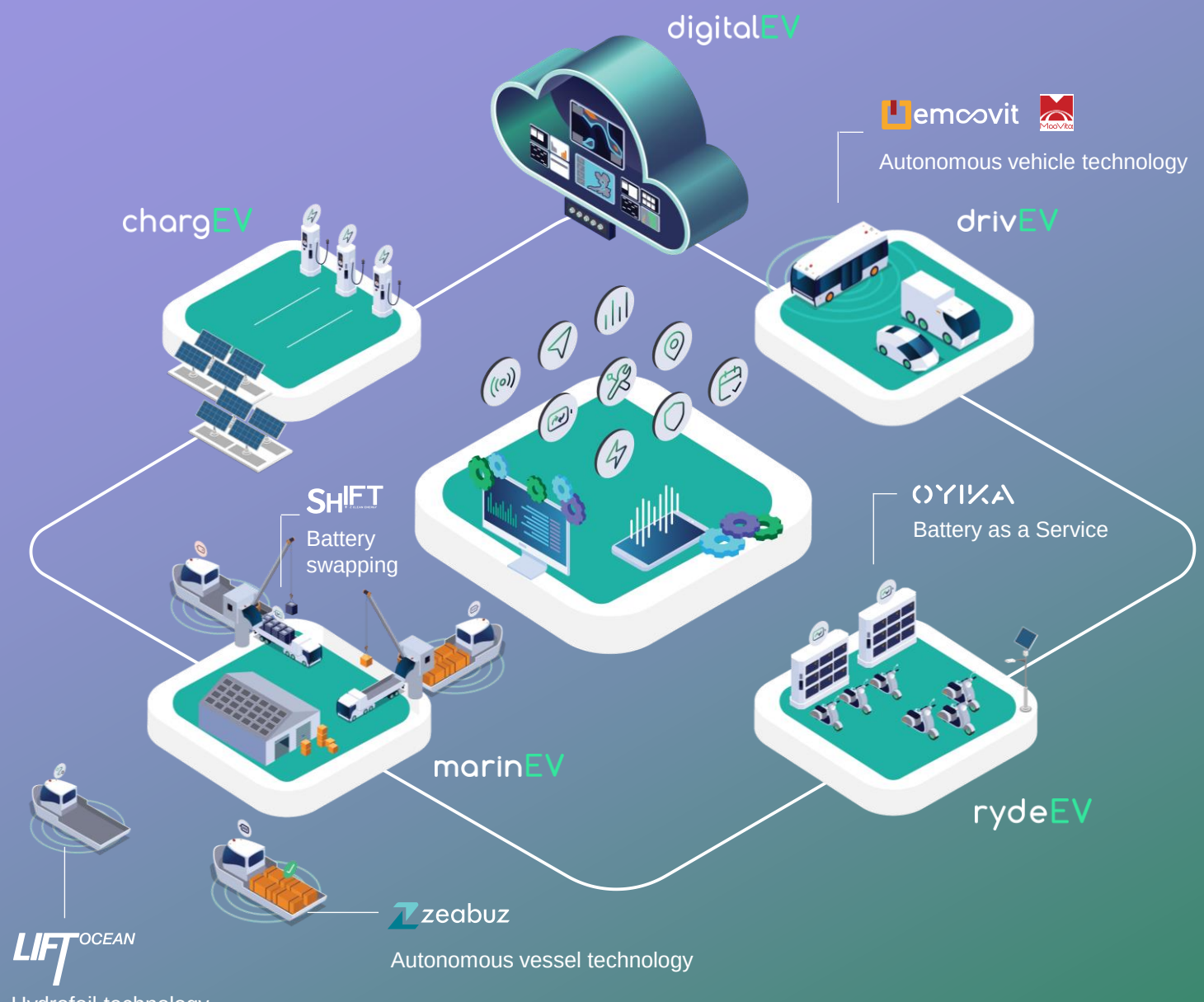
YINSON GreenTech

Enhancing Operational and Environmental Safety with Electric Harbour Crafts

18th Jul 2025



YINSON GreenTech

ZERO Emissions End to End logistics

Our integrated ecosystem opens new opportunities for businesses to increase efficiency and have cleaner operations.

