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Lloyd's Register Foundation

Analysis of Airspace Infringements in European Airspace

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My Background

2012 – Now	Research student in aviation safety at Lloyd's Register Educational Trust Transport Risk Management Centre, Centre for Transport Studies
2011 – 2012	MSc in Transport from Imperial College and UCL
2007 – 2011	Undergraduate degree in Civil Engineering from Cyprus University of Technology

Motive: Helios crash in Athens 2005

- 121 fatalities (93 adults, 22 passengers are children and teenagers)

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Outline of Presentation

- Definition of Airspace Infringements (AIs)
- Studies by EUROCONTROL
- Proposed methodology
- Results
- Conclusions

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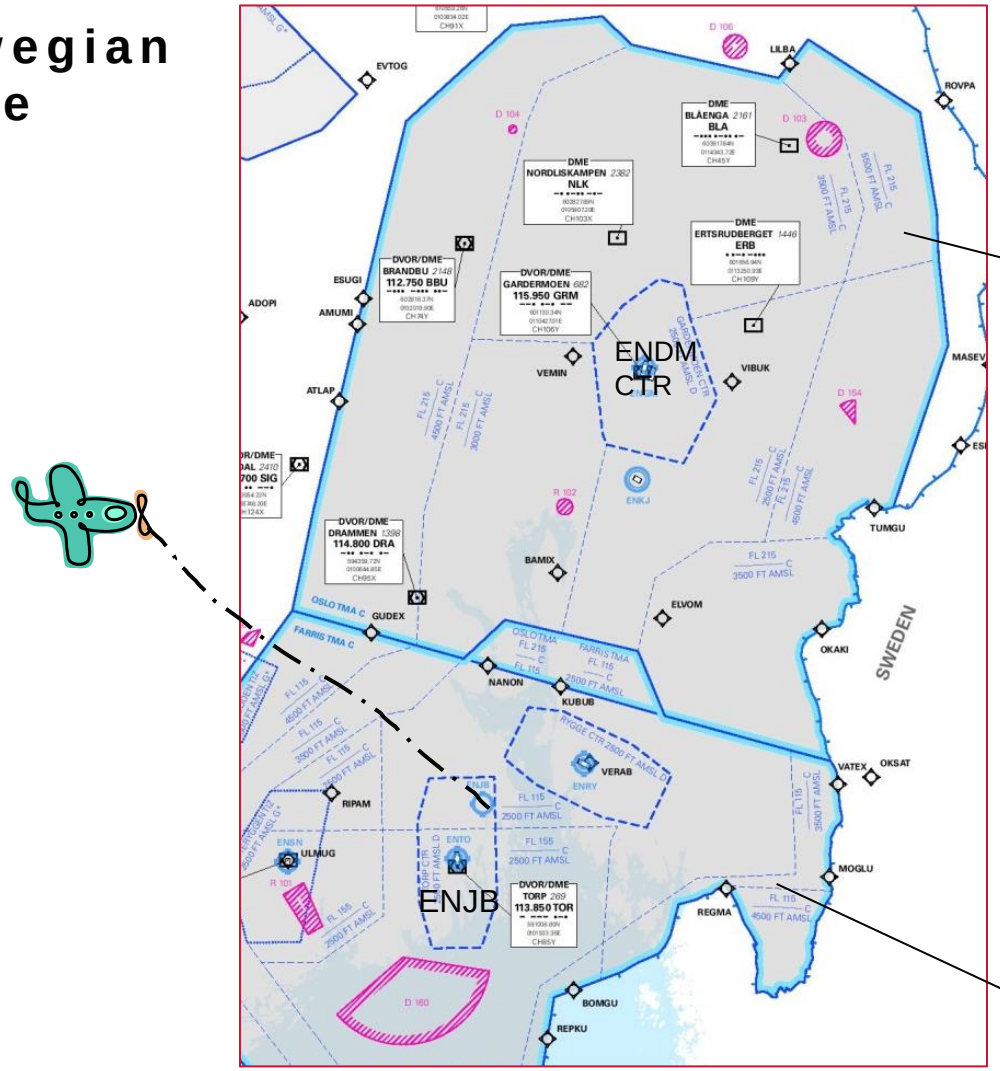
What is an Airspace Infringement (AI)?

