



RESEARCH ARTICLE

**REVISED** Navigating the challenges of passenger name record data and the way forward

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Christiana Aposkiti <sup>1</sup>, Freideriki Makri <sup>1</sup>

<sup>1</sup>P.Kanellopoulou Str.4, KEMEA, Center for Security Studies, Athens, 10177, Greece

<sup>2</sup>P.Kanellopoulou Str.4, Hellenic Police, Athens, 10177, Greece

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**Abstract**

**Background**

The TENACITY EU-funded project investigates the multifaceted challenges surrounding the utilisation of Passenger Name Record (PNR) data following the implementation of the PNR Directive (EU) 2016/681, which marks a significant shift in EU air travel intelligence.

**Methods**

This study employed a combination of research and survey methodologies to gather data from various stakeholders involved in the implementation of the PNR Directive. The survey focused on identifying the key obstacles faced by Passenger Information Units (PIUs), including the absence of standardised practices and issues of data quality.

**Results**

The findings highlight two primary obstacles confronting PIUs: the lack of standardised practices among stakeholders and the poor quality of PNR data. Additionally, fragmented implementation and certain regulatory barriers were identified as factors that present challenges to the optimal utilisation of PNR data for counterterrorism and crime prevention efforts.

**Conclusions**

Addressing these challenges requires nuanced solutions, with technological tools presenting potential remedies to operational

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1. **Laura Drechsler** , KU Leuven, Leuven, Belgium  
**Abdullah Elbi**, KU Leuven, Leuven, Belgium
2. **Elif Mendos Kuşkonmaz** , University of Essex, Colchester, UK
3. **Maria Tzanou** , The University of Sheffield, Sheffield, UK
4. **Niovi Vavoula** , University of Luxembourg, Esch-sur-Alzette, Luxembourg
5. **Elaine Fahey** , City St. Georges, University of London, London, UK
6. **Asif Qumer Gill** , University of Technology Sydney, Ultimo, Australia

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constraints. There is a collective call for mandating specific data elements to enhance the effectiveness of PNR data utilisation. This paper provides insights and recommendations to enhance PIUs' capabilities, contributing to the ongoing discourse on EU travel intelligence.

### Keywords

PIUS Challenges, Travel Intelligence Recommendations, Passenger Name Record (PNR), Passenger Information Units (PIUs), counterterrorism, crime prevention, EU PNR Directive, Advance Passenger Information (API)



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**Corresponding authors:** Christiana Aposkiti ([c.aposkiti@kemea-research.gr](mailto:c.aposkiti@kemea-research.gr)), Freideriki Makri ([f.makri@kemea-research.gr](mailto:f.makri@kemea-research.gr))

**Author roles:** **Aposkiti C:** Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Supervision, Visualization, Writing – Original Draft Preparation; **Makri F:** Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Supervision, Visualization, Writing – Original Draft Preparation

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**REVISED Amendments from Version 1**

In response to the reviewers comments, we made several revisions to the article. We acknowledged the methodological limitations regarding sample size and survey anonymity and provided a more detailed explanation of the sample representativeness. Suggestions for future research, such as interviews and workshops, have been added. We clarified that no studies were excluded based on methodological flaws or bias; inclusion was based on relevance to the PNR Directive and PIU operations. Minor additions on the EU historical context were made. The article more clearly communicates its focus on operational challenges faced by PIUs, rather than a broader political or historical analysis of the PNR Directive. Operational issues were emphasised further. The recommendations section was revised to clarify that suggestions for automated tools address immediate operational needs identified by PIUs, with broader legal implications reserved for future research. The legal section was expanded to address Case C-817/19 and recent EDPS opinions, while emphasising that a full legal analysis is outside the study's primary scope. We improved methodological transparency by specifying the number of survey questions, adding graphs in the Extended Data section, and informing when findings were drawn from literature rather than the survey. The absence of a formal risk or bias assessment is explicitly mentioned as a limitation, and the 'Consent to participate' section has been updated. Finally, all reviewed documents are now listed as sources, and the Conclusion clarifies that the study focuses on PIU challenges, setting the stage for future research on the legal implications of the findings.