YINSON GreenTech

THE

MARINE

SEGMENT

ELECTRIC MARINE VESSELS

DIGTAL PLATFORM & REMOTE SERVICE

AUTONOMOUS VESSEL TECH

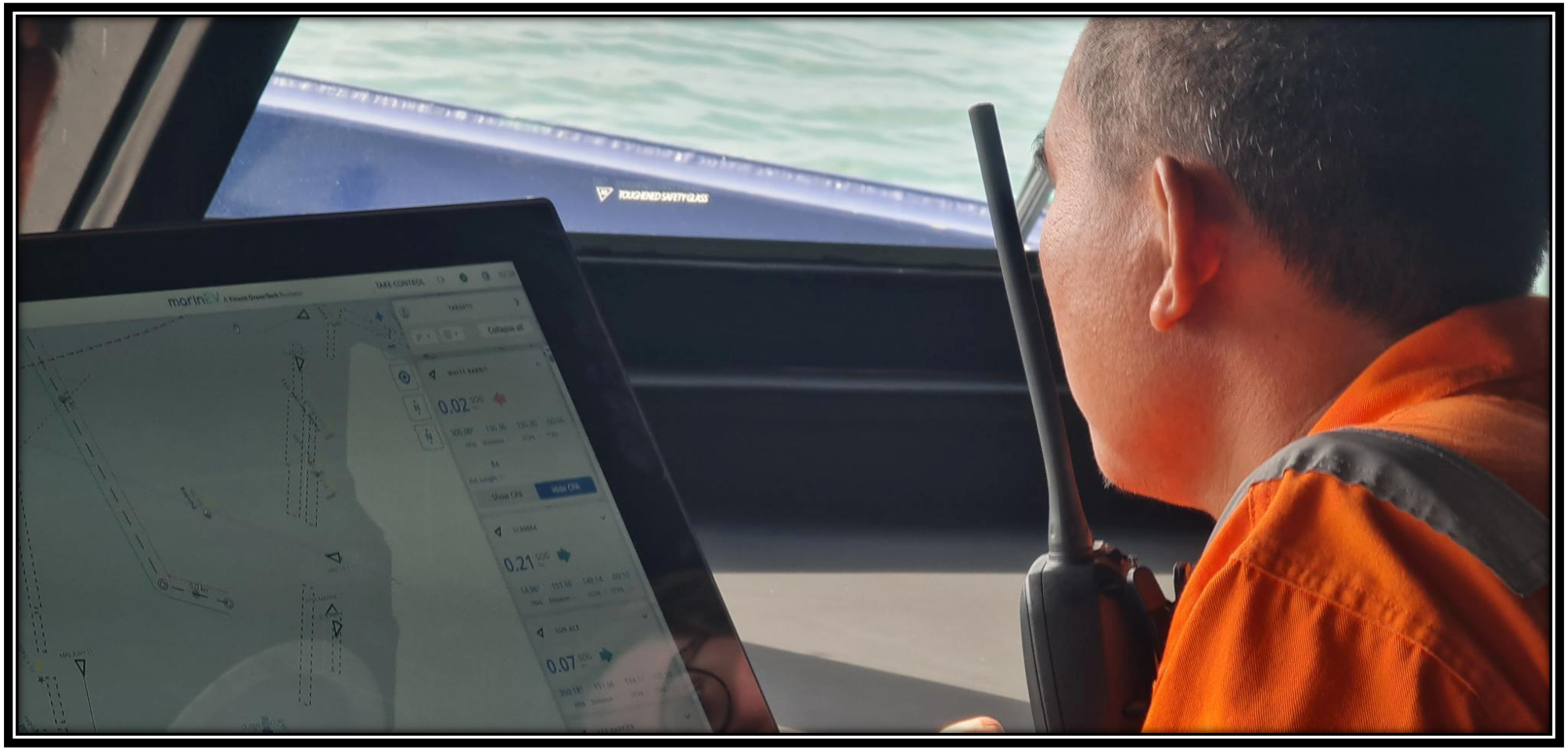
YINSON GreenTech

Contents

Smart Navigation System

Risk-based Approach to Lithium-Ion Batteries

Smart Navigation System

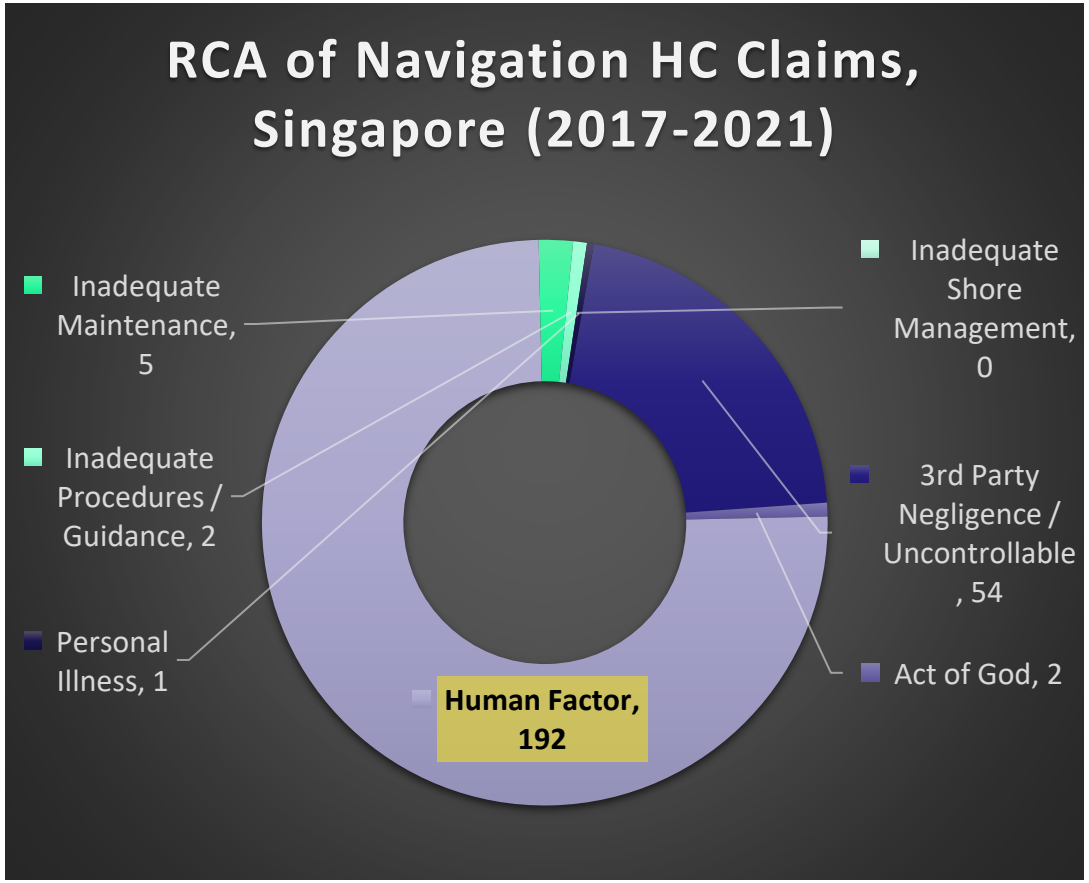


Smart Navigation System

Addressing the Root Cause of Navigational Incidents

- The “Human Factor” remains the leading root cause of navigation related claims for harbour operating in Singapore waters.
- This broad category covers:
  - Workplace conditions,
  - Equipment and task design, and
  - Organisational influences,

  All of which can lead to human errors and poor decisions.
- By recognising and addressing “Human Factors”, we can intervene early and prevent them from escalating into navigational incidents



Source: Capt. Hari Subramaniam (Shipowner’s Club), Safety@Sea Week – Harbour Craft Safety Forum, Aug 2022

