



# Potential Safety Benefits of Automation in Future Rotorcraft

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# Introduction



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- Bell has a long history of developing aircraft for diverse missions
- As we look towards our future, automation plays a key role in enabling our customers to operate with improved safety
- Today Bell will focus on:
  - How we view automation
  - Aircraft safety incidents
  - How automation might help

**Bell's focus is on Automation that Improves Capability, Reduces Pilot Workload, and Increases Safety**

# Automation

# Bell Safety Pillars

## Bell Safety

### Automation

Develop automation solutions for high workload tasks where pilot error is most likely.

### Awareness

Integrate new avionics and sensor technology to improve pilot awareness.

### Alternatives

Provide alternative solutions to the pilot and passengers if they enter an unsafe condition, such as inadvertent icing, engine failure over hostile terrain, and pilot incapacitation.

### Accident Survivability

Push the limits on what is possible above and beyond what is required by the certification standards.

Automation, Awareness, and Alternatives are all places Automation can help

# Levels of Automation

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BASIC  
AUTOMATION

1

Autopilot/  
Flight Director

ADV. SUPERVISED  
AUTOMATION

2

Flight Management  
System

SUPERVISED  
AUTONOMY

3

Advanced Perception  
and Response

UNSUPERVISED  
AUTONOMY

4

Complex Decisions

**Automation**

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Minimal human input within well-defined /  
restricted parameters

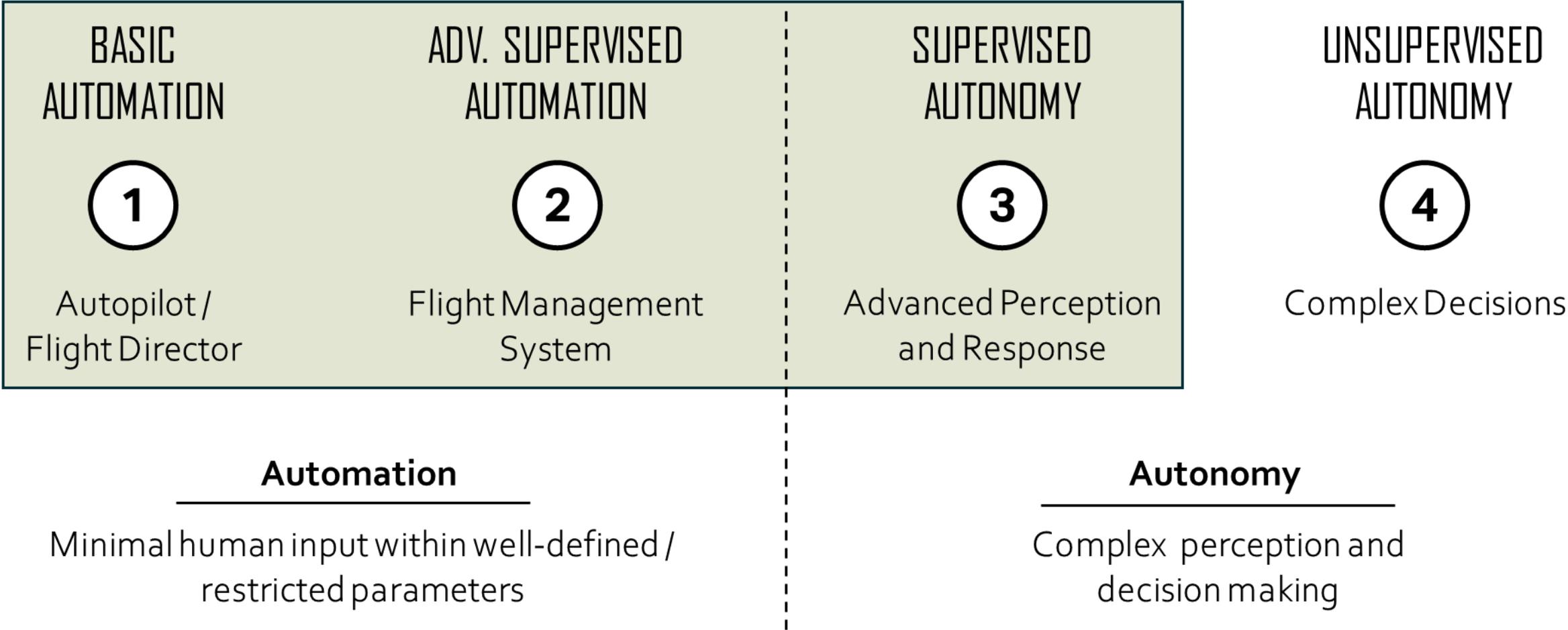
**Autonomy**

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Complex perception and  
decision making