**Any further responses from the reviewers can be found at the end of the article**

**Introduction**

The 9/11 attack signified a new era on the field of travel intelligence which refers to 'the systematic collection, analysis, and utilisation of travel-related information and intelligence to enhance security measures and law enforcement efforts' (Kanellopoulos, 2024) since it highlighted the importance of the processing of Passenger Name Record (PNR) data, which prior to the attack were mainly collected by the air carriers in a non-systematic way to book air travel reservations, to fight and even prevent terrorism and organised crime (De Hert & Papakonstantinou, 2010). The attack led to the implementation of the Aviation and Transportation Security Act in 2001 by the United States (US Government Publishing Office, 2001), which consequently opened the path of the air travel intelligence landscape as it is known today.

A few years later, the terrorist attack in Madrid in 2004 initiated the European Union's (EU) more active role in the fight against terrorism, as it adopted a stricter policy for the protection of its external borders. The EU's policy towards the prevention of terrorist attacks is underpinned by the implementation of the Advance Passenger Information (API) Directive (The Council of the European Union, 2004), and the Schengen Borders Code (The European Parliament & the Council of the European Union, 2016b), that foster the information and intelligence exchange with third countries in relation to the cross-border movement of people. The EU has undertaken additional efforts in border management embodying a multi-faceted approach to safeguarding its borders and combating

terrorism and serious cross border crime that complement the API Directive. More recently, these efforts include the Entry Exit System (EES)<sup>1</sup> and the European Travel Information and Authorisation System (ETIAS) which are not still in operation<sup>2</sup>.

In this context, the use of PNR data has been integral to the international cooperation efforts of the EU against terrorism and serious crime for nearly two decades with the implementation of the Passenger Name Records (PNR) Directive (EU) 2016/681 (henceforth "the Directive") being the cornerstone of them. The Directive regulates the use of PNR data in the European Union for the prevention, detention, investigation and prosecution of terrorist offences and serious crime and calls for each Member State to establish a Passenger Information Unit (PIU) (The European Parliament & the Council of the EU, 2016a). The PIU serves as the sole authority for collecting, storing, processing, and transferring under specific conditions PNR and API data<sup>3</sup> to other PIUs, National Competent Authorities (NCAs), Europol, and third countries. This process must fully respect fundamental rights, including privacy and personal data protection.

The European Commission's Review of the Directive (European Commission, 2020b) highlights the increasing recognition globally, not limited to EU Member States, of the utility of PNR data as a tool for law enforcement in the fight against terrorism and serious crime. Yet, the findings also showed that the implementation of the Directive faces delays and fragmentation. Data quality and accuracy were considered paramount for improving the collection of relevant data used to combat terrorism and serious crime. Despite EU legislation, variations in perception and methodologies in implementing the Directive were reported. PIUs officers outlined incomplete, inaccurate, or untimely data entry, while the 'broad' and 'relatively unclear formulation' of the Directive was considered the main reason why PIUs did not move to spontaneous transfers (European Commission, 2020a).

In this complex travel intelligence landscape, the Travel Intelligence Against Crime and Terrorism - TENACITY project<sup>4</sup> envisions to address key challenges by developing innovative

<sup>1</sup> More information on the Entry Exist system can be accessed via: [https://travel-europe.europa.eu/ees\\_en](https://travel-europe.europa.eu/ees_en).

<sup>2</sup> More information on ETIAS can be accessed via [https://travel-europe.europa.eu/etias\\_en](https://travel-europe.europa.eu/etias_en).

<sup>3</sup> As mentioned in recital no.9 of the Directive (2016/681), *some air carriers retain as part of the PNR data the API data they collect, while others do not. The use of PNR data together with API data has added value in assisting Member States in verifying the identity of an individual, thus reinforcing the law enforcement value of that result, and minimising the risk of carrying out checks and investigations on innocent people. It is therefore important to ensure that where air carriers collect API data, they transfer it irrespective of whether they retain API data by different technical means as for other PNR data.* It is important to underscore that, for the purposes of the present Article, any reference to PNR data presupposes adherence to the definitional parameters outlined within the Directive.

<sup>4</sup> More information about the TENACITY project can be accessed via: <https://tenacity-project.eu/>

tools, offering trainings, and establishing a holistic approach to prevent and fight terrorism and crime through travel intelligence. The present document reports on the findings of a survey conducted in the context of the TENACITY project, that was addressed to the PIUs, one of the main actors of today's travel intelligence, with the aim of identifying key challenges in the transmission, collection, and processing of PNR data. Based on the outcomes of the survey, the present report also provides a list of recommendations that could pave the future of the processing of PNR data by enhancing the capabilities of the PIUs. As such, the document seeks to contribute to the existing literature concerning travel intelligence within the European Union, which currently remains somewhat limited in scope and depth. While this article aspires to provide insights on the operational effectiveness of the PNR directive, it does not move to a comprehensive analysis of the various historical and political aspects that are related to the adoption and implementation of the directive.

