Coordination

Standardized

Closed-loop, traceable workflows (procurement, inventory, maintenance).

Safety Assured

End-to-End safety (operation, maintenance, inspections)

Tailor-designed

Integrates science missions & ship operations.

Highly Integrated

Merge PMS, WMS, ERP for ship management.

Operating Efficiently

Remote coordination, intelligent alerts, reducing operation costs.

RV Management: Traditional → Smart



Questions?

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