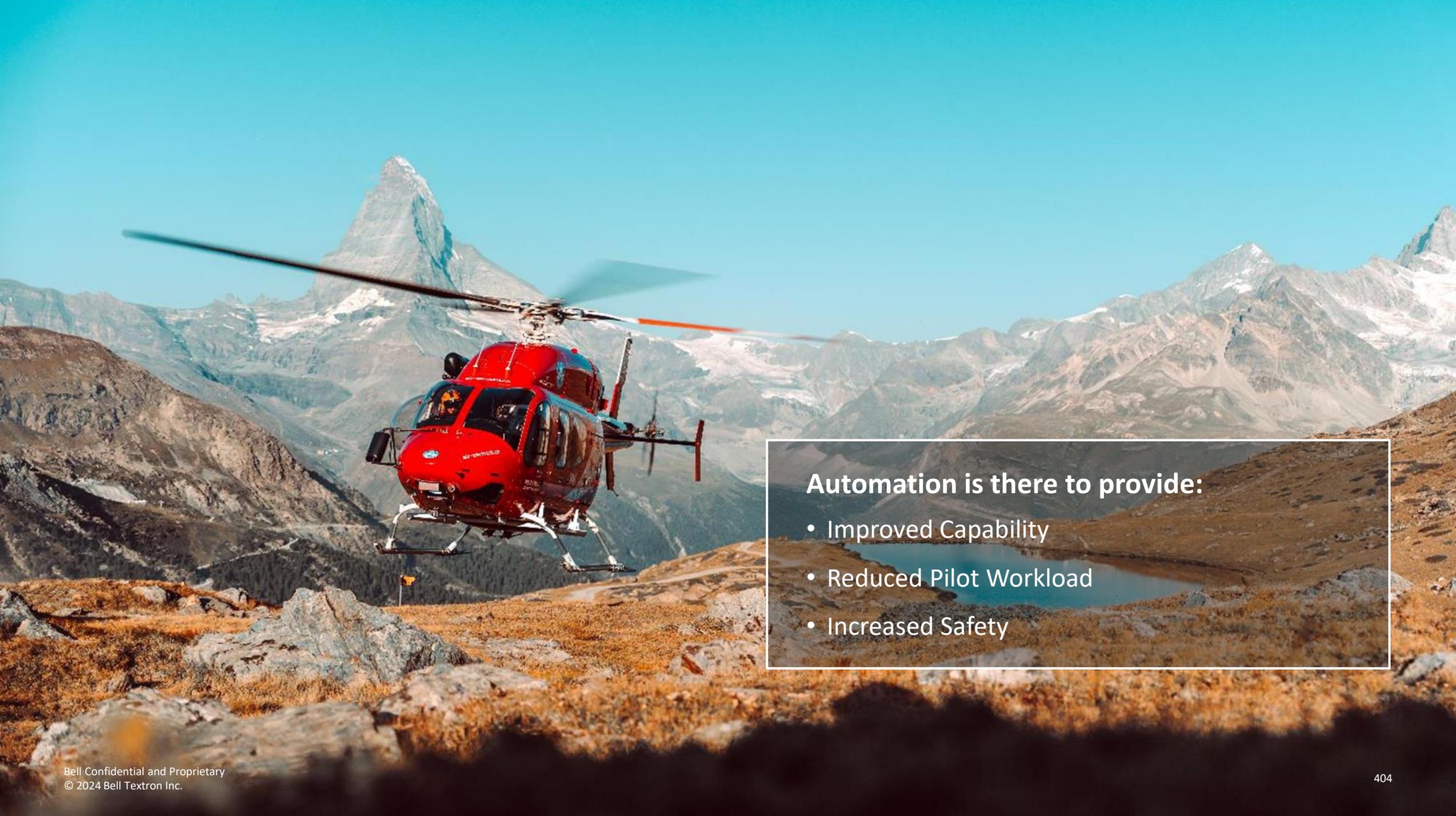
# Levels of Automation

*Commercial Aircraft Focus*



# Levels of Automation – Detailed

Level	Key Capabilities	System Responsibilities
<b>Basic Automation</b>	Autopilot Flight Director	Heading / Course Hold Altitude Hold Airspeed Hold Coupled Approach
<b>Advanced Supervised Automation</b>	Flight Management System	Sequenced Automation Estimation of Future State NavAid Autoselect Directs the Flight Director
<b>Supervised Autonomy</b>	Advanced Perception & Reaction Task Sequencing Full Authority AFCS	Advanced Control Modes Obstacle Detection Terrain & Traffic Awareness Hazard Avoidance Performance Limited (Self awareness) Automated Takeoff & Landing