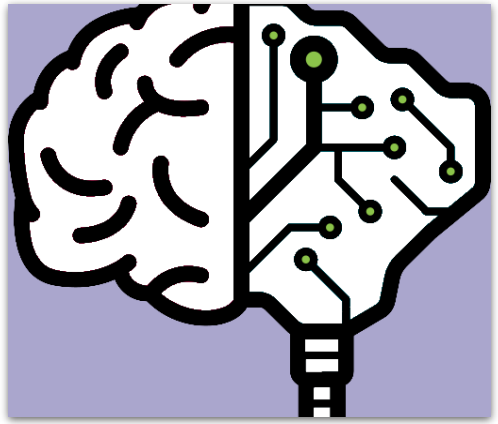
Smart Navigation System

Zeabuz Technology – Situational Awareness, and Motion Planning and Control Systems

Situational Awareness System (SAS)

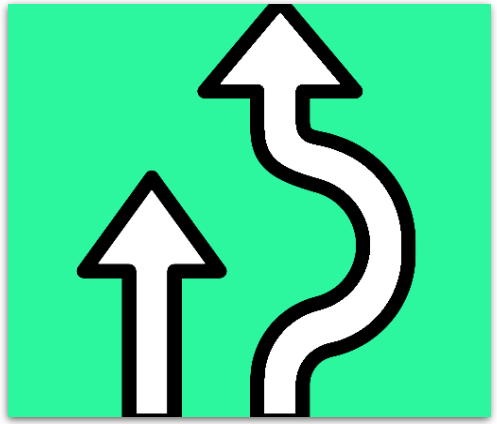
- Inputs from radar, Lidar, Camera, AIS
- Expected outputs:
  - Target tracking
  - Target classification
  - Trajectory Prediction

Motion Planning



- Inputs from SAS and Waypoint Setting, processed by collision avoidance algorithm
- Expected outputs:
  - Navigation advice
  - Course and speed references

Motion Control

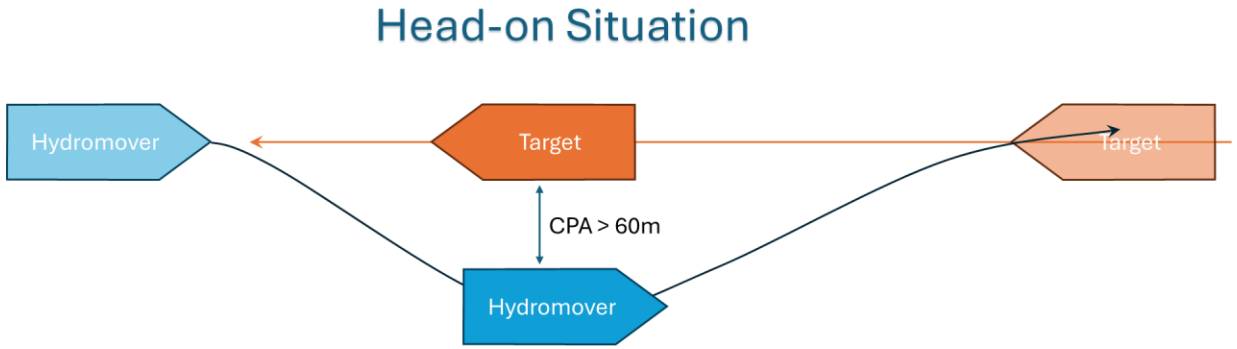


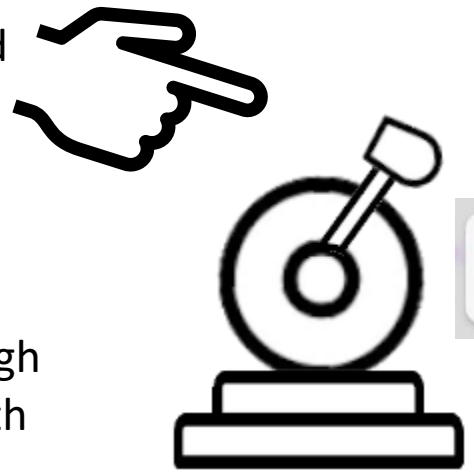
- Inputs from Motion Planning unit
- Expected outputs:
  - Course controller
  - Speed controller
  - Thrust allocation