## Methods

In the context of the TENACITY project, it was considered necessary to deliver an in-depth analysis of the current state of play of the processing of PNR data in European countries. To do so, the Centre for Security Studies (KEMEA) provided an analysis - as presented in this article - based on a survey that took the form of a questionnaire and was circulated, from early December 2023 to early February 2024, through the EU Survey platform, to all PIUs participating in the TENACITY consortium and the EU PIUs. Fourteen PIUs replied to the survey<sup>5</sup>. The participation to the survey was anonymous in order to protect the privacy and personal data of the respondent, whose role within their PIU varied from analysts, shift leaders, carrier connectivity experts, operators to officers, heads of the PIUs, and directors. Unclear or missing information were not taken into consideration. Due to the 'anonymous' nature of the survey, the researchers were not able to contact the respondents for any clarification needed. The limited access to participants is a common hurdle when the research targets security actors (Glouftsiou & Leese, 2023). While the findings presented herein reflect the opinions of the surveyed PIUs, it is noteworthy to stress that, yet upon identifying challenges, the participating PIUs within the TENACITY project affirmed the presence of similar issues among their counterparts in other nations. Furthermore, the survey results broadly align with the report on the review of PNR Directive (European Commission, 2020b), which takes into consideration all EU PIUs.

Inclusion criteria for the review encompass research studies, reports, and evaluations specifically focused on the implementation of the PNR Directive and Passenger Information Units (PIUs), incorporating both qualitative and quantitative

methodologies such as surveys, interviews, case studies, and observational studies. Systematic reviews and meta-analyses that provide data on PIUs are also included. Studies must be published in English, or in other languages if translation resources are available. The article's primary scope is to present the results of a survey with EU PIUs in the context of the TENACITY project, along with some findings occurred from their analysis. Although existing literature has been used, and cited accordingly, to support the analysis of the results, the article does not include an exhaustive review of the relevant literature.

More specifically, the survey aimed at the identification of i) the level of implementation of the technical solutions to process PNR and API data, ii) the technical solution developed, and iii) the user and system requirements and challenges faced by PIUs. Questionnaires have been widely used to collect data from stakeholders and thus they constitute the backbone of any survey (Roopa & Rani, 2012). Although questionnaires are usually used to collect primary quantitative data (Reja *et al.*, 2003), the present survey targeted the extraction of both quantitative and qualitative data. In this respect, the survey consisted of sixteen (16) open and closed questions. The quantitative data were analysed by using graphs, that can be found in the 'Extended data' section.

The data collected from the survey were analysed to provide a thorough picture of the state-of-play of the PIUs. The data collected related to the challenges faced by the PIUs were analysed and resulted into the identification of six areas of challenges: i) data transmission, ii) collection of data, iii) data quality, iv) data analysis, v) staff matters, and vi) legal matters. Each category of challenges integrates various gaps that are presented in the following section.

## Limitations

Several limitations must be acknowledged. To start with, despite the sample size offering a diverse mix of roles and functions, it can be considered as relatively small (14 PIUs). In addition, the anonymous nature of the survey, restricted the authors' ability to seek any clarifications and follow up questions. Still, receiving replies from a broad range of positions, from analysts to directors, gave a broad view of the operational and technical issues the PIUs are facing. Moreover, confidentiality prevents the authors from mentioning explicitly which responses came from EU or third-country PIUs, yet it must be noted that the challenges that are referred to in this article appear to be widely shared across various PIUs.

Second, one significant limitation of this study is the absence of a formal risk of bias assessment. No standardised tools were used, and no reviewers were assigned to independently evaluate bias. Readers should approach the results with caution, acknowledging that unidentified biases in the included studies could influence the overall conclusions. To strengthen future research, it would be helpful to use more thorough methods for assessing bias, to enhance the robustness of findings. Future research would also benefit from including interviews

<sup>5</sup> Due to confidentiality considerations and the discretion required regarding the origins of responses, the authors have opted not to disclose whether the replies received originate from European Union Passenger Information Units (PIUs) or from third countries.

or workshops with PIU representatives to explore these topics in more depth.

