Building Back Better – Democratisation of Performance Monitoring with Open Data

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*Abstract*—The COVID-19 pandemic accelerated the use, sharing, and distribution of data on a global basis. Higher levels of transparency were achieved with continual updates of pandemic related information. The air transportation sector – while by definition an information rich industry – is a notable exception. While different organizations offered aggregated data on air traffic developments on national or airport level, complementary data on air traffic movements for further analysis is not available publicly. The advent of crowd collected open data has gained higher visibility to fill this vital gap. This paper investigates the feasibility of utilizing

This paper proposes an open approach to the operational performance monitoring of air transport. A novel performance measure to assess the level of traffic synchronization and queuing is developed. This will allow to evaluate on-going industry recovery and identify operational inefficiencies or bottlenecks.

Keywords—component, formatting, style, styling, insert (key words)

# Introduction (*Heading 1*)

The COVID19 pandemic shifted the focus and attention of political decision-makers and strategic planers over the past year. The unprecedented decline of regional and international air traffic poses challenges in terms of funding of the air transportation system in general and planned air traffic management modernization. While it is unclear how today’s travel constraints and the vaccine roll-out will play out, both airspace users and air traffic service providers are committed to “build back better.” This will include a higher emphasis on operational excellence. Higher levels of operational efficiency are considered to be enablers for reduced queueing, both in the airspace and on the ground, and lower associated fuel burn and emissions. It will be essential to ensure that with increasing traffic levels, inefficiencies are immediately tracked and remedied.

Air transportation services are by definition an information rich environment. However, today, the access and availability of open data for the monitoring and validation of air transport /air navigation system performance or related published results of studies and research exercises is limited [1][2]. Within this context, crowd collected open data gains a higher momentum and visibility. Opensky Network became a key resource for open air transport data during the COVID-19 pandemic [3]. Opensky Network provides a global flight-by-flight record of observed tracks on a monthly basis for interested researchers or practitioners [4]. For detailed studies, the associated trajectory data can be accessed via the Network resources. There is an active community establishing tools for the extraction and processing of the data. Demonstrating the feasibility and utility of using an existing open data source to assess the current air transportation system performance, and trace the development of the performance levels with returning traffic demand is vital.

The paper follows a data-driven exploratory approach. Based on the operational performance indicators promoted by ICAO, a performance monitoring toolchain is developed building on the open air transport data. The public availability of the data in a near real-time set-up ensures that independent validation of observed operational performance is available to policy makers, strategic planners, practitioners, and researchers. A novel traffic synchronization oriented performance metric is developed. The metric aims to isolate operational and airspace related dimensions or inefficiencies. The approach will be presented as use-case analysis of three European airports that show significant differences in traffic patterns and approach concepts. The analysis of the arrival management techniques will support the evaluation of the achieved performance levels in terms of ground-based or airspace holding/queueing and delay absorption.

# Building Back Better

On March 11, 2020, the World Health Organisation declared the novel coronavirus (COVID19) outbreak a global pandemic. Initial cases were reported in Wuhan, China, in December 2019, and spread rapidly around the world causing severe acute respiratory symdromes. Communicable disease control resulted in massive restrictions on international and regional air traffic and passenger travel. The unprecedented decline in air traffic demand resulted in severe financial strains on the air transport industry as revenue streams were disrupted. For example:

* Airlines reduced air transport services) to a minimum resulting in the grounding of substantial portions of the aircraft fleet due to the lack of passenger demand based on social distancing requirements, travel restrictions and bans [5][6];
* Airports had to reduce their operations, including closing down terminals and runways. The latter often to offer parking space to the grounded fleet [6][7].
* Air navigation service providers trimmed down staffing and operations in response to the decline in traffic
* Support industry (aircraft manufacturers, maintenance and servicing) had to reduce to minimum staffing or shut-down their production [9].

The financial support or lack thereof for airlines and airports has been widely covered in the media. A variety of studies showed the interplay or consequences of the travel constraints.

To date, lower attention was given to the inherent change in terms of air transport services.

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Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

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Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

## Units

* Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as “3.5-inch disk drive”.
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* Do not mix complete spellings and abbreviations of units: “Wb/m2” or “webers per square meter”, not “webers/m2”. Spell out units when they appear in text: “. . . a few henries”, not “. . . a few H”.
* Use a zero before decimal points: “0.25”, not “.25”. Use “cm3”, not “cc”. (*bullet list*)

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*a**b* 

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## Some Common Mistakes

* The word “data” is plural, not singular.
* The subscript for the permeability of vacuum **0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter “o”.
* In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
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* Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.
* Do not confuse “imply” and “infer”.
* The prefix “non” is not a word; it should be joined to the word it modifies, usually without a hyphen.
* There is no period after the “et” in the Latin abbreviation “et al.”.
* The abbreviation “i.e.” means “that is”, and the abbreviation “e.g.” means “for example”.

An excellent style manual for science writers is [7].

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**The template is designed for, but not limited to, six authors.** A minimum of one author is required for all conference articles. Author names should be listed starting from left to right and then moving down to the next line. This is the author sequence that will be used in future citations and by indexing services. Names should not be listed in columns nor group by affiliation. Please keep your affiliations as succinct as possible (for example, do not differentiate among departments of the same organization).

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Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include Acknowledgments and References and, for these, the correct style to use is “Heading 5”. Use “figure caption” for your Figure captions, and “table head” for your table title. Run-in heads, such as “Abstract”, will require you to apply a style (in this case, italic) in addition to the style provided by the drop down menu to differentiate the head from the text.

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#### Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation “Fig. 1”, even at the beginning of a sentence.

1. Table Type Styles

| Table Head | Table Column Head | | |
| --- | --- | --- | --- |
| Table column subhead | Subhead | Subhead |
| copy | More table copya |  |  |

1. Sample of a Table footnote. (*Table footnote*)
2. Example of a figure caption. (*figure caption*)

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity “Magnetization”, or “Magnetization, M”, not just “M”. If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write “Magnetization (A/m)” or “Magnetization {A[m(1)]}”, not just “A/m”. Do not label axes with a ratio of quantities and units. For example, write “Temperature (K)”, not “Temperature/K”.

##### Acknowledgment *(Heading 5)*

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

##### References

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Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it was cited. Do not put footnotes in the abstract or reference list. Use letters for table footnotes.

Unless there are six authors or more give all authors’ names; do not use “et al.”. Papers that have not been published, even if they have been submitted for publication, should be cited as “unpublished” [4]. Papers that have been accepted for publication should be cited as “in press” [5]. Capitalize only the first word in a paper title, except for proper nouns and element symbols.

For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

1. Bourgois, Marc, and Michael Sfyroeras. 2014. “Open Data for Air Transport Research: Dream or Reality?” In *Proceedings of the International Symposium on Open Collaboration*, 1–7.
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1. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
2. I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
3. K. Elissa, “Title of paper if known,” unpublished.
4. R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
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6. M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.

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