Augmenting aviation incident analysis with Artificial Intelligence, and the curse of dimensionality



Human AI teaming Knowledge and Understanding for aviation safety

Kirwan, B.,<sup>1</sup>, Elliott, R.<sup>2</sup> Bolger, L.,<sup>2</sup> Biliri, E.,<sup>3</sup> Koussouris, S.,<sup>3</sup> Durante, N.G.,<sup>4</sup> Wright, P.,<sup>4</sup> Newman, D.,<sup>5</sup> and Bettignies-Thiebaux, B.<sup>1</sup>

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## Our goal

is to pave the way for human-centric-AI via the exploration of interactive AI prototypes in a wide range of aviation contexts



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https://haikuproject.eu/

#### **Our challenge**

is to deliver truly human-centric Digital Assistants, capable to 'fit' the way humans work.



#### Who we are



Horizon Europe R&I Program (September 2022 - August 2025)

15 Partners from 10 different countries, bringing together Human Factors expertise, domain's key end-users and technology suppliers of excellence







#### What we're trying to do...

"The overall vision is to facilitate Al systems that **enhance human capabilities** and **empower individuals** and society as a whole while respecting **human autonomy** and **self-determination**."

We want to **augment** human performance.

# London Luton Airport is the UK's 5<sup>th</sup> busiest airport and has a good safety record. Certain incident types are however considered 'stubborn' and difficult to eradicate.



The HAIKU project was asked to see how AI could help.

# Seven years of data, half a million movements, several hundred incidents...















## But six months in, we hit a wall...



# The Curse of Dimensionality

The curse generally refers to issues that arise when the number of datapoints is small relative to the intrinsic dimension of the data.

For LTN incidents, of which there are several hundred, there are >20 aspects (dimensions) of interest (time of day, airline, congestion etc.).

Each incident must have all these aspects described, and there need to be many more incidents for effective model-building.

### Over a period of 2 years, HAIKU helped LTN move from this...

Points of	Engagement	by Company

Total

Menzies	87	32%
Azzurra / GH London	66	24%
Swissport	36	13%
Signature	5	2%
General Aviation	8	3%
Groundlink	1	0%
Wilson James	9	3%
Other	14	5%
Harrods	16	6%
LLA Security	7	3%
Wizzair	7	- 3%
World Fuel/Esso	2	1%
Easyjet	1	0%
Dnata	6	2%
Ryebridge	2	1%
Netjets	1	0%
TCR	1	0%
LLA Technical Services	3	1%



Weekly Safety Report Weekending 26th May 2024.pdf (i) Q Q (î) 🖉 🗸 🗋 🕢 🖂 Qy Search Weekly Safety report week ending: 26/05/2024 (Week 21) Airside Incidents MOR Airfield 0 Airside Collisions MOR Airspace 1 Spillages 0 **Observations** 0 Personal Injury Incorrect Taxi Routing **Red Incidents Full Emergency** 0 0 Amber Incidents Local Standby Near Miss Reports 22 Ground Incidents 0 Points of Engagement Bird Strikes (Controllable) 0 Safety Leader Engagement 25 Safety Assurance checks carried out 180 Safety Recognition Events Safety Assurance check deficiencies 2 **Top Near Misses** (5) Incorrect parking of vehicles and 1 Insecure Load equipment (0) 1 Abandoned vehicle or equipment (m) Failure to give priority to aircraft (1) (1)3 (1)

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London Luton Airport

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A safety meeting of around 25 key airport business partners in July 2023, where the Safety Dashboard was presented and discussed between the business partners and the data scientists



Stands 62 and 71 were highlighted by the data analysis as prone to taxiway error.

Stand 62 is for business jets, and many business jet pilots are unfamiliar with LTN's layout.

Stand 71 is a cul-de-sac and not as well signposted as other stands. A 'hotspot' on the taxiway system was identified. Changes were subsequently made to the airfield, including directional paint markings, new Delta/Foxtrot signage (see Figure 8) on taxiway Alpha.

There have been two incorrect taxi events in the eight months since the new signage has been installed, compared to six events in the previous eight months.



# Not the Usual Suspects...

.....

The dashboard was also very helpful to the Stack in ruling out potential factors, e.g. many business partners thought that these incidents occurred at busier times, however the dashboard showed that it was during the quieter times.

Similar results were obtained when looking at other 'usual suspects' for incident causation, such as weather (in particular, low visibility), also found not to be a strong factor.

IGHTS WITHIN 15' FROM INCIDENT				Act	ual Time and Da	ite v C		
<ol> <li>incident happened</li> <li>Datetime ↑↓</li> </ol>	I during cons A/D ↑↓	truction day Runway # ↑↓	Stand ↑↓	рах ↑↓	A/D Airport ↑↓ Code	Operator ↑↓	Flight # ↑↓	т1/ғво ↑↓
2023/11/01 14:51	D				KEF		2122	GA
2023/11/01 14:48	D	25	41L	75	GLA	EZY	651	T1
2023/11/01 14:47		25			KUN	FR	2145	T1
2023/11/01 14:45	D	25			POZ	W9	1902	T1
2023/11/01 14:42	D	25	41R	124	KIV			T1

Same day - flights/hour - Average flights/hour (all time) - Max flights/hour (all time)

AY STATUS AND AIRPORT CONGESTION



#### Conclusions

Sometimes you think you have a lot of data, but it's not actually enough for 'serious' AI.

Despite the dimensionality issue, the Dashboard has helped LTN identify actionable safety insights to reduce incident rates.

The Dashboard helps airport partners understand which factors are <u>not</u> key, so they can avoid spending resources on areas not driving incident rates.

Overall, the Dashboard is an example of Al augmenting human performance. Safety is enhanced via this human-Al partnership.