Southern Norwegian airspace

Controlled airspace

Uncontrolled airspace



AIP Norway Avinor

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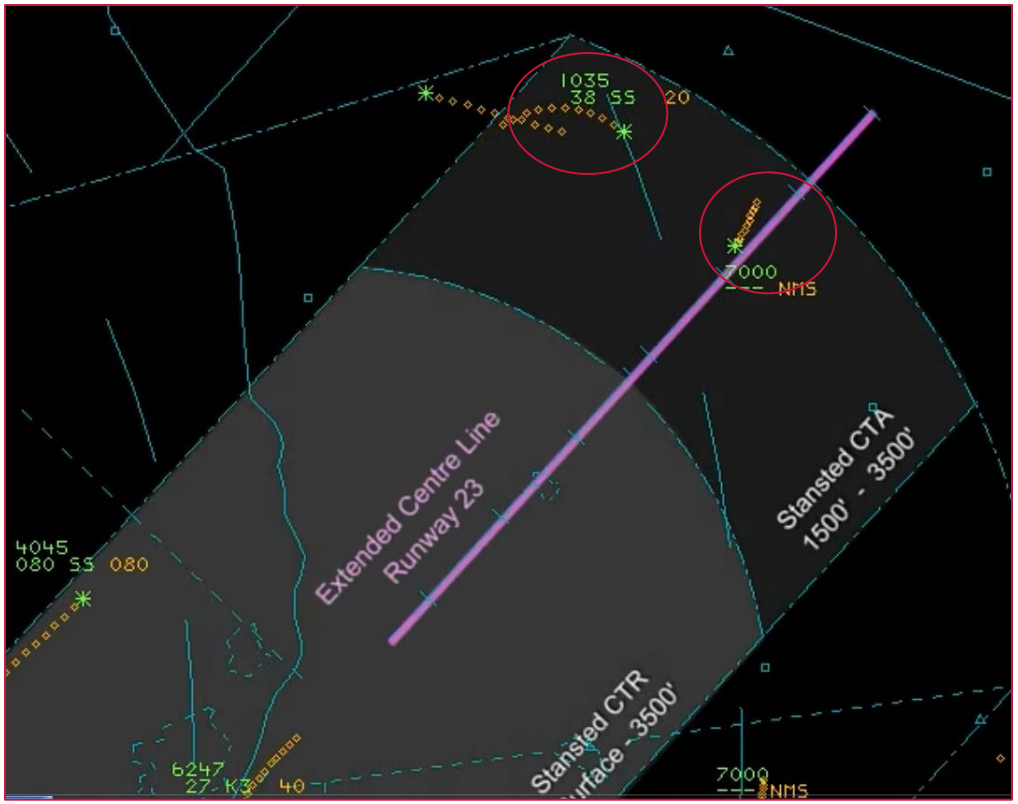
Consequences

- No problem to controllers and traffic in controlled airspace
- Delays
- Loss of separation with other traffic and high risk of a mid-air collision