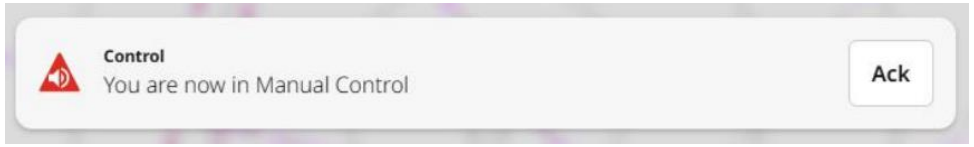
Smart Navigation System

Application to Harbour Crafts – Sandbox Trial

- The system was applied and tested on Hydromover in a MPA approved sandbox trial
- The system was able to provide COLREG compliant navigational advice and manoeuvres **upon acceptance** by the Master
- The following COLREG collision avoidance manoeuvres were tested with simulated and actual targets:
  - R13 – Head-on
  - R14 – Overtaking
  - R15 – Crossing
- Master can easily override the system through adjustments (course or speed) to the azimuth lever in emergencies or failure modes



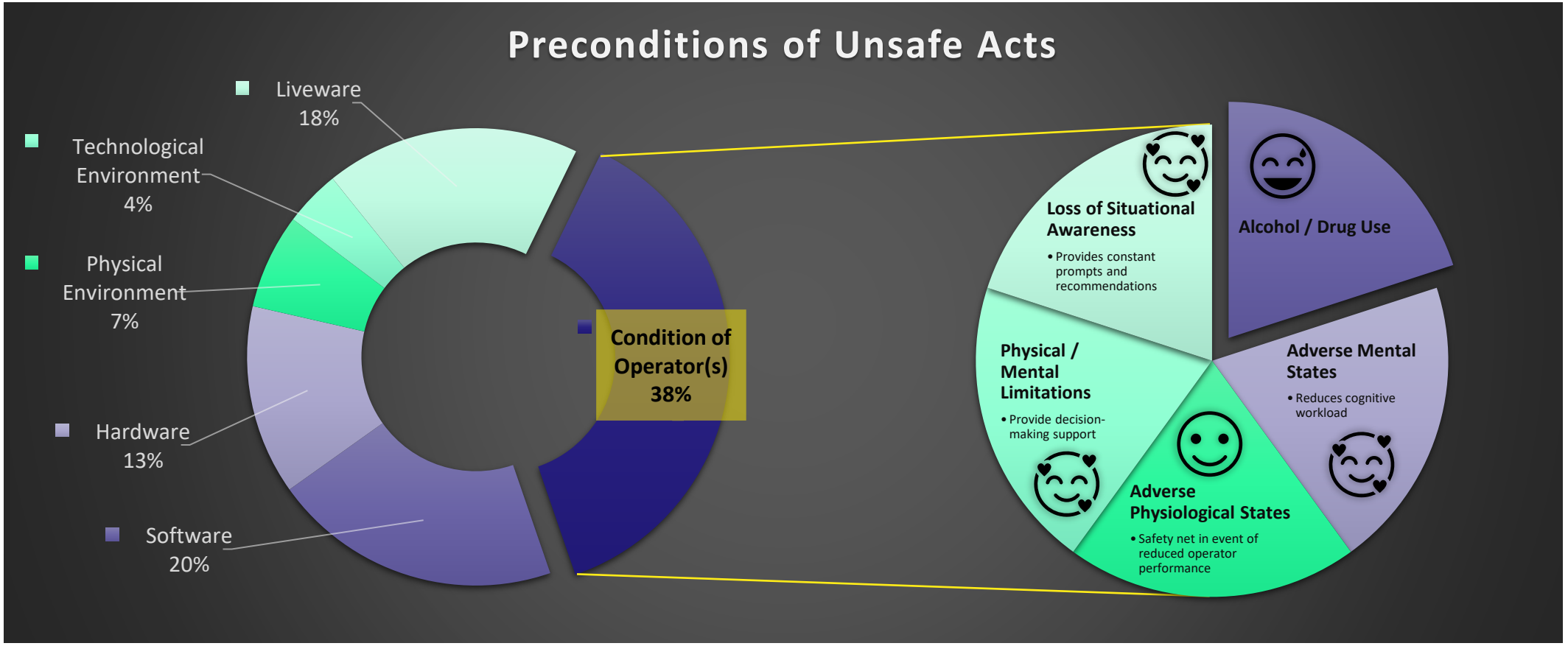




Smart Navigation System

Does this Address the Root Cause “Human Factor”?