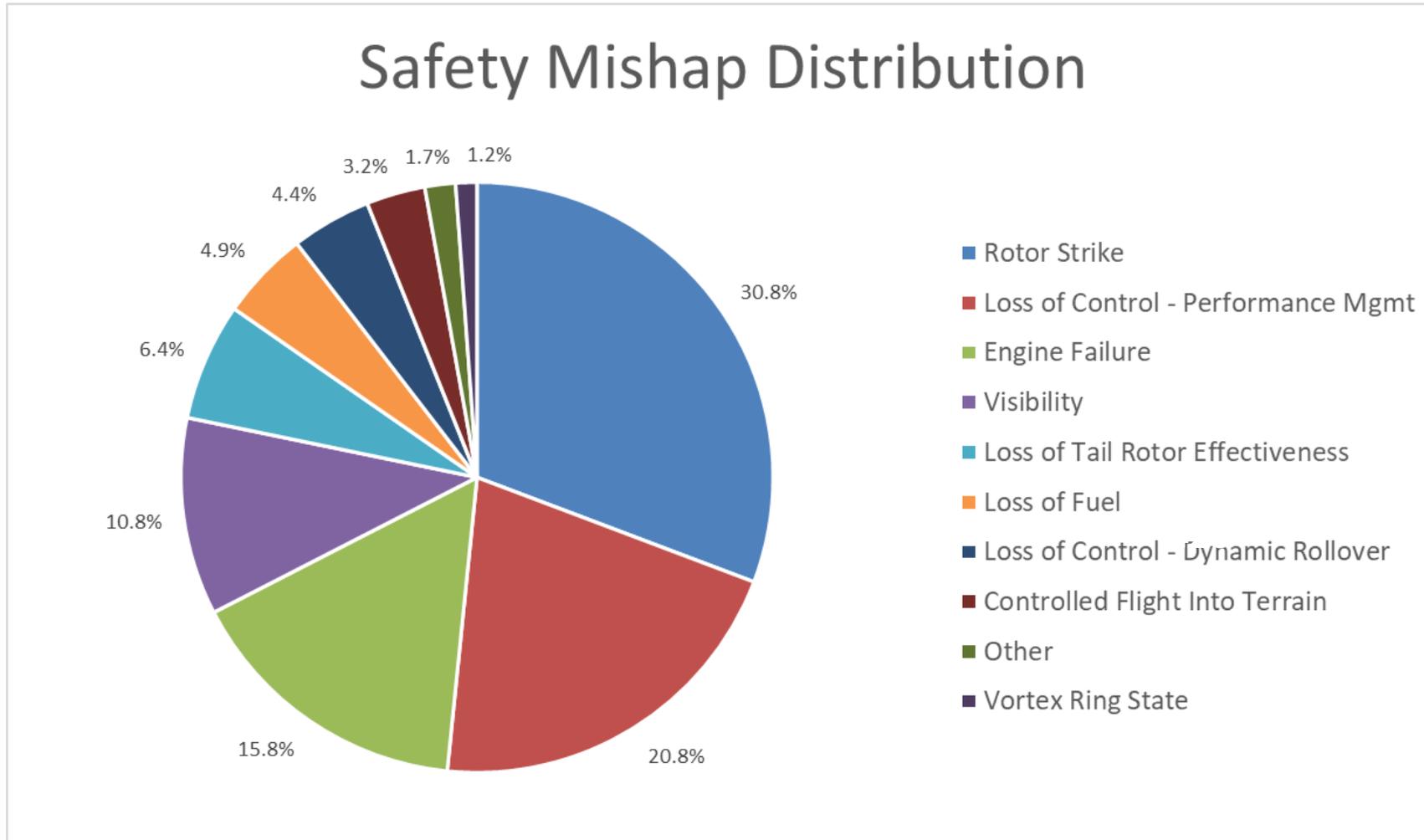


**Automation is there to provide:**