FlyOnTrack Website

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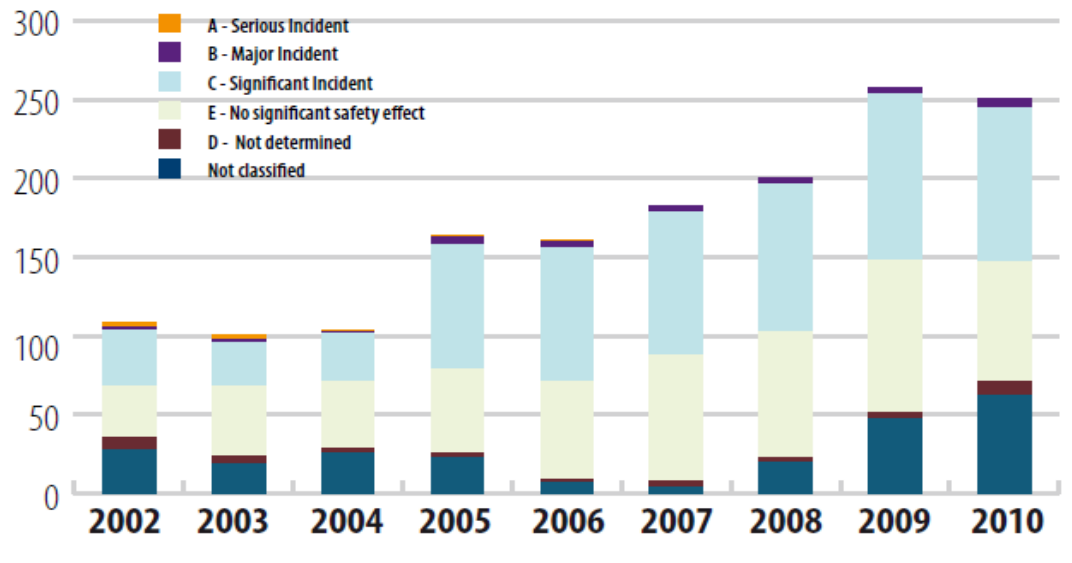
European Statistics



Unauthorised Penetration of Airspace
Occurrence per million flight hours and severity

- Frequency of incidents
- Impact on safety
- Unclassified/Not determined incidents

Safety Regulation Commission (2012)

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Studies by EUROCONTROL

	Part I: Safety Analysis of Airspace Infringements in Europe 2007	Part II: General aviation airspace infringement survey 2007	Part III: Case study Switzerland
Data			
Safety data	X		X
GA pilot survey/ discussion		X	X
Methodology			
Incident analysis	X		X
Frequency analysis	X	X	X
Severity analysis		X	X
Findings			
Detailed factors		X	
Correlations			X
Scenarios	**X**		X
Insufficient information	**X**		X

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Aims of this Presentation

Development of a robust safety analysis methodology for AIs involving GA in Europe using incident reports

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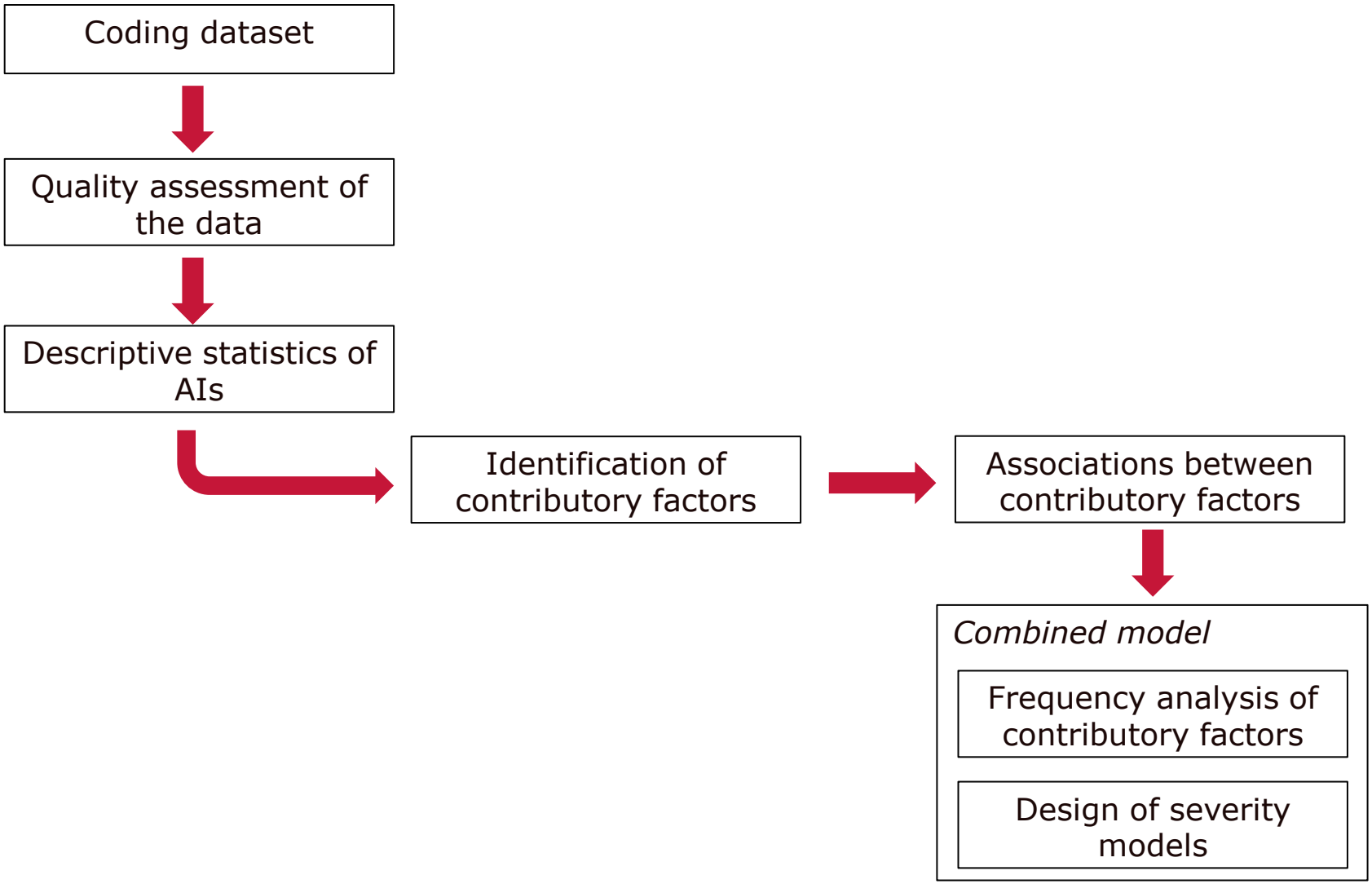
Methodology