- Based on a 2021 Human Factor Analysis for Maritime Accidents*, “Preconditions for Unsafe Acts” represented 32.7% of contributory factors, with “Condition of Operator(s)” the most represented second-level causal factor.



Source: Hasanspahić, N., Vujičić, S., Frančić, V., & Čampara, L. (2021). The Role of the Human Factor in Marine Accidents. Journal of Marine Science and Engineering, 9(3)

Risk-based Approach to Lithium-Ion Batteries

Class A
Ordinary Combustibles

Class B
Flammable Liquid

Class C
Flammable Gas

Class D
Combustible Metals

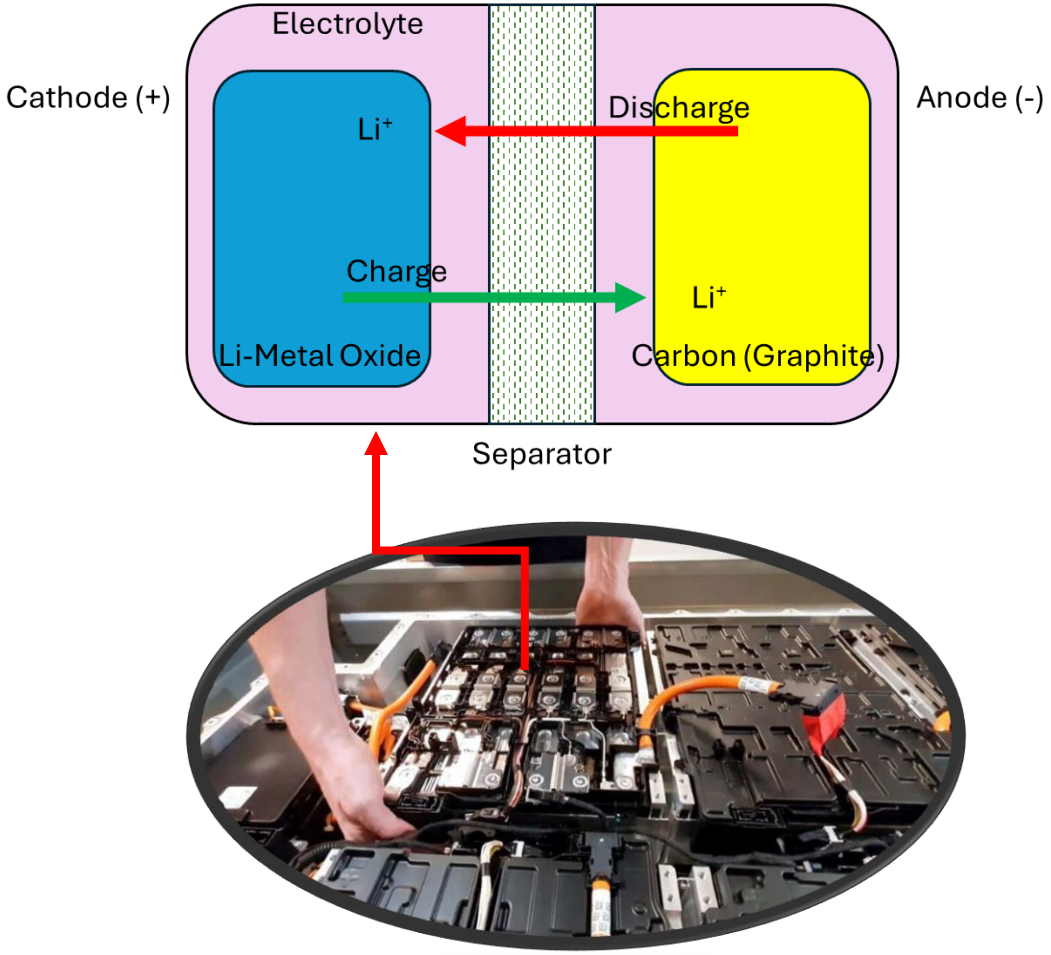
Class F
Grease Fires

Risk-based Approach to Lithium-Ion Batteries

Lithium-Ion Battery Basics

- Lithium ions travel through the electrolyte during the charging and discharging process.
- The separator prevents the direct contact between the anode and cathode, but allows lithium-ion flow