## Results

The current section concentrates on the challenges and issues PIUs are tackling while implementing the PNR directive, without providing a comprehensive analysis of the relevant regulations that frame their function. Most of the challenges were identified throughout the process of the data collected and handled by the PIUs, that is from the data transfer phase to the data collection, the data analysis, and the data quality. Apart from operational issues, the participants to the survey identified also technological, procedural, organisational and internal problems as well as several aspects of a legal nature. All of the challenges listed below are based on the survey results and occasionally are complemented with existing literature findings.

### Data transfer

One of the most important challenges the PIUs are facing is related to the field of data transmission. Under the Directive, the custodians of the PNR data are the PIUs to which the air carriers shall transfer PNR data. Following their processing, the PIUs may transfer PNR data or the results of their analysis to the national competent authorities, to the PIUs of other Member States, and to Europol (The European Parliament & the Council of the European Union, 2016a). On a case-by-case basis Member States may also exchange PNR data or the processing results with third countries.

From the early 1990's inception of collecting passengers' data to use them in the fight against terrorism, the need of following a standardised approach became evident (World Customs Organisation, 2015). Understanding the gravity of the risks, the World Customs Organisation (WCO), the International Air Transport Association (IATA), and afterwards the International Civil Aviation Organisation (ICAO) developed a series of standards to support advance submission of passenger data. Amongst others, the WCO/IATA/ICAO<sup>6</sup> standards offer guidelines for the transmission of PNR data from air carriers to the PIUs. Similarly, the implementation of the EU PNR Directive and the establishment of common protocols and formats in order for air carriers to transfer PNR data to PIUs (European Commission, 2017) follows the same approach. Indeed, the implementation of a standardised procedure for data transmission has multiple benefits for both the air carriers and the PIUs. These benefits include faster data analysis and checking across the various databases, improved compliance by air carriers, lower costs for both airline companies and governments, and system harmonisation (World Customs Organisation (2015).

However, the survey showed that, even with the existing standards, the PIUs are facing data standardisation issues. First of all, it should not be taken for granted that all the actors

involved in the PNR/API data transfer implement existing standards. According to the survey, some air carriers may not support automated transmissions of PNR data, which makes the data collection and data management process more complicated. The lack of automated means does not necessarily lead to a complete lack of data, but it may result in delays, errors, or data of low quality, which consequently affect the PIUs' effectiveness and operational capabilities to identify threats. Secondly, the EDIFACT PNRGOV (International Air Transport Association, 2016), which is the standard for PNR data transmission, is a standard message and not a standard content, which implies difficulties in managing them due to possible variations in the format or duplications (World Customs Organisation, 2015). As such, these related to data transmission challenges have implications on both the collection and quality of the data. While these issues do not necessarily amount to non-compliance with the EU PNR Directive, they highlight operational gaps and the need for rigorous mechanisms that will ensure the common application of standards across all stakeholders.

As above mentioned, according to the Directive, the PIUs shall be responsible for i) the PNR data collection from air carriers, their process and transferring of those data or processing results to the competent authorities, and ii) the exchange of those data and processing results with other EU PIUs and with Europol. Yet, challenges arise in both processes. Regarding the transmission of PNR data to NCAs, several respondents mentioned that problems arise as some Member States do not obtain secure channels to transmit them.

Regarding the exchange of data from PIU to PIU, the Directive identifies two cases: i) a PIU may transfer data on its own initiative to another PIU, or ii) after receiving a request from another PIU. In the former case, in which a PIU spontaneously transferred PNR data to another PIU, were limited, with a significant number of Member States to have never spontaneously transferred data to another EU PIU (European Commission, 2020b). As for the latter case, the analysis of the survey results pointed out the challenge of the increasing number of requests, and thus, the increasing workload of the PIUs. Specifically, the practice of sending broad and unspecified requests to more than one PIU was highlighted together with the need of the PIUs to check the data and information collected against databases ahead of sending a request to another PIU. In addition to that, the respondents to the survey indicated that not all PIUs are using the agreed PIU-PIU template to request data, which has been used by the majority of Member States in an effort to facilitate the exchange of PNR data (ibid.).