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Avinor safety data (2008-2012)

CASE STUDY

AVINOR

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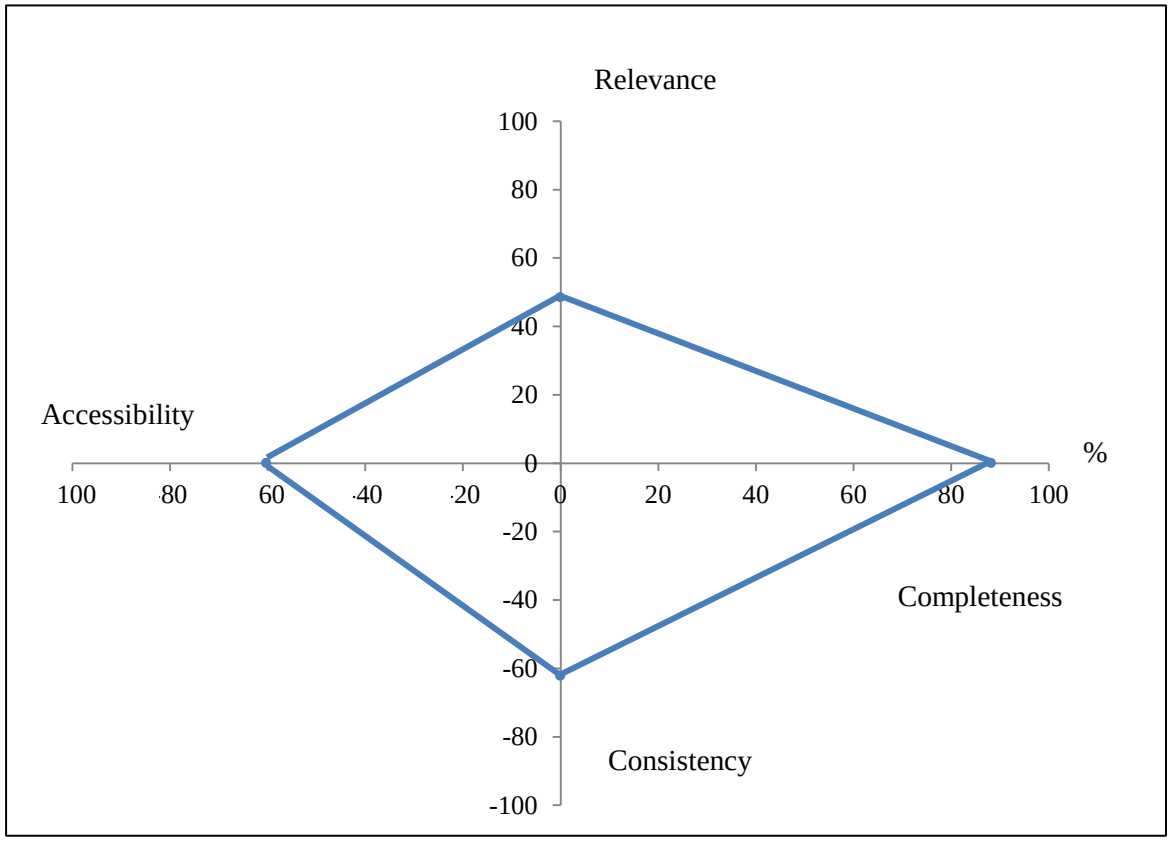
Quality Assessment