- The electrolyte composes of lithium salt and solvent, the specific type of which depends on the application of the battery
- The specific type of battery is determined via the material of the Li-metal oxide, such as:
  - Lithium Nickel Manganese Cobalt (NMC), and
  - Lithium Iron Phosphate (LFP).

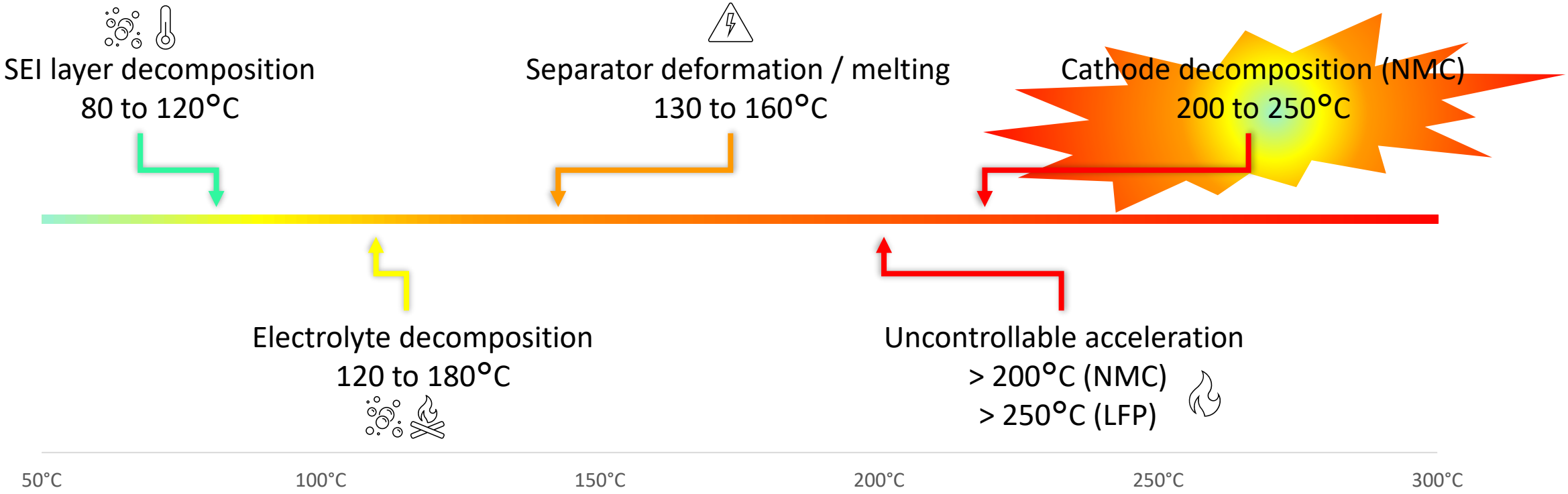
The above are the main battery types in electric vessels



Risk-based Approach to Lithium-Ion Batteries

Understanding Thermal Runaway

- Thermal runaway is a condition in which heat generated within the battery exceeds its ability to dissipate that heat, triggering a vicious cycle of rapidly rising in temperature and exothermic decomposition of internal materials. ***This results in gas release, pressure build-up, and can potentially lead to explosion and/or fire.***