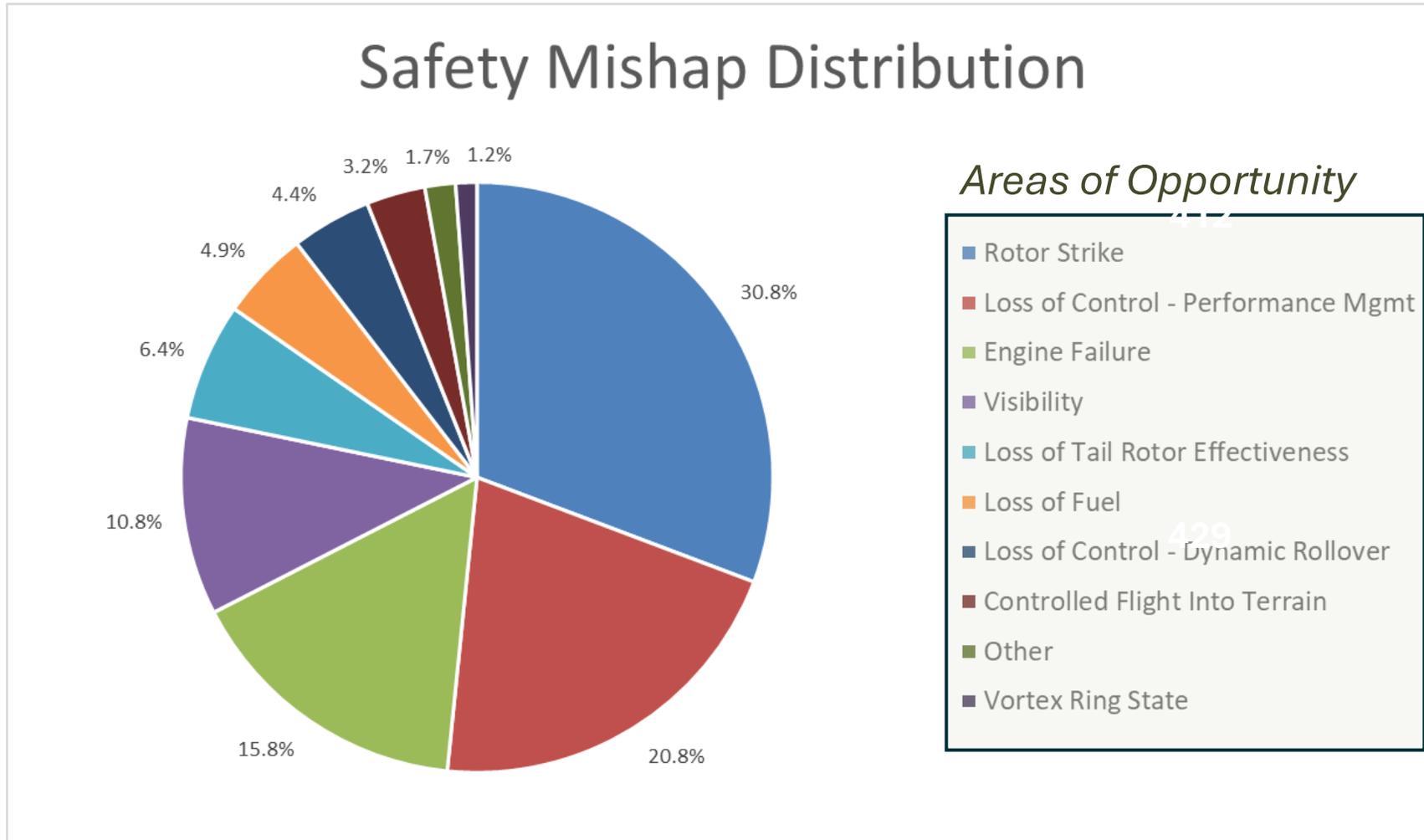
- Improved Capability
- Reduced Pilot Workload
- Increased Safety