Descriptive Statistics

- 88% incidents: Infringing aircraft
- 80% incidents: GA aircraft VFR
- 75% incidents: En-route flight phase
- 54% incidents: Airspace Class D
- 31% incidents: Airspace Class C
- 70% incidents: Pilot is involved

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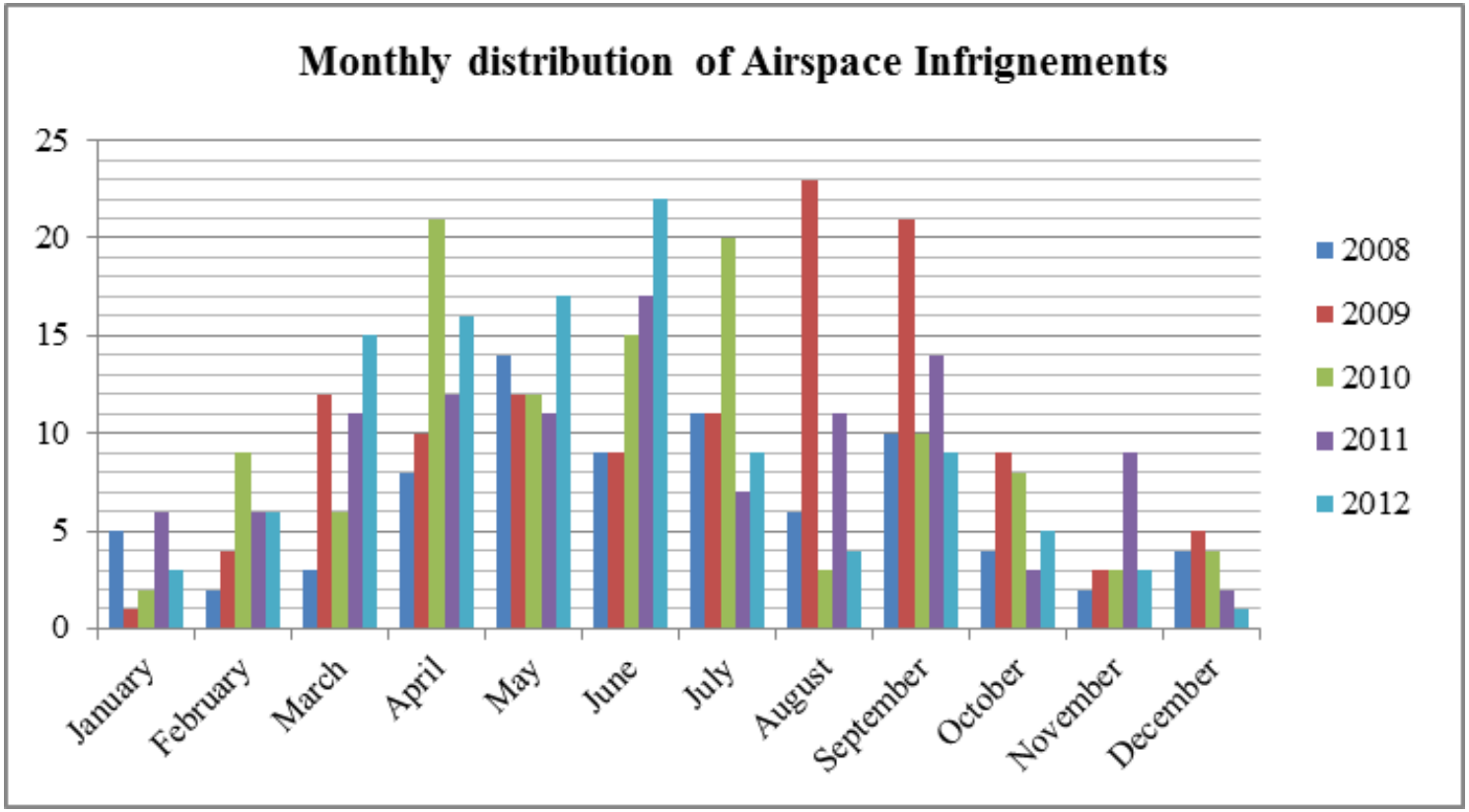
Phenomenon of Seasonality



