Acceleration, Leverage, Agility

Merchant Marine Future:
Human Processes, Technology, and Reliability

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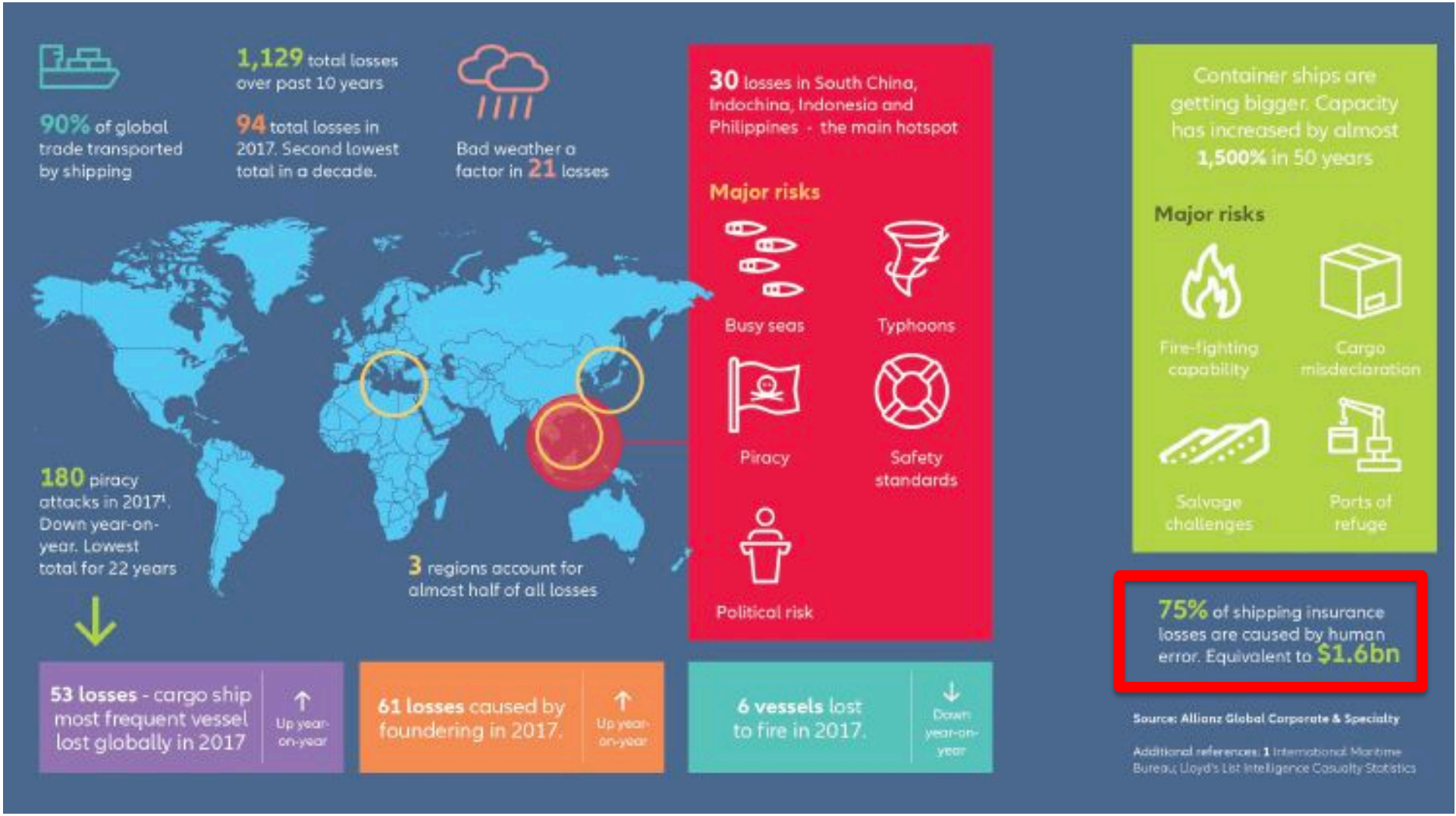
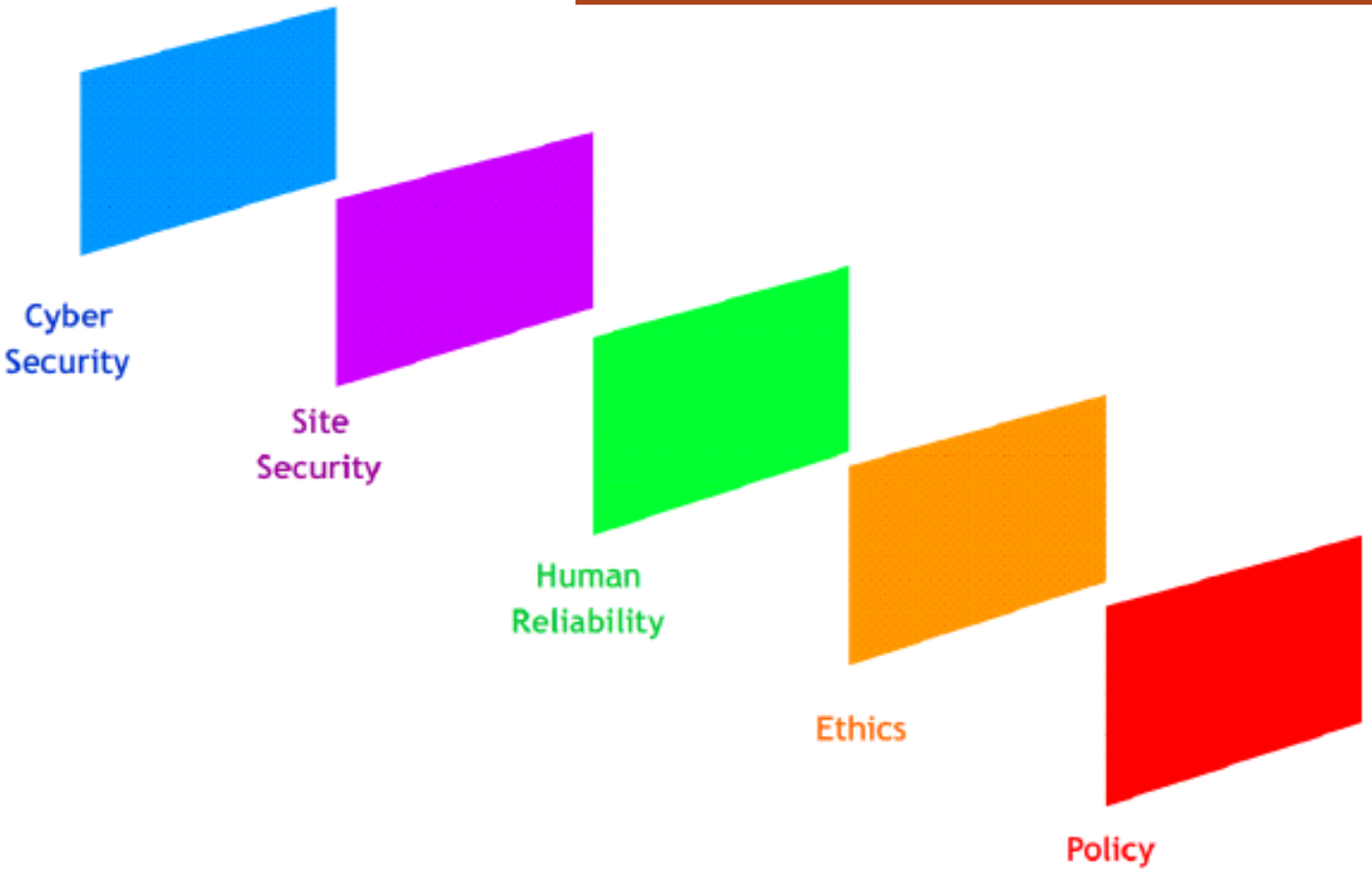
SAFETY & SHIPPING REVIEW IN NUMBERS