### Collection of data

The PIUs are becoming more and more operational and some, being in a more advanced position than others, mentioned that they often lack the necessary technological infrastructure to efficiently handle the vast amount of PNR data generated by air travel. The volume of data generated can overwhelm outdated systems, leading to delays and inefficiencies in processing critical information. PIUs may lack access to advanced

<sup>6</sup> More information are available here: <https://www.wcoomd.org/en/topics/facilitation/instrument-and-tools/tools/api-pnr.aspx?p=1>

technologies that facilitate large-scale data analysis. Without access to tools such as machine learning algorithms and big data analytics platforms, PIUs struggle to effectively process and analyse the vast amount of PNR data at their disposal.

Moreover, the acquisition of PNR data from travel agencies presents significant challenges attributable to a combination of logistical hurdles and several legal complexities (as explained under the section “legal matters”). Non-carrier economic entities, notably travel agencies and tour operators, may frequently deviate from the standardised data formats typically adhered to by air carriers. Consequently, this variance often culminates in incomplete datasets, thereby impeding the thoroughness of threat assessments.

According to Article 6 par. 2 of the Directive during the passengers’ assessment before their arrival or departure (a), The PIUs have the mandate to compare PNR data against databases on the grounds of terrorism and serious crime prevention, detection, investigation, and prosecution, always in line with existing EU, national, and international rules ([The European Parliament & the Council of the European Union, 2016a](#)). However, from the replies received, the PIUs mentioned that they often face difficulties in establishing efficient connectivity with other databases, limiting their ability to cross-reference PNR data with other relevant information sources. This lack of integration hampers the effectiveness of security measures and compromises the ability to detect potential threats.

Lastly, the establishment of a reliable link between new and historical flights of the same individual poses a significant challenge for PIUs. Without efficient mechanisms in place to track individuals across different flights, identifying patterns of suspicious behaviour becomes increasingly difficult.

### Data quality

Another major challenge the PIUs are facing is that of the poor data quality. The quality of the data collected by the PIUs refers to representativeness, completeness, accuracy, and consistency of the data. The PIUs have to deal with the poor quality of data for various reasons. Usually, the passengers book their airline tickets on their own or through a travel agency. The respondents to the survey indicated regular ‘misspellings’ as an important issue which affects the data accuracy and completeness. In most cases misspellings are not done intentionally by the passengers or the travel agents, in order to hide a criminal action ([Glouftsiou & Leese \(2023\)](#)).

Regarding the completeness of data, the optional nature of certain passenger data also impacts data quality. It should be clarified that airline companies are not legally bound to validate the data they are collecting. ANNEX I of the Directive lists the data that, if collected by an air carrier in the normal course of their business, they should be transmitted to the PIUs, data like the dates of travel and travel itinerary, ticket information, contact details, travel agent, payment information, seat number, and baggage information are collected ([European Commission, n.d.](#)). Based on the findings of the survey and review report on the implementation of the Directive ([European Commission, 2020a](#)), it has been underscored that certain data

categories must be mandated for collection by air carriers, with date of birth being deemed the most important. Furthermore, in addition to non-mandatory data collected, the absence of validation procedures prior to their acquisition from PIUs introduces inaccuracies. For instance, it is prevalent for travel agents to provide their contact details instead of those of the passengers during ticket booking. The responses received revealed that the PIUs face significant challenges related to both data quality and data processing limitations. On the data quality side, common issues include inaccuracies like misspellings and missing information, undermine the completeness and accuracy of the datasets available to PIUs. On the data processing side, the challenges occur due to the fact that there are no automated technological solutions that validate the quality of the data received. This results to manual verification, which adds extra workload on the PIU personnel and might cause delays in operational workflows. While these processing challenges do not directly impact the quality of the data itself, they do make it much harder for PIUs to manage and make use of PNR data effectively

To face the challenge of poor data quality, several PIUs cross-validate PNR data with data and information from other sources, most notable the API data, when applicable ([Glouftsiou & Leese, 2023](#)). Even though, the API data are considered more accurate, their collection is not mandatory for intra-Schengen flights, and the fact that ID’s checks are not always conducted at the airports, diminish the potential of leveraging from the cross match between API and PNR data. Against this background, the possible adoption of the EU Regulation ([European Commission, 2022](#)) 2019/818, is anticipated to address several data quality issues encountered by the PIUs and thus minimise the security gaps that they are currently facing with.