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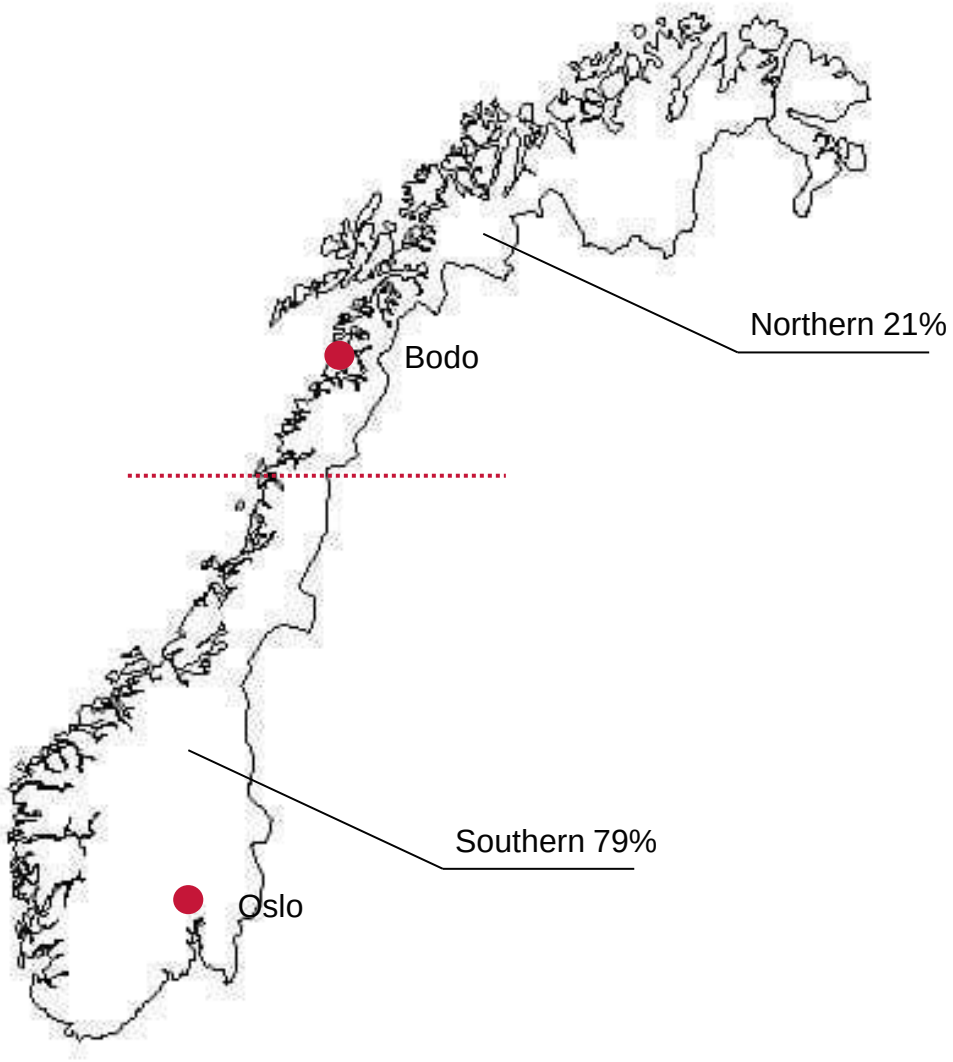
Location of Incidents