SHARP FOCUS

Current State

There are risks to our people and our ships if we don't keep up, take action and understand our systems or automation processes.

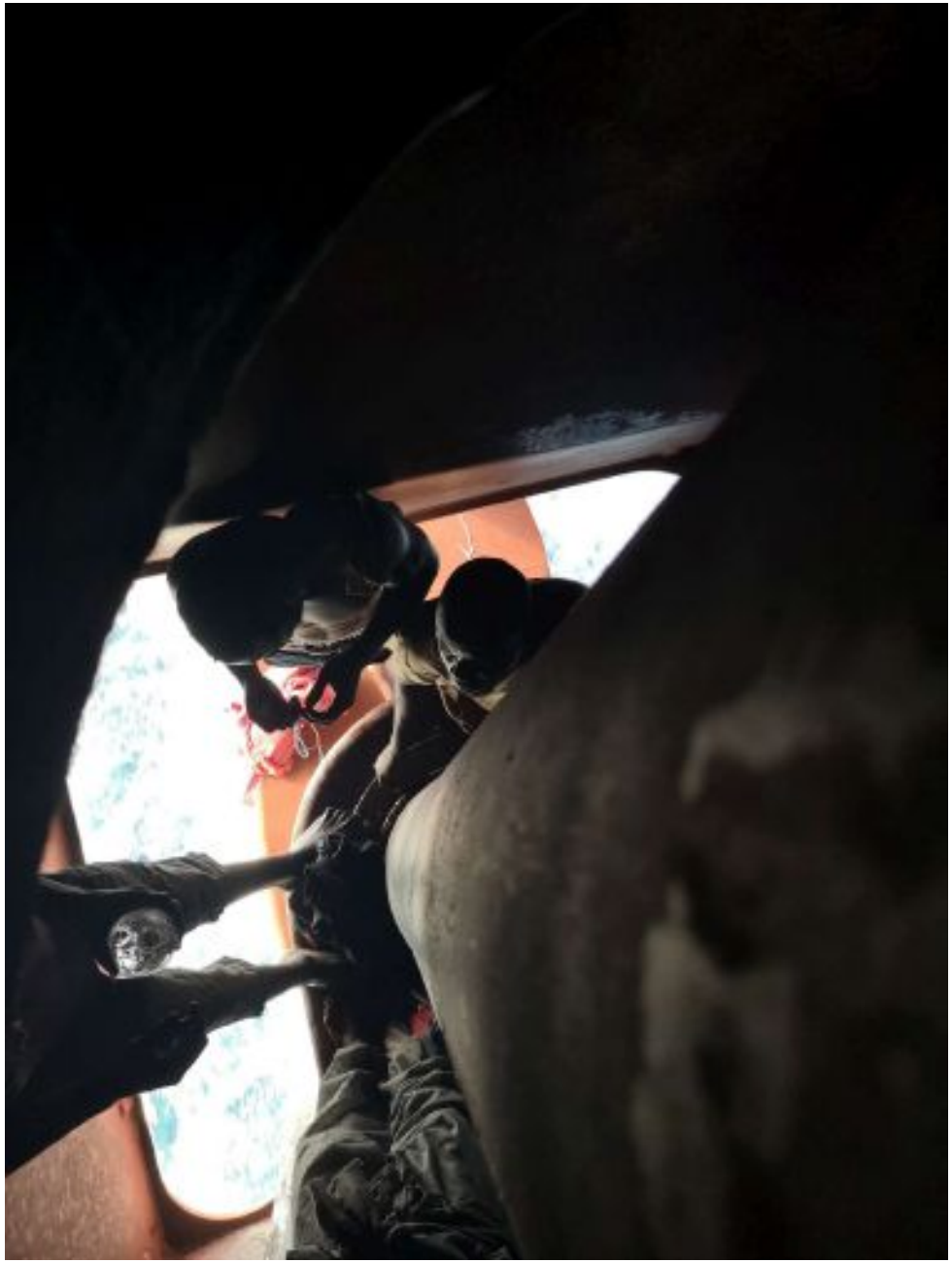