# Safety Data

# Safety Mishap Data - Bell



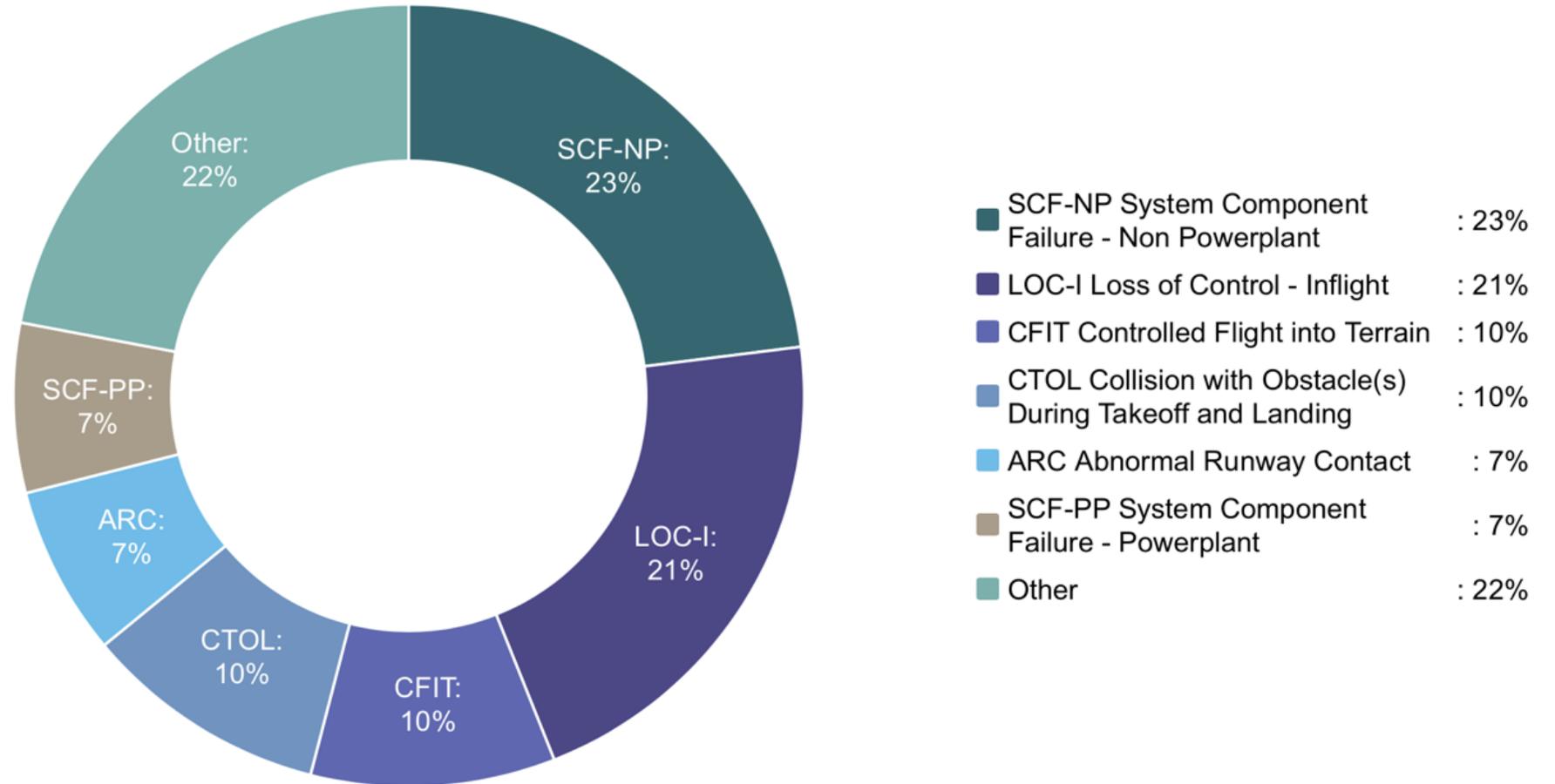
# Safety Mishap Data - Bell



# Safety Mishap Data – HeliOffshore 2024 Report

## Accident Data

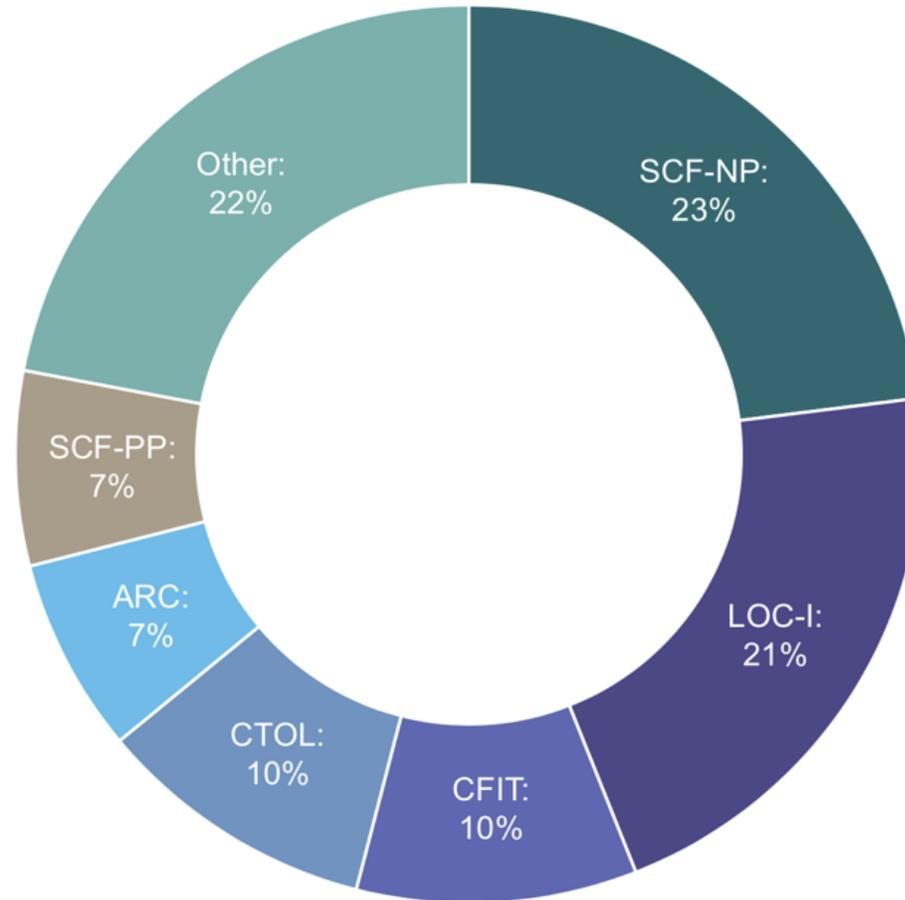
- All accidents  
2013-2023



# Safety Mishap Data – HeliOffshore 2024 Report

## Accident Data

- All accidents 2013-2023



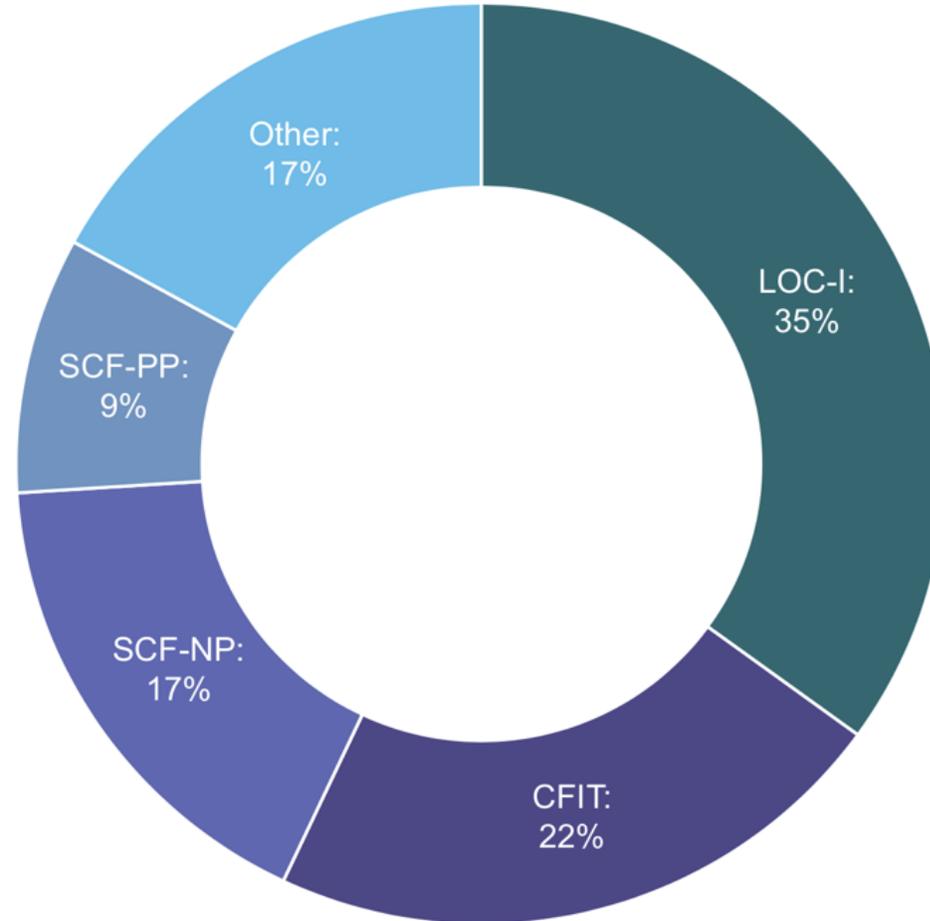
## Areas of Opportunity

SCF-NP System Component Failure - Non Powerplant	: 23%
LOC-I Loss of Control - Inflight	: 21%
CFIT Controlled Flight into Terrain	: 10%
CTOL Collision with Obstacle(s) During Takeoff and Landing	: 10%
ARC Abnormal Runway Contact	: 7%
SCF-PP System Component Failure - Powerplant	: 7%
Other	: 22%