### Data analysis

Another factor that impacts both the quality and the subsequent analysis of the data collected is that of different PNRs for the same trip. Even though the Directive includes the ‘split/divided PNR information’ in the PNR data, it does not include the ‘linked PNR information’. The ‘split/divided PNR information’ refers to the process of dividing a PNR record locator into two or more, so as to handle the reservation separately, while the linked PNR is the process of connecting a PNR locator with another PNR locator. The latter is usually conducted upon request from the passenger or the travel agent in order for the passengers to sit together in the plane. Apart from that, it is possible for travel agents and passengers that are flying together to book separate tickets and not link them at all. While seemingly innocuous, this practice may obscure vital information from PIUs.

The capabilities of the PIUs are also affected by the practice of ‘broken travels’. Broken travels include multi-stage routes that combine many different modes of transport and is a technique highly preferred by terrorists for entering EU ([Hornak, 2015](#)). Currently, the EU PNR Directive only covers the collection and processing of passenger data from air carriers, which limits PIUs’ ability to get a full picture of cross-border movements, in particular when other modes of transport are

used. This gap is a limitation of the Directive itself, as it does not currently apply to other modes of transport. PIUs echoed this concern in their survey responses, highlighting that while the current framework is effective for air travel intelligence, it leaves significant gaps when individuals use disconnected legs of travel to potentially hide their movements. PIUs noted that without access to data from other modes of transport, it becomes much harder to spot suspicious travel patterns. Addressing this gap would mean expanding the Directive to include multi-modal travel data collection and integration, ensuring a more robust and holistic approach to travel intelligence.

### Staff matters

Since the adoption of the Directive ([The European Parliament and the Council of the European Union, 2016a](#)), there has been a notable increase in the operational functionality of EU PIUs leading to one significant challenge, which is the efficient management of the vast amount of PNR data generated by air travel. The operational efficiency of PIUs is influenced by various factors, such as technological advancements and staff training. While some units have made significant strides in these areas, others lag behind due to resource constraints or organisational limitations. At the same time, several PIUs highlighted the need for trainings in data analysis, which is crucial for extracting insights from PNR data in order to also develop robust targeting rules. Without proper training, staff may struggle to effectively utilise available resources, leading to gaps in security.

### Legal matters

Lack of reciprocity with third countries further complicates efforts to effectively process PNR data. As highlighted in the Staff Working Document on Review of the Directive ([European Commission, 2020b](#)), the intensification of requests for PNR data from third countries, not having a respective PNR Agreement with the EU, has, in some cases, led to retaliatory measures. For instance, reports indicate that certain third countries have directed their national airlines to cease PNR data transfers to the EU Member States, thereby affecting the implementation of the Directive and creating potential security risks. Additionally, air carriers may face conflicts of laws between EU data protection regulations and requirements from destination countries, potentially resulting in sanctions. It was thus considered imperative, from several PIUs, to introduce a comprehensive international cooperation strategy to facilitate the transfer of PNR data to and from EU countries, fully respecting fundamental rights.

In their survey responses, PIUs highlighted that they are facing challenged in adapting their operations to the evolving legal requirements - especially following the CJEU's ruling in Case C-817/19 ([Court of Justice of the European Union, 2022](#)). This judgement reinforced the need for strict necessity and proportionality when retaining PNR data. In practice, this means that PNR data can only be retained beyond the initial six months, if there is clear, objective evidence of a real risk linked to terrorism and serious crime. Moreover, the judgement makes a distinction between intra and extra EU

flights requiring Member States to provide justification on the collection of PNR data for intra EU flights, with clear evidence of necessity and proportionality. PIUs have highlighted that this distinction poses additional operational challenges, as it necessitates a careful balancing of public security needs with fundamental rights, including privacy and data protection.

Last, the judgment also emphasised the need for meaningful human oversight in the use of automated systems for PNR data processing, however, PIUs have raised concerns about how transparent and reliable these systems are, stressing the need for clear guidelines to align with these legal standards. In addition, recent EDPS opinions on PNR agreements with countries like Canada ([EDPS, 2024](#)), Norway ([EDPS, 2023a](#)), Iceland ([EDPS, 2023b](#)), and Switzerland ([EDPS, 2023c](#)) have provided guidance, particularly on compliance with EU standards for data retention, oversight, and proportionality. While these opinions offer a framework for international data-sharing obligations, they also highlight the ongoing complexities faced by PIUs in meeting both operational and legal requirements<sup>7</sup>.