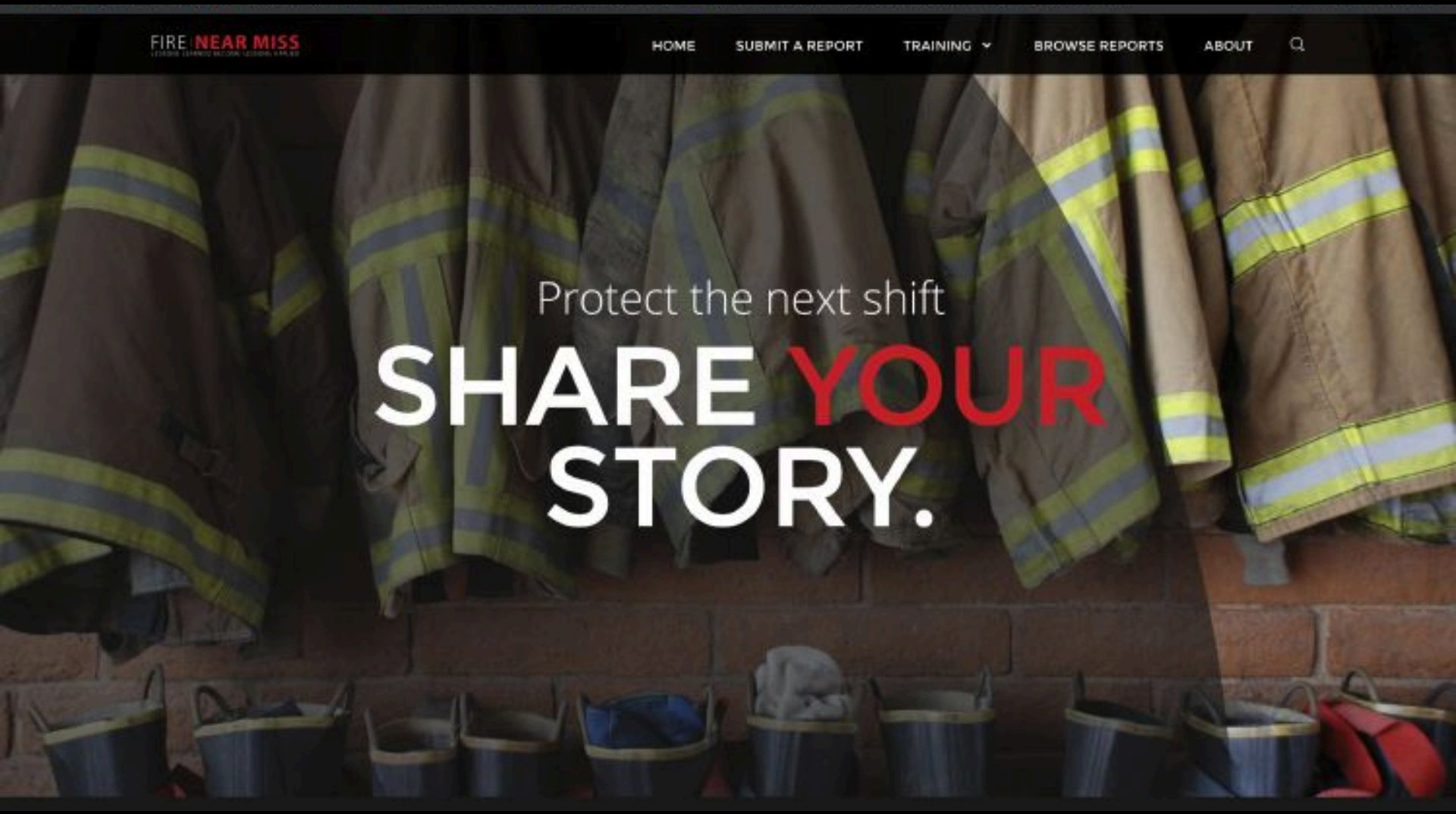
"In nearly all penetrations on the .mil network, people have been the weak link."
- Cybersecurity's Human Factor: Lessons from the Pentagon - HBR 2015