# Safety Mishap Data – HeliOffshore 2024 Report

## Accident Data

- Fatal accidents  
2013-2023

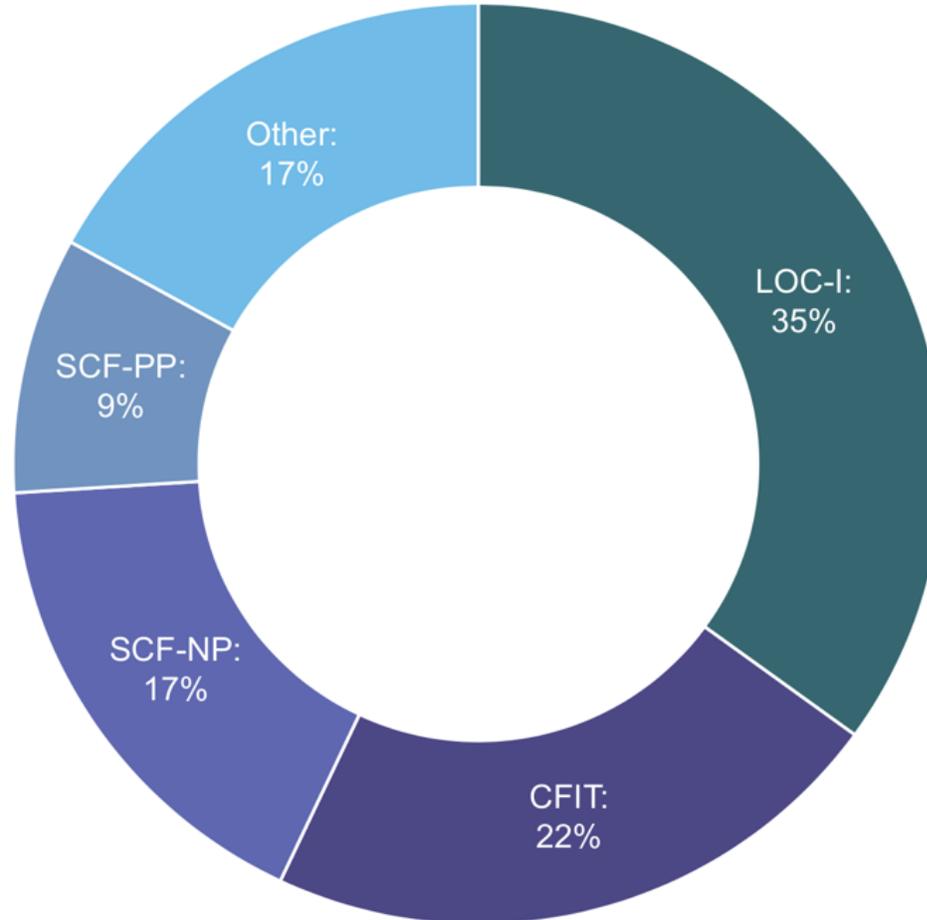


LOC-I Loss of Control - Inflight	: 35%
CFIT Controlled Flight into Terrain	: 22%
SCF-NP System Component Failure - Non Powerplant	: 17%
SCF-PP System Component Failure - Powerplant	: 9%
Other	: 17%

# Safety Mishap Data – HeliOffshore 2024 Report

## Accident Data

- Fatal accidents 2013-2023



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# Our Aircraft

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Complex  
Missions

Price  
Sensitive

**Each platform is unique with different needs & missions, but across the board automation can help**

# Our Aircraft

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# A Drive to Safety

# A Drive to Rotorcraft Safety

## Rotorcraft Safety Promotion Concept (RSPC) for Design and Equipment

- FAA intent to encourage voluntary product improvements to raise the level of safety
- Safety Continuum recognizes differences in acceptable levels of safety and certitude
- Encourage practical and economical installations of safety enhancing systems