- Location related to:
  - Quality of flight plan
  - Two-way radio contact

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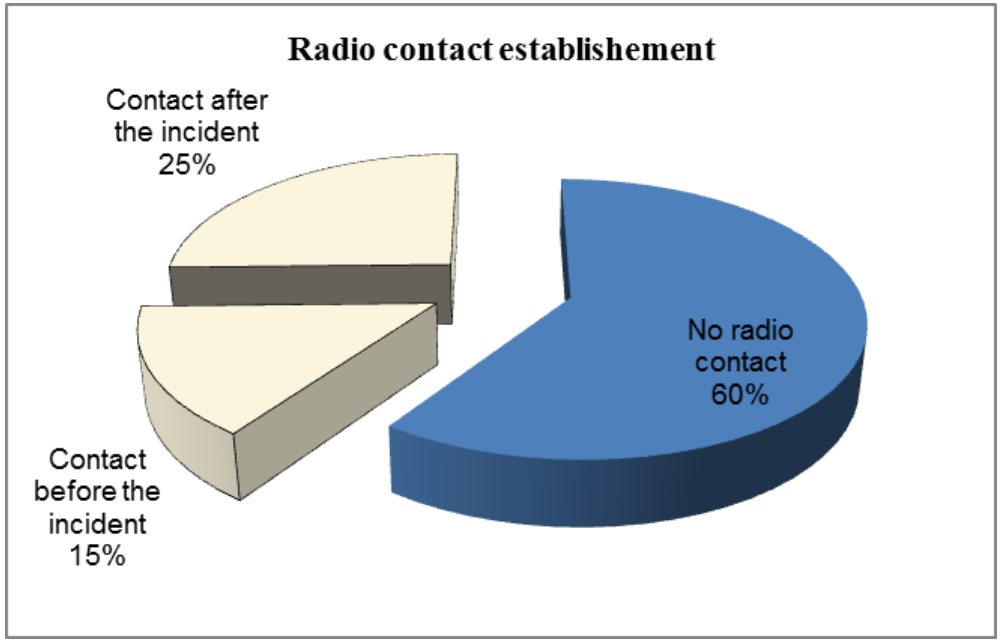
Two-way Radio Contact



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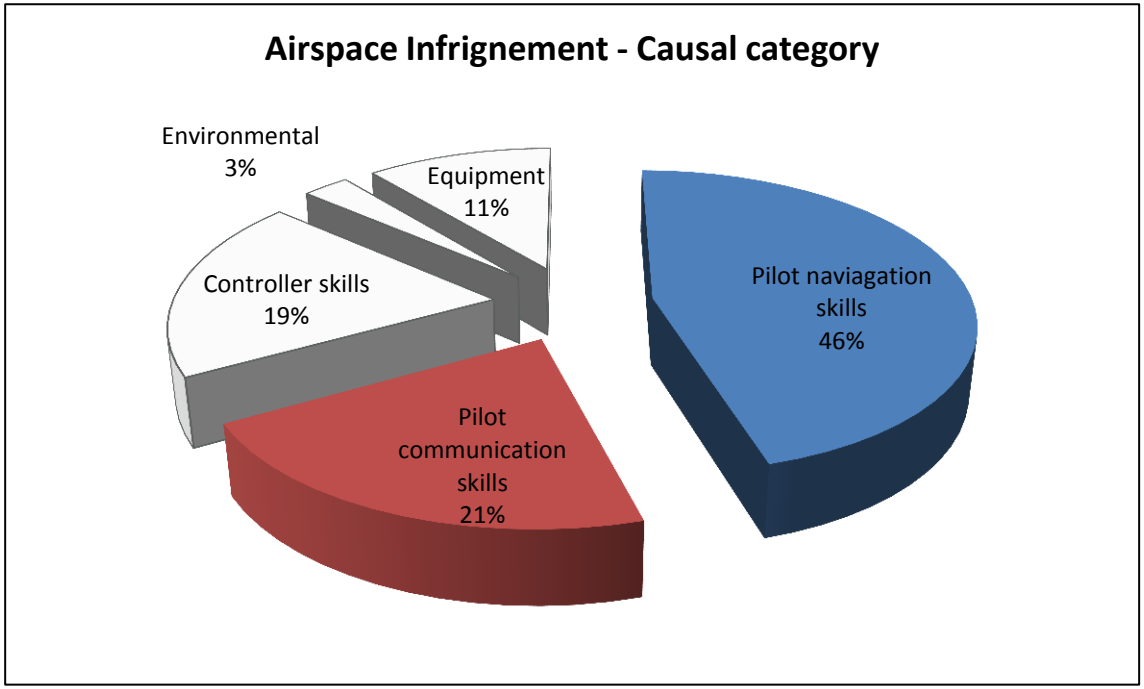
Causal Category



- Quality of flight plan
- Inadequate knowledge of navigation:
  - Airspace structure
  - Airspace procedures
  - Airspace boundaries

COMBINED MODEL

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Stage I: Ranking Contributory Factors

Ranking	Contributor	Frequency
1	**No/Poor radio contact**	**317**
2	Use of wrong frequency	68
3	No/Poor of Flight Plan	58
4	Inadequate knowledge of airspace boundaries	56
5	Inadequate knowledge of airspace procedures	49
6	Loss of awareness	47
7	Unfamiliar airspace and/or route	45

Stage II: Severity Models

- Two models:
  - Safety effect on aircraft involved
  - Safety effect on ATM
- Binary discrete choice models
- Binary depended variable = likelihood of each category (a) of variable
  - 0 “no impact” → ESARR class D and E
  - 1 “significant” → ESARR class A, B and C

$$\text{Logit}\left(P_i(\text{a})\right) = \text{LN}\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 x_1 + \cdots + \beta_k x_k \quad (1)$$

$$P_i(a) = \frac{\exp(\beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k)}{1 + \exp(\beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k)} \quad (2)$$

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Safety Effect on Aircraft Involved

Binary logistic regression model

(Level of confidence 95%)

2008-2011 data

Parameter	Value	Odds	Significance
Intercept	-0.788	0.455	0.036
Pilot is involved	1.588	**4.893**	0.004
Summer period	0.321	1.379	0.321
Location of incident (South)	0.738	**2.092**	0.007
Inadequate knowledge of airspace procedures	-0.662	0.516	0.095

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Safety Effect on ATM Service

Binary logistic regression model

(Level of confidence 95%)

2008-2011 data

Parameter	Value	Odds	Significance
Intercept	-1.984	0.137	0
Summer period	0.925	1.572	0.43
No/Poor flight plan	0.925	**2.522**	0.082
No/Poor radio contact	-0.428	1.535	0.233

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Conclusions

- Qualitative and quantitative analysis for high-quality data
- Factors related to navigation and communication skills of pilots are found in Avinor data
  - Quality of flight plan
  - Knowledge of airspace boundaries
  - Establishment of two-way radio contact
- Directly useful for *Avinor*
  - e.g. southern Norway, spring time
  - Pilot's performance when they fly near to the boundary of controlled airspace using new VFR flight planning and navigation software

- Further research
  - Understand general aviation pilot's factors by discussing with pilots, flight instructors and other stakeholders and observations

Thank you for your attention!