Site Security

- Example

- Technology and operations must be reliable, dependable and safe.




FIRE NEAR MISS
HOME
SUBMIT A REPORT
TRAINING
BROWSE REPORTS
ABOUT
Protect the next shift
SHARE YOUR STORY.

Near Miss Reporting

- ❑ Lacking adequate near-miss training.
- ❑ Not being fully engaged in the development and operation of near-miss reporting.
- ❑ Not being followed up on.
- ❑ Fearing reprimand/discipline. Feeling their near-miss reports
- ❑ Lacking adequate motivation / even disincentives.
- ❑ Not providing unwavering support to near- miss reporting.
- ❑ Overly time consuming.

Ref: ASTM - F3256 − 17: Standard Guide for Reporting and Recording of Near-Misses for Maritime Industry

Example:

Aviation Safety Reporting System

"Confidential. Voluntary. Nonpunitive."

"Between 2010 and 2019, exactly one person died in an accident on a U.S. passenger airline."

Assessments

Contributing Factors / Situations : Aircraft
Primary Problem : Aircraft

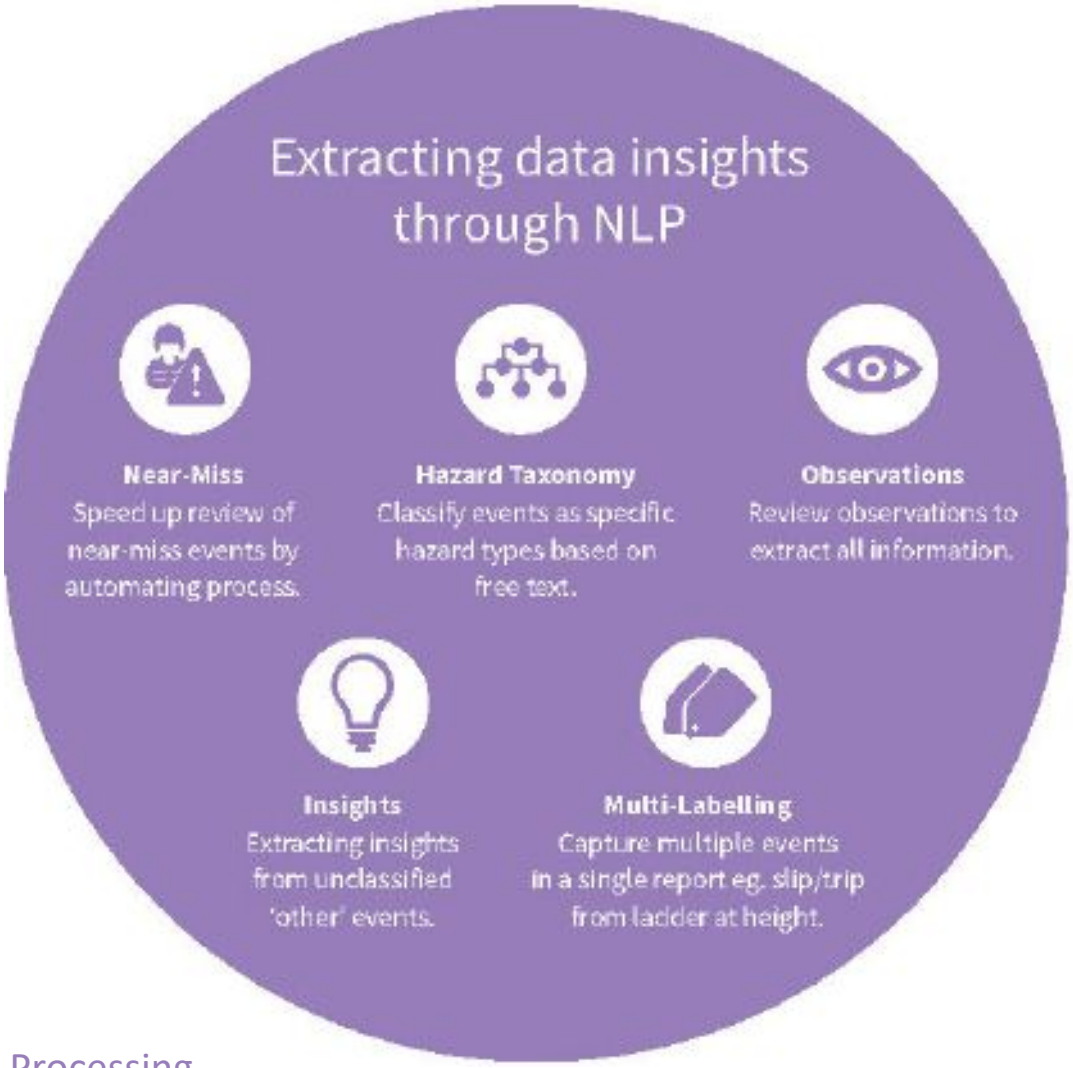
Narrative: 1

Day 3 of 3 departing in a MAX 8 after a long overnight. I was well rested and had discussed the recent MAX 8 MCAS guidance with the Captain. On departure, we had strong crosswinds (gusts > 30 knots) directly off the right wing, however, no LLWS or Micro-burst activity was reported at the field. After verifying LNAV, selecting gear and flaps up, I set "UP" speed. The aircraft accelerated normally and the Captain engaged the "A" autopilot after reaching set speed. Within two to three seconds the aircraft pitched nose down bringing the VSI to approximately 1,200 to 1,500 FPM. I called "descending" just prior to the GPWS sounding "don't sink, don't sink." The Captain immediately disconnected the autopilot and pitched into a climb. The remainder of the flight was uneventful. We discussed the departure at length and I reviewed in my mind our automation setup and flight profile but can't think of any reason the aircraft would pitch nose down so aggressively.

Synopsis

B737 MAX First Officer reported that the aircraft pitched nose down after engaging autopilot on departure. Autopilot was disconnected and flight continued to destination.

Using AI for Actionable Intelligence



NLP: Natural Language Processing

Source:
[2] https://www.spe.org/en/hsenow/hse-now-article-page/?art=5252