## FAA – Part 27 Rotorcraft Safety Continuum for Systems & Equipment



Federal Aviation  
Administration



Presented to: EASA Rotorcraft Symposium

By: Andy Shaw

Rotorcraft Standards Branch, FAA

Date: December 5, 2017

# A Drive to Rotorcraft Safety

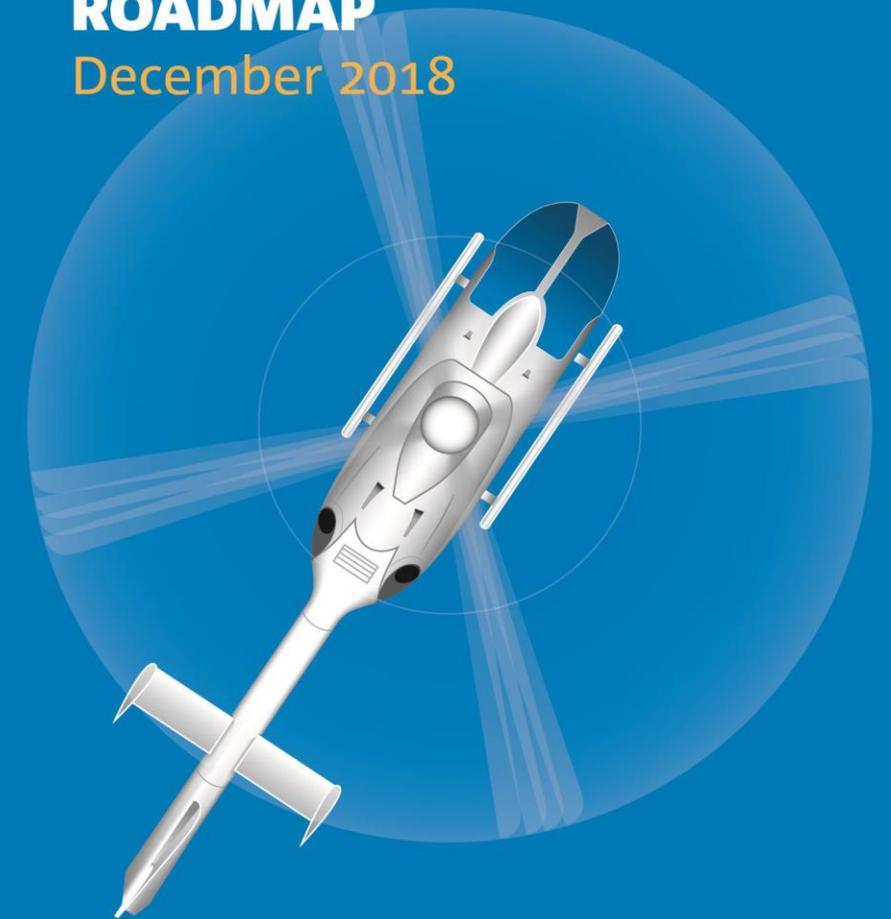
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Including, but not limited to:

- Autopilots for improved stability
- Wire Strike Protection Systems
- Helicopter Terrain and Warning Systems (HTAWS)
- Synthetic Vision Systems (SVS), Head Up and Head Down
- Helicopter Flight Data Monitoring (HFDM) Systems



## ROTORCRAFT SAFETY ROADMAP December 2018



# Automation Opportunities

# Automation Opportunities

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Based on assessment of the mishap data, Bell has identified major automation opportunities in the following areas:

- Hazard Awareness & Avoidance
- Automated or Assisted Takeoff & Landing, to include CAT A Reject
- Envelope Protection to include Aircraft Structural/Control Limits
- Vortex Ring State & Loss of Tail Rotor Effectiveness Protection
- Autorotation entry & autorotation landing assisted modes
- Advanced Control Modes for reduced pilot workload in Hover & Cruise

# Safety Mapping to Opportunities

The Table below maps the capabilities from the previous slide to mishap Data:

Safety Mishap	Automation Opportunity							
	Hazard Awareness	Hazard Avoidance	Automated Takeoff	Automated Landing	Autorotation Assist	Upset Recovery	Envelope Protection	Advanced Control Modes
Rotor Strike	X	X						
Loss of Control - Performance Mgmt			X	X	X	X		X
Engine Failure				X				
Visibility	X	X						
Loss of Tail Rotor Effectiveness							X	
Loss of Fuel					X		X	
Loss of Control - Dynamic Rollover	X		X	X				
Controlled Flight Into Terrain	X	X						
Vortex Ring State							X	

# Next Steps

# Autonomous Laboratory for Future Autonomy (ALFA)



# Conclusion

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To enable increases safety through automation, Bell has focused on:

- Identifying safety-driven Target Capabilities
- Ensuring Aircraft & Subsystem Design (Air Vehicle, Avionics, Flight Controls) are developed with these capabilities in mind
- Reducing development risk through internal research & development
- Ensuring alignment between our development teams, our flight safety team, and our customer needs

**Developing & fielding safety-driven capabilities can meaningfully enable safer operation of Bell Aircraft**



THANK YOU