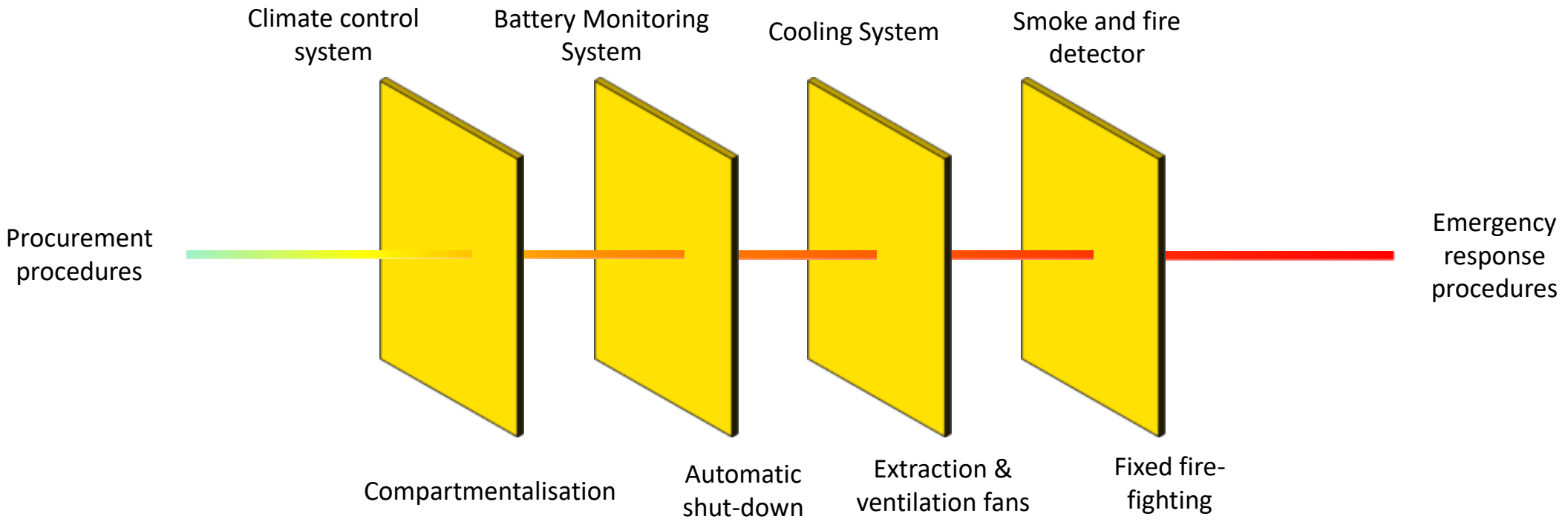
Risk-based Approach to Lithium-Ion Batteries

Risk Controls Against Thermal Runaway

- Common causes of heat generation are:
  - Overcharging / discharging
  - Large external temperatures
  - Shorting
  - Mechanical abuse
  - Dendrite formation

- A good BMS and design philosophy can eliminate most causes of thermal runaway.

- The best approach to deviations is containment of thermal runaway to individual cells and heat dissipation mechanisms.



Risk-based Approach to Lithium-Ion Batteries

Environmental Benefits of Electrification

GHG reduction
(CO2, N2O, CH4)

Pollutant reduction
(NOx, PM, SO2, etc)

Noise reduction
(Motor vs engine)

Oil pollution reduction
(Bunkering,
maintenance, etc)

Closing Summary

Smart Navigation Systems

- Addresses human factor-related navigational risks
- Enhance decision-making and operational safety
- Test bed for future autonomous crafts?

Electrification of Habour Crafts

- Risks and hazards exists, but with awareness can be controlled
- Wider environmental benefits beyond GHG
- Potential for net-zero goals?

YINSON GreenTech

- Presentation by:
- Name: Daniel Ong
- Designation: HSEQ Manager
  Development Manager
- M: +65 9633 1010
- E: daniel.ong@yinson.com

For Business and Media Enquiries:

Name: Eric Chean

Designation: Senior Business

M: +65 8748 0467

E: eric.chean@yinson.com

Thank you!

Passionately delivering **powerful** solutions

www.yinson.com