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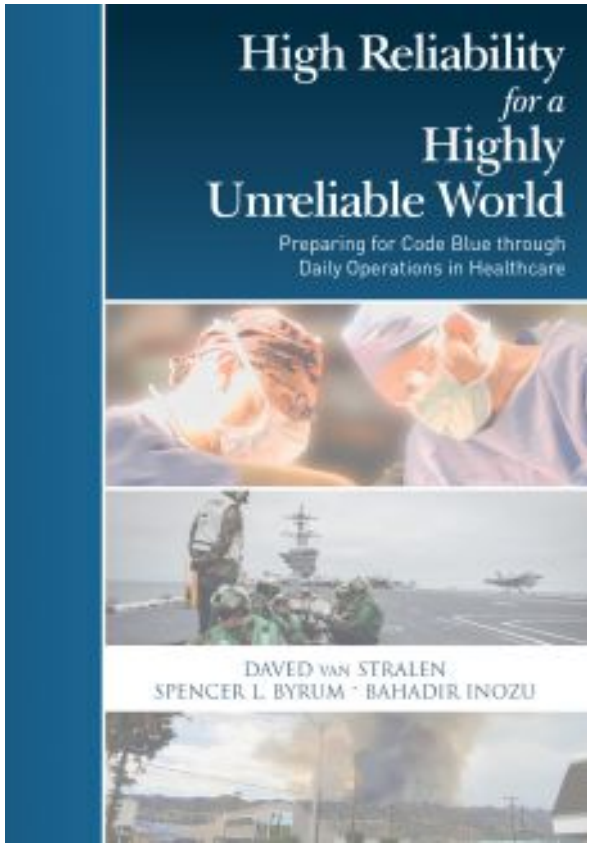
High Reliability Principles



- **Preoccupation with failure** embodies the vigilance towards system vulnerability and early engagement of problems.
- **Reluctance to simplify** recognizes the complexity of multiple interactions at the local level, the organization is reluctant to simplify or to keep simple.
- **Sensitivity to operations** describes the priority of local discrepancies, disturbances, and interruptions while maintaining strategic operations.
- **Deference to expertise** recognizes the importance of local knowledge gained from interacting with the situation.
- **Commitment to resilience** supports the open-ended working of a problem until it resolves.

Ref: High Reliability for a Highly Unreliable World, D. van Stralen, S. Byrum, B. Inozu, 2018

The Principle of On-Scene Initiative

- *…front-line operations be given latitude to act quickly and decisively …, without waiting for direction from higher levels in the chain of command.*
- *… the concept of allowing the person on scene to take the initiative… —remains central to the Coast Guard's view of its command relationships.*
- *Many of our operations are of an emergent, unpredictable nature, … best handled by personnel near or at the scene. Thus, we push both authority and responsibility to the lowest possible level.*
- *This culture is based upon the trust that operational commanders place in their subordinates' judgment.*
- *While decisive action requires unity of effort in getting all parts of a force to work together, rapid action requires a large degree of decentralization, giving those closest to the problem the freedom to solve it.,,"*

Assessment

ASSESSMENT AREAS (FACTORS)	SAMPLE SURVEY ITEMS
Safety Climate	All employees feel free to report errors without fear of retribution.
Safety Management/Supervision	I know who is responsible and accountable for safety in my work area.
Organizational Effectiveness	I believe that morale is high at my work location/Base.
Safety Information Management	I get all the information that I need to perform my job safely.
Workload/Fatigue Management	I seldom feel overburdened by my daily work assignments.
Maintenance Specific	My Work Location/Base has a sufficient supply of qualified maintenance personnel