### Recommendations

Although it is the PIUs that have mainly to deal with the above-mentioned challenges, their resolution requires a collaborative effort amongst policymakers, security practitioners, and industry to develop and promote innovation. Notably, technological advancements can enhance the operational capabilities of the PIUs, but their deployment is not sufficient to solve core problems. Based on the results of the survey, the present section presents a series of recommendations to fill the capability gaps of the PIUs that pertain to the technological, political, legal sphere. These suggestions are presented as initial steps that aim to enhance PIUs operations based on the challenges identified. Although the current article does not include a comprehensive analysis of the legal and operational implications their implementation may bring, future research could step on them to further explore the various aspects of their adoption.

### Validation of the data quality prior to their transmission to the PIUs

As previously described, the air carriers are not responsible for the validation of the data provided by the passengers. This implies that the passengers may provide information that is not verified until their collection from the PIUs, causing informational gaps and operational obstacles. An effective validation mechanism could enhance the data quality without causing additional cost to the air carriers. This mechanism shall have at its core tools that automatically validate the quality of the data and in case of mistakes, misspellings, or missing data do not allow the passenger to move to the booking of an airline ticket. In combination with the automatic verification of the contact details provided in the ticket reservation, this mechanism could significantly enhance the PIUs capabilities. The new provisional agreement on air passenger data moves towards

<sup>7</sup> For further insights into the legal aspects of PNR data regulation, see [Vogiatzoglou et al. \(2020\)](#), [Thönnies & Vavoula \(2023\)](#), and [Gerards \(2023\)](#).

this direction as establishes the automated data-collection and verification mechanisms to guarantee the accuracy of the data (The Council of the European Union, 2024).

#### Automation of data quality controls

Contrary to the previous recommendation which refers to the quality control prior their transmission to the PIUs, this recommendation refers to the validation of the data quality upon their collection by the PIUs. Some survey participants mentioned some tools that conduct data quality controls, but they are insufficient. This lack of automated data quality controls to check for possible errors, misspellings, invalid data poses a huge workload to the PIUs which they have to check manually the data transmitted by the air carriers. The development and deployment of tools that can automatically validate the data quality and detect mistakes or fields that have not been filled correctly could minimise the heavy workload of the under-staffed PIUs. In a subsequent step, the detected errors could be used to generate error reports per air carrier so as to inform the latter respectively.

#### The development of automated tools that will generate rule suggestions based on previous hits

A recommendation stemming from the development of automated tools generating rule suggestions based on previous hits is to prioritise the refinement and enhancement of these automated systems. By leveraging advanced machine learning algorithms and data analytics, these tools can analyse historical hits or encounters, as well as feedback and validation from the PIU's operators, thereby generating more accurate and effective targeting rule suggestions over time. The establishment of mechanisms for real-time feedback and validation from the operators will be essential to ensure the relevance and reliability of the generated rule suggestions. Those suggestions, that will include detailed explanations on the utilized criteria and relevant weights, could then be manually reviewed and potentially fine-tuned by the PIU experts and analysts and transformed into actual rules, that could be activated upon successful evaluation for a given time period. This process of refinement will not only enhance the efficiency and effectiveness of targeting efforts but also enable the adaptation to evolving threats and changing operational environments.

#### Standardisation of data transfers to third countries and to Competent Authorities (CA)

In order to enhance data transfers between PIUs and third countries, several steps can be taken. Firstly, leveraging EU Security Research initiatives is suggested as effective starting points for involving PIUs and standardizing data sharing practices. However, it is emphasized that additional funding is imperative to sustain and expand such endeavours. Secondly, there is a consensus among multiple PIUs on the necessity to establish uniform and secure channels for data exchange, particularly with third countries and NCAs. While some PIUs currently rely on email for data transfer, many advocate for the implementation of automated solutions to streamline this process. Thirdly, it has been proposed to revise existing data exchange methods, such as the excel template utilised for sharing passengers' data via Europol's SIENA message system

(Europol, 2022). Suggestions include incorporating drop-down menus to minimize errors and enhance efficiency in data transmission. These recommendations aim to facilitate smoother and more secure data transfers, thereby improving collaboration and information exchange among relevant stakeholders.

#### Standardisation of transfers of data from non-carrier economic operators

The operational value of the collection of the information from non-carrier economic operators, like tour operators and travel agencies was highlighted in the review of the implementation of the Directive (European Commission, 2020a). A recommendation for the standardisation of transfers of data from non-carrier economic operators is to establish clear and uniform protocols and guidelines for data transfer processes. This entails developing standardised formats, protocols, and encryption methods to ensure secure and efficient transmission of data between non-carrier economic operators and PIUs. Additionally, providing comprehensive training and support to non-carrier economic operators on data protection regulations, privacy safeguards, and compliance requirements will be crucial to ensure adherence to established standards, EU, and national legislation. By promoting consistency and coherence in data transfer procedures, standardization efforts can enhance interoperability, streamline operations, and mitigate potential risks associated with data breaches or inconsistencies, ultimately contributing to more effective and harmonized security measures across borders.

#### The collection of specific passenger's data elements shall become mandatory

In light of the current voluntary nature of the collection of PNR data as outlined in Annex I of the Directive and considering that air carriers are expected to transfer data collected in the normal course of their business, exists a potential challenge regarding data availability. To address this, it is recommended that certain key data elements are made mandatory for collection by air carriers. These mandatory data fields should include but not be limited to: date of birth, contact details, API, payment method, date of booking, final confirmation on the boarding status of passengers indicating whether they have boarded or not, itinerary details, information regarding travel companions when applicable, and document information, including number, issuance country, expiration date, and citizenship. Ensuring the mandatory collection of these data elements would enable analysts to have a comprehensive dataset necessary for conducting thorough assessments. This recommendation is crucial for enhancing the overall quality and completeness of the data available for analysis and decision-making within the aviation security domain.

#### Expansion of the PIUs' mandate to other modes of transport

It is recommended that the European Union and its Member States adopt a unified and coordinated approach towards the expansion of travel data collection beyond air carriers to include other modes of transport such as maritime, trains and buses, in full compliance with the principle of proportionality and necessity. This holistic approach is essential for enhancing

cross-border cooperation in combating terrorism and serious crime, as it ensures security measures cover multiple transportation modes, reducing the potential for individuals to exploit gaps in information sharing. By extending collaboration among PIUs to encompass various modes of transport, security analysts can obtain a more comprehensive view of a traveller's journey, thereby minimising operational gaps posed by "broken travels" and indirect routes. Additionally, this unified approach streamlines efforts, reduces duplication of resources, and fosters public confidence in passenger safety and security. Towards this direction, (The Council of the European Union, 2019) to explore the necessity and feasibility of collecting, storing, and processing of PNR data from cross-border forms of transport other than air traffic the Council of the European Union, is moving towards the right direction has already made recommendations, indicating progress in the right direction.

## Conclusions

The survey conducted in the context of the TENACITY project showed the diverse nature of the challenges that accompany all the phases of the PNR data processing, from the transfer phase to the collection, and process phase. The present study focused on the operational effectiveness of PIUs, taking a closer look at the broader goals of the PNR Directive would be a worthwhile direction for future research. The lack of commonly used standards by all the involved stakeholders and the poor data quality can be placed at the base of the challenges faced by the PIUs that cause a 'domino effect' to their operational capabilities. Consequently, there is a collective desire for certain data elements to be mandated for collection by air carriers, such as passengers' dates of birth. It is noteworthy though that the nature of the challenge may differ from the nature of a possible solution. For example, most of the PIUs participated to the survey stated that the existing technological tools cover a big part of their operational needs, yet a possible solution to the lack of personnel to deal with the heavy workload, could be the development of automated tools to perform quality controls to the PNR data received. Moreover, while some PIUs are currently processing PNR data from carriers lacking automated transmission capabilities, the availability of datasets for comparison remains limited. This challenge extends to PIUs collecting PNR data from other modes of transport.

The Directive has marked air travel intelligence in the EU and put the PIUs in the centre of it. Its review showed the

significant added value of their creation and operation in the field of travel intelligence, and crime and terrorist prevention. Therefore, it is important to explore the ways on how they can be evolved in the future and by extension to further support travel intelligence strategies. The identification of key challenges confronting PIUs serves as an initial step in this trajectory, paving the way for informed enhancements and ensuring the continued efficacy of travel intelligence initiatives in full respect of fundamental rights.

## Consent to participate

All participants provided informed consent by filling an online information sheet and consent form for participation in the survey conducted as part of the TENACITY project.

## Data availability statement

The sensitive nature of the TENACITