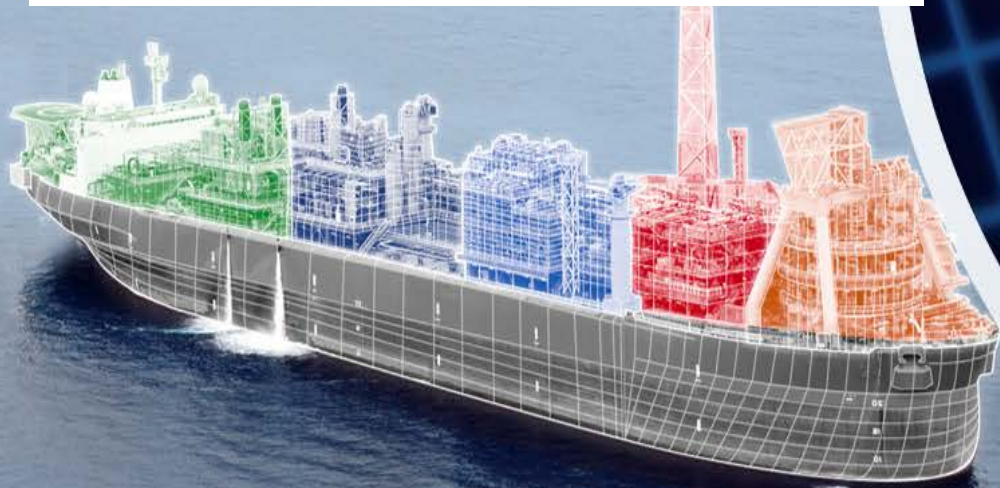# The Class Society approach to MASS

Tony Boylen

Principle Specialist Assurance of Autonomy
Lloyd's Register Marine & Offshore
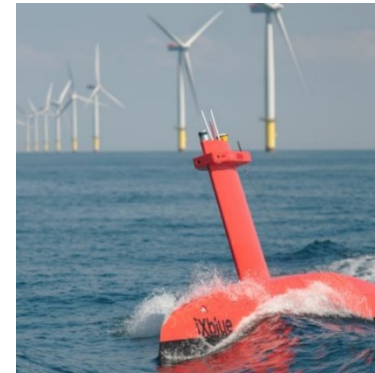
MASRWG Conference
20 January 2021

Unmanned Marine Systems

Some real-world applications

Lloyd's Register

Unmanned Marine Systems

Some real-world applications

Ocean going, autonomous vessel:

- Retrofit of an autonomous navigation system to support manned operations

- Test system performance in open ocean

- Prove 'safety of system' in the open ocean

- Analyse 'human vs machine' performance

- Gather data on navigational scenarios
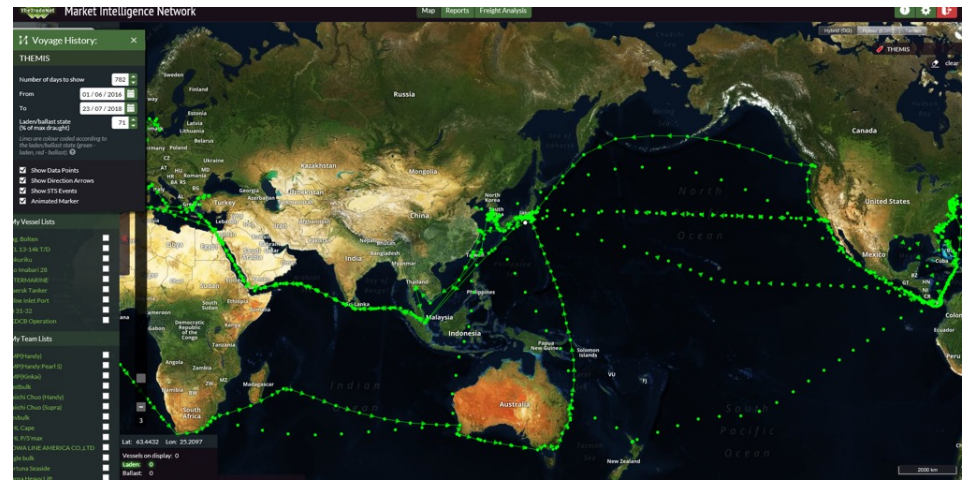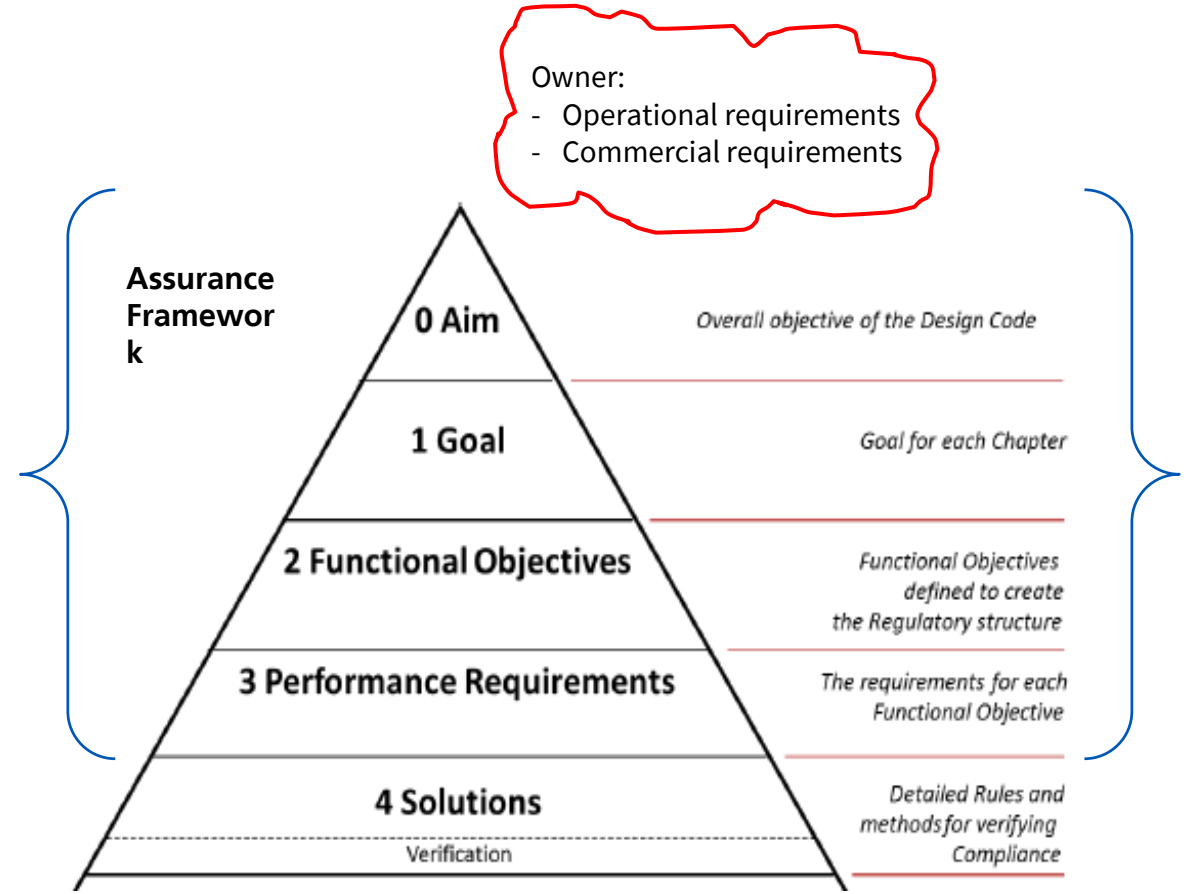
Unmanned Marine Systems

LR UMS Code – structure

Tier 0 – Aim

"The Unmanned Marine System (UMS) shall be safe, dependable, capable and resilient in all Reasonably Foreseeable Operating Conditions"
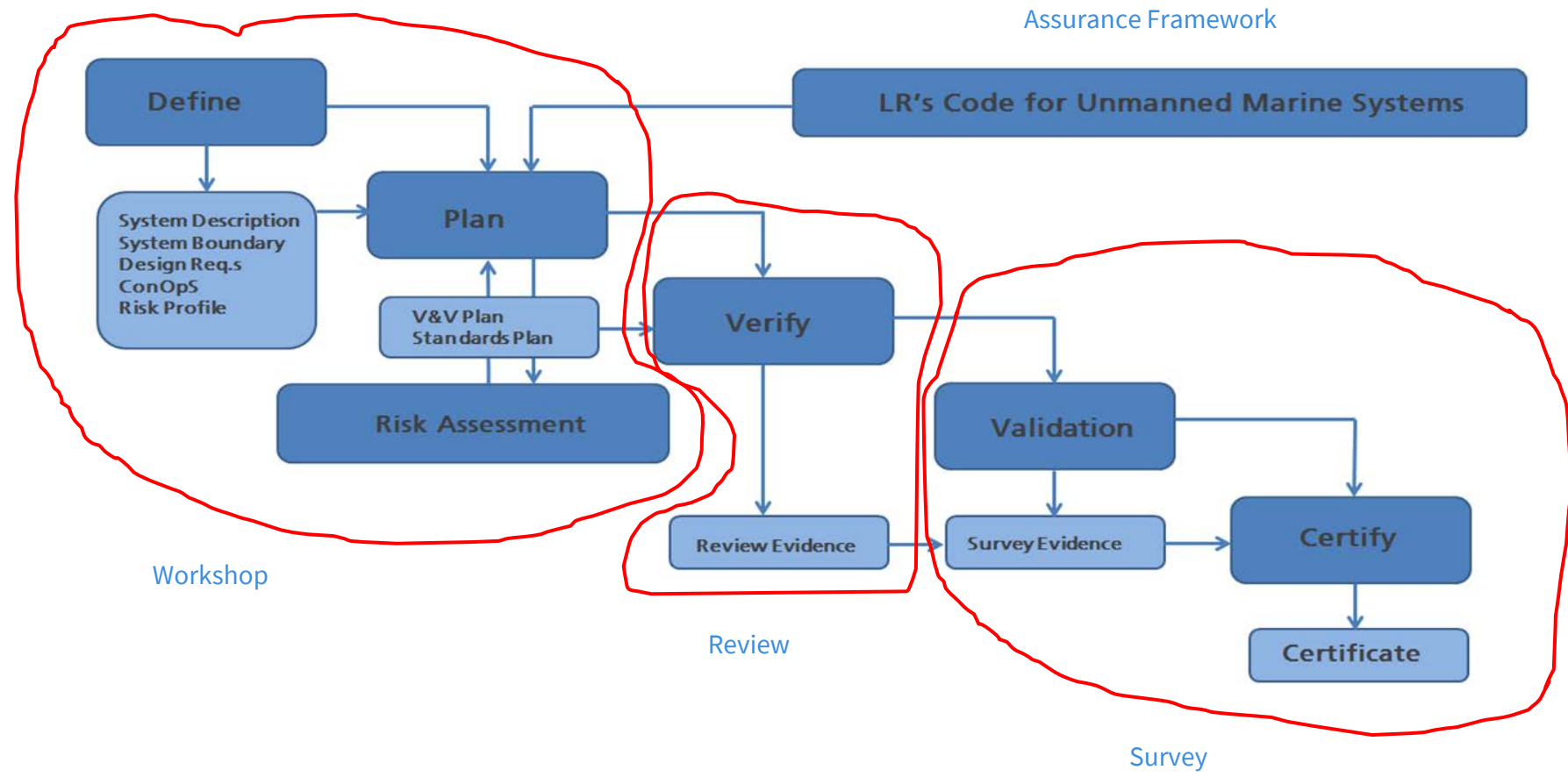
Nine Chapters, each having:

- Goal
- Functional Objectives
- Performance Requirements

Owner:
- Operational requirements
- Commercial requirements

Assurance Framework

|	
0 Aim	*Overall objective of the Design Code*
1 Goal	*Goal for each Chapter*
2 Functional Objectives	*Functional Objectives defined to create the Regulatory structure*
3 Performance Requirements	*The requirements for each Functional Objective*
4 Solutions / Verification	*Detailed Rules and methods for verifying Compliance*

Unmanned Marine Systems

LR UMS Code – certification process

Unmanned Marine Systems

LR UMS Code – verification plan

- Define Solution

- Justify Standards

- Assign Performance Requirements

- Determine Verification/Validation Process

- Identify Risk Controls

- Identify Survey Requirements

- Capture Evidence
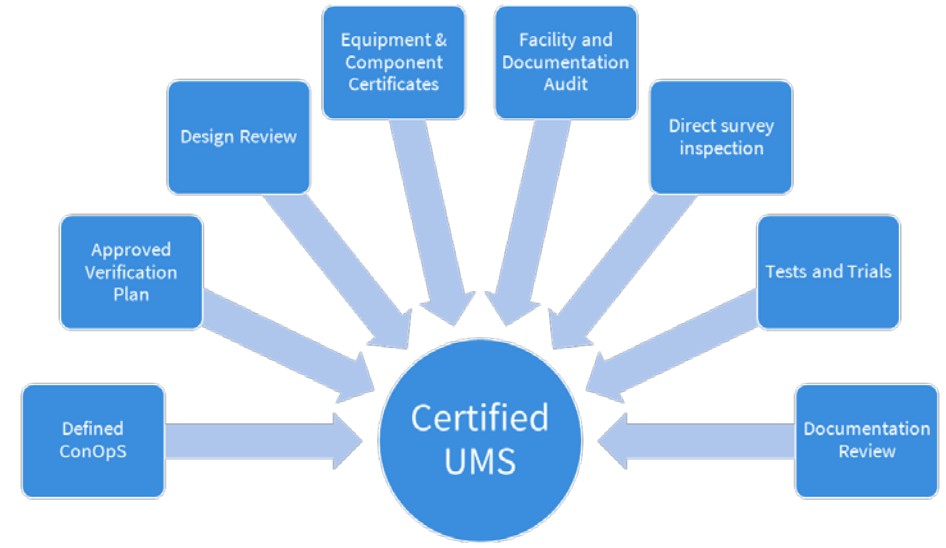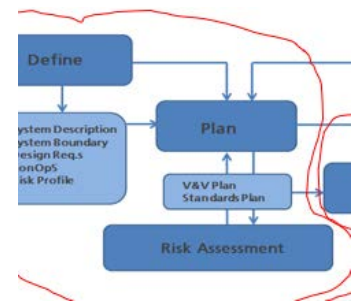
Unmanned Marine Systems

Levels of autonomy

- Manual: no autonomous function; all action and decision-making performed by human operator

- On-board Decision Support: all actions taken by human operator, but decision support tool can present options / influence the actions chosen. Data is provided by systems on board.

- On & Off-board Decision Support: all actions taken by human operator, but decision support tool can present options / influence the actions chosen. Data may be provided by systems on or off-board.

Unmanned Marine Systems

Levels of autonomy

- Active Human in the loop: decisions and actions are performed with human supervision. Data may be provided by systems on or off-board.

- Human in the loop as operator/ supervisor: decisions and actions are performed autonomously with human supervision; operators have opportunity to intercede and over-ride on high impact decisions.

- Fully autonomous: rarely supervised operation; decisions are entirely made and actioned by the system.

- Fully autonomous: unsupervised operation; decisions are entirely made and actioned by the system during the mission.

Unmanned Marine Systems

Levels of autonomy
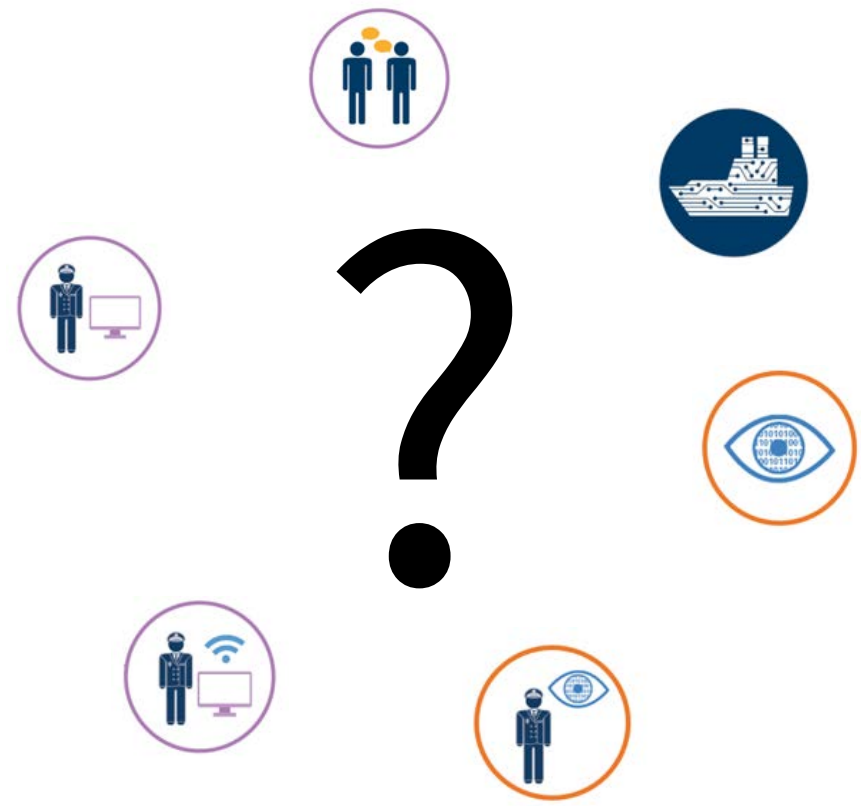
Managing risk – application of best practice

Depending upon the size of an autonomous ship, good Practice may include but is not limited to:

Classification Rules and Procedures
- LR ShipRight Procedure for assignment of digital descriptive notes for autonomous and remote access ships, March 2019
- Unmanned Suface Vehicle (USV) - LR Code for Unmanned Marine Systems, February 2017
- LR Best Practice Guide for Equipment Manufacturers; The Human-Centred Approach, April 2014
- LR Guide to resources; Human-Centred approach to ship and equipment design, August 2014
- LR ShipRight Procedure for Human-Centred Design, November 2020

International Standards

Industry guidance
- Maritime Autonomous Surface Ships (MASS) UK Industry Conduct Principles and Code of Practice, version 4, 17 Dec 2020
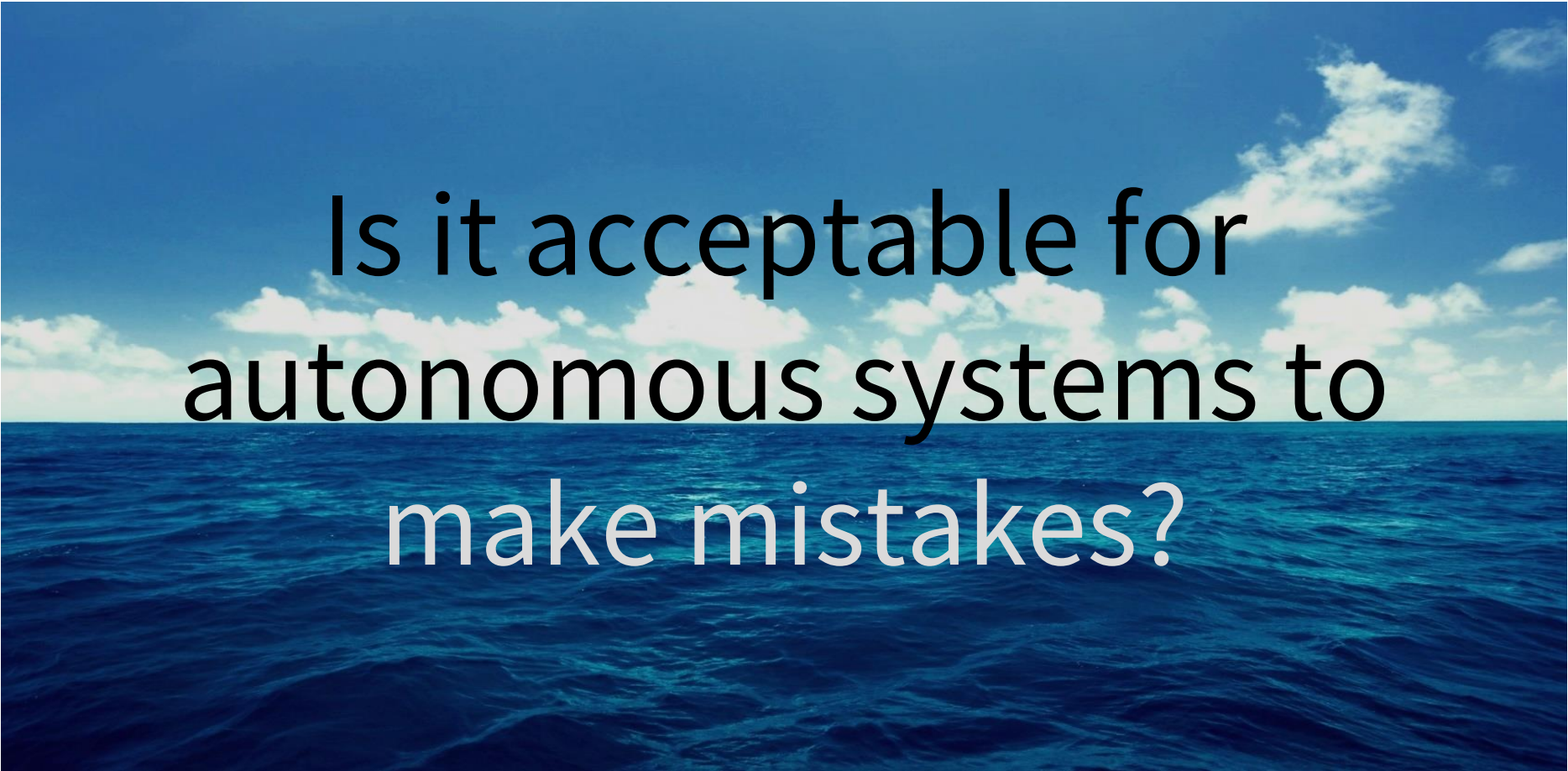
What is a 'safe look-out'?

BBC.CO.UK

Failure of the Imagination

Is it acceptable for autonomous systems to make mistakes?

Free Images : water, waterfall, boat, escape, river, canoe, paddle, vehicle, closeup, extreme sport, kayak, waterway, boating, poland, watercraft, kayaks, the risk of, rafting, i with, kajakowa, a small pan 2218x1652 - - 562675 - Free stock photos - PxHere

Management of other traffic…..

Free Images : water, waterfall, boat, escape, river, canoe, paddle, vehicle, closeup, extreme sport, kayak, waterway, boating, poland, watercraft, kayaks, the risk of, rafting, i with, kajakowa, a small pan 2218x1652 - - 562675 - Free stock photos - PxHere

Management of other traffic…..within the environmental context

Storm Leaves Trail of Destruction in Philippines -
The New York Times (nytimes.com)

Sensor characteristics

- ability to detect objects, distinguish distinct objects, and the features of the sensor that may lead to incorrect decisions such as noise or poor contrast.

Degradation

- change of performance in differing weather conditions will provide vital information for verification of the system as a whole.
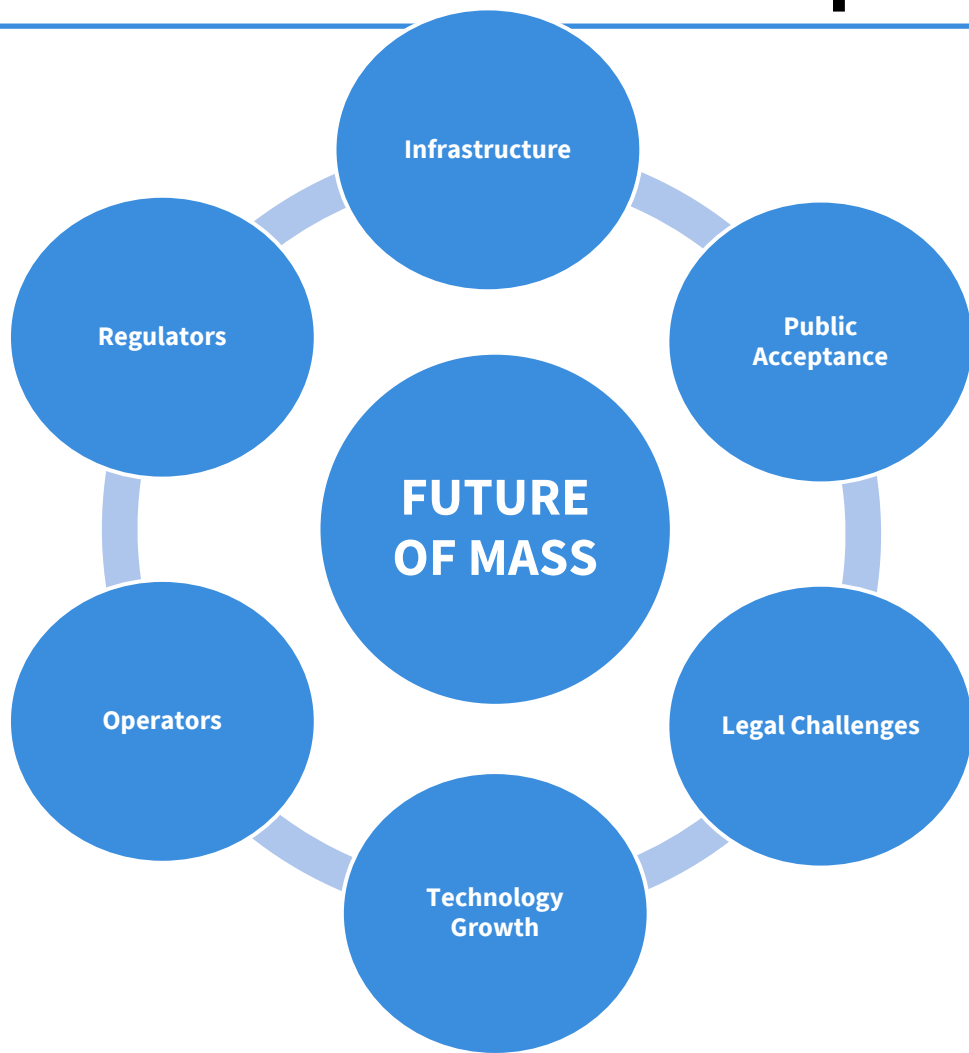
"Sir, the possibility of successfully navigating an asteroid field is approximately three thousand seven hundred and twenty to one."

"Never tell me the odds!"

—C-3PO and Han Solo, The Empire Strikes Back

https://starwars.fandom.com/wiki/Hoth_asteroid_field

The need for Collaboration and not Competition

MASRWG Conference Presentation

Tony Boylen

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