Ref: Organizational Safety Effectiveness Survey (OSES)

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Tech Enabled Vigilance

Recognize → **Disseminate** → **Trigger**

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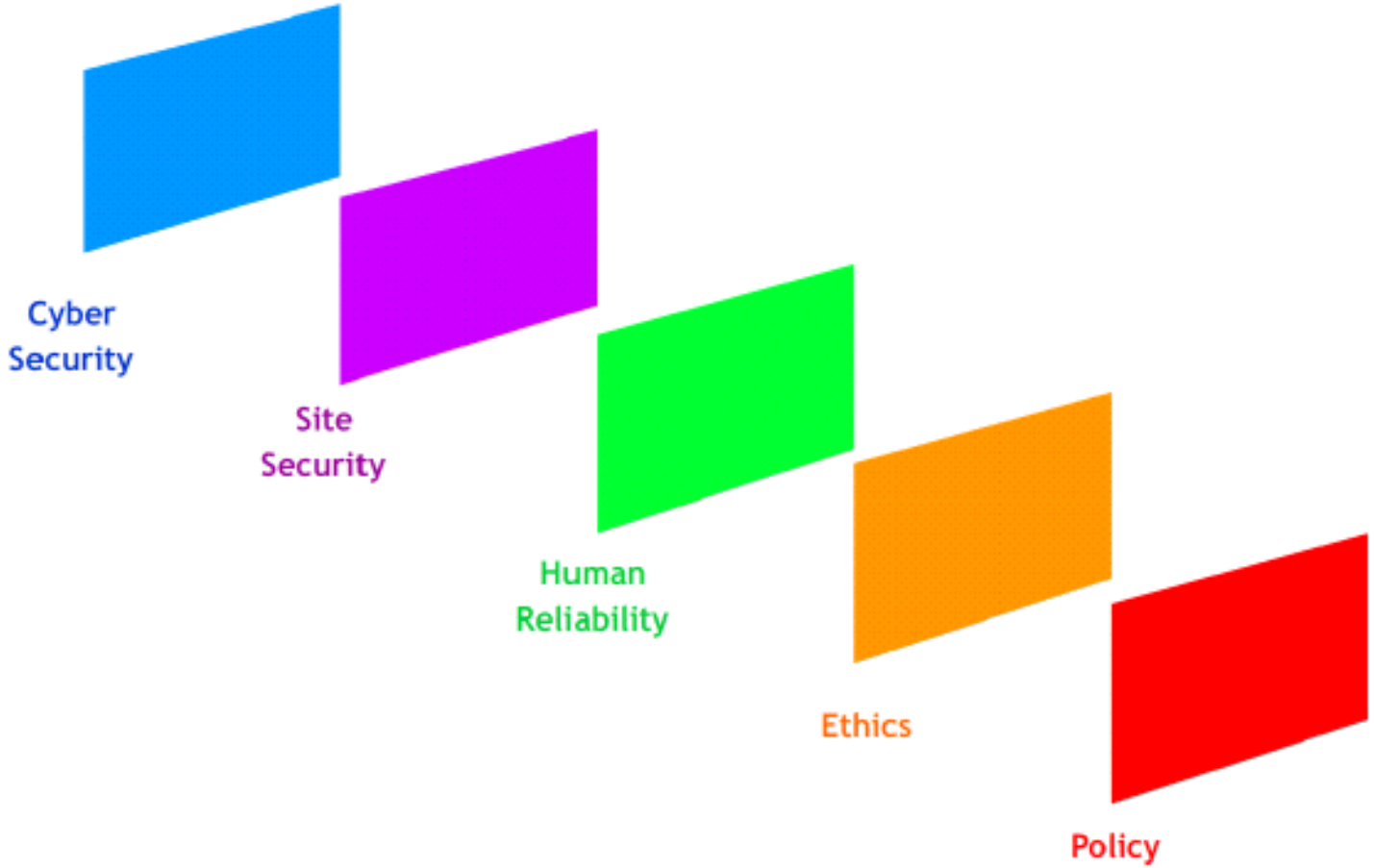
AI Enabled Vigilance with High Reliability



Summary

- ❑To be more proactive, we need a more dynamic management of the unexpected
  - ➢ Embrace failures and learn from them – fast
  - ➢ New technology accelerates learning
- ❑Organize workforce to function as a single unit
  - ➢ Systematic way of sharing information
  - ➢ Real time identification of potential risks
- ❑Close the holes of your risk control system
- ❑Apply the state-of-the art tools available from AI to enhance and automate the risk identification process within your organization:
  - ➢ Solve problems & intervene effectively
- ❑Refine what is learned and disseminate the lessons so that better ways and interventions are constantly updated
  - ➢ Improve the status quo & Increase resilience
  - ➢ High Reliability Organization Framework is proven

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SHARP FOCUS
Make Sure

BACK UP SLIDES

DISCUSSION

- Technology should work for the mariners, not just for the ship, and both **technology and operations must be reliable, dependable and safe.**
- People **have to understand the technology** and automation in order to be safe, and for the systems and ship to be secure.
- Education and training pipelines have to transform over time to include not just technology changes, automation systems, and analytic processes (thinking sensors and performance management), **but decision support and learning acceleration as well.**
- Future professional development must include a path toward **frequent learning and growth**, which will increase total training time in small courses and topics appropriate for **ship technologies, human processes, and safety requirements** – with direct application to licenses.
- There are **risks to our people and our ships if we don't keep up, take action and understand our systems or automation processes.**
- What happens if we don't take action?
- **What are the risks** we incur if we don't train our people, share knowledge, update systems to keep them reliable and secure, etc.?
- How can we transform education and training, which are very full pipelines now, to 'flex' for new technologies and topics?

Leverage technology to discover the needle in a haystack

Leading event/ root cause data are always present in the lead up to an event, regardless of how obscure or hidden

Prevention of any high risk event requires detection and intervention

Traditional (manual) processing methods are either too slow or too expensive at least some of the time

Unconstrained data processing & analysis capabilities will detect 100% of system failures and allow intervention

High Reliability Organization

- HROs have been successful in avoiding disasters for long periods of time, despite being in a high-risk field where accidents can be expected due to complexity.
- Scientifically proven way an organization can respond to crisis, chaos, and adversity
- Effective way of processing challenges and overcoming them as a single unit
- Proven in Nuclear, Aviation, Defense, Firefighting and Healthcare industries
- “The Gold Standard for Safety”

Principles of High Reliability Organization

ANTICIPATION

Preoccupation with Failure

Reluctance to Simplify

Sensitivity to Operations

Stay out of trouble

CONTAINMENT

Commitment to Resilience

Deference to Expertise

Get out of trouble

Ref: Managing the Unexpected, Weick & Sutcliffe (2015)

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Recognize

Unexpected event happens or an anomaly is observed

- Equip each member of your organization with a tool to report all anomalies as they occur in real time
- Provide organizational support and reinforcement for documenting anomalies to propagate behavior
- Provide strict immunity to those who catch and pass on potential breakdowns, regardless of outcome
- Reward those that are diligent and have keen powers of observation that consistently report anomalies
- Report all anomalies and let the system determine whether they are problems that require intervention

Disseminate

Alert key personnel

- Aggregate and deliver alerts to team members that are expected to have critical input to address the anomaly
- The report is delivered as it was first observed
- Team members understand their role is just to observe. Information is not generalized or simplified
- The alert is open and continues to be passed through the organization with any salient feedback from all those that it has passed through
- Combine alerts from various sources to include perspectives, equipment readings, and/or automated reports/observations

Trigger

Cycle from response to recovery and then to resilience

Shift back & forth from execution to problem solving

- Rank prioritization of alerts (code Yellow, Orange, Red etc.) ensure that receipt and response fall within the range of time that is warranted
- **Engage and Reduce the risk**

- Archives of signals, alerts, and solutions become rich organizational data for the present and future
- Recognition is systematized for those that observe as well as those that respond consistently with sound actionable solutions
- Verifiable Experts become stronger organizational nodes that can be more readily tapped into within emergent crisis situations

LEARNING ORGANIZATION

Education and training pipelines have to transform over time to include not just technology changes, automation systems, and analytic processes, **but decision support and learning acceleration as well.**

Discussion

- Do you know all your vulnerabilities?
- Near Misses?
  - Do you think all your near misses and anomalies are reported?
  - …And analyzed, corrective actions were taken in a timely manner
  - ..And feedback was provided, and rewards were given… and your safety management system is becoming more resilient continuously?
  - Are you a learning organization?

Structured vs. Unstructured Data

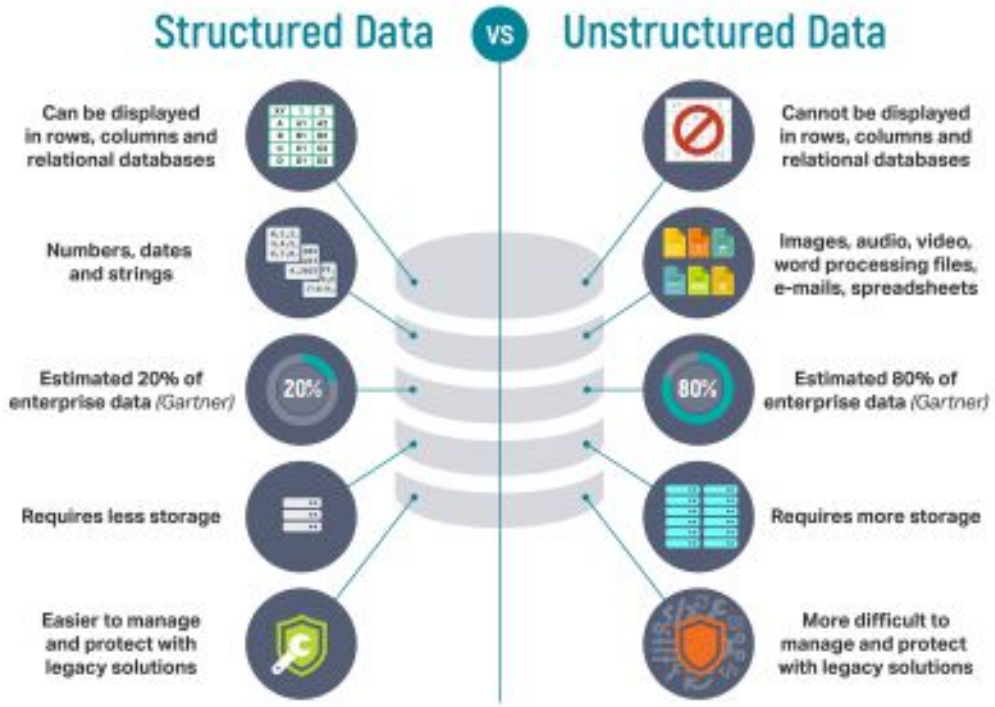

Image source: https://www.igneous.io/blog/structured-data-vs-unstructured-data

Mapping Free Text to Causality Analysis Form

TYPE OF LOSS		DESCRIPTION OF EVENT
☐ People (Safety/Health) ☐ Asset (Damage) ☐ Environmental ☐ Financial (Fines, Claims, Insurance)	☐ Non-Conformity (Product/Service) ☐ Reputation/Complaint ☐ Process/Business	

Free text

NLP Analysis

Mapping Risk Factors to the Forms

Systematic Cause Analysis Technique

Near Miss Risk Analysis

Free-form Text Incident Description

- The loading arm 1x12” was connected to ship No.5 port manifold for loading gasoline.
- Although vessel crew had requested to test connection with air/nitrogen, terminal representative refused to test.
- Before loading operation, in line up process shore valve and ship’s manifold valve were opened.
- Cargo leakage in manifold connection as droplets were observed, terminal was informed immediately.
- The arm was drained and disconnected.
- Finally the arm was connected properly, the connection was checked and confirmed that there was no leakage.

Risk Template

Risk Factor	Score
Environmental Release (to Air/Water/Soil)	0.8
Fire	0.75
Cargo Damage and/or Loss	0.75
Explosion	0.5

- Automatically detects risks from free-form text incident description.
- Scores are also assigned to unobserved probable risks (e.g. fire, explosion) based on leading observed risk factors (cargo leakage).
- Risk factors can be used for analytics and features for forecasting models.

NLMatics

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Causality Analysis

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Cause	Personnel	Equipment	Score
Failure to Follow Procedure/Instruction	Terminal Rep	Manifold Valve	0.8
Failure to Comply with Customers/Stakeholders Requirements	Terminal Rep	Manifold Valve	0.75
Improper Motivation	Terminal Rep		0.75
Lack of incentive	Terminal Rep		0.5
Inadequate communication/implementation of policy/procedure/practice	Terminal Rep, Vessel Crew		0.4

- ❑ Root causes are identified, scored and attributed to relevant personnel/equipment/process.

NLMatics

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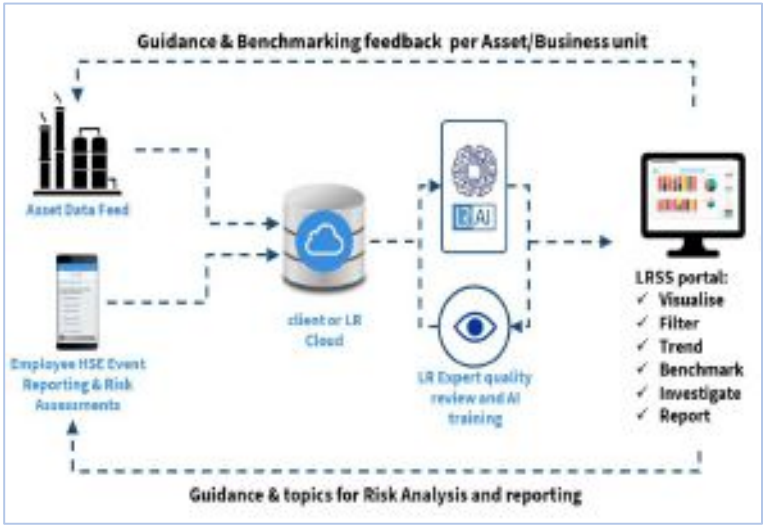
Examples from other industries

- **Application: "**Martinovic et al (2016) analyze minor slope failures on the Irish Rail network and using machine learning techniques establish a link between past rainfall and failures, the impact of increased rainfall (or climate change) - GoSAFE rail project the researchers will develop these techniques for other failure modes; notably for bridges, tunnels and level crossings" [2]

- **Application**: Business Finland agency's recent project employed NLP technology of the AI to investigate all risk factors related to accidents which either took place or could be prevented. Some results showed that AI was able not only to process a huge amount of accident-related data but also help the human operators identify essential trends to add, when drafting new occupational health & safety guidelines for a particular company or even industry. [3]

- **Application:** LR model on the image to the left [5]



Source:

[2] http://www.gosaferail.eu/concept/near-miss-concept
[3] https://incidentreport.net/case/AI_meets_incidentreporting.html
[5] https://www.spe.org/en/hsenow/hse-now-article-page/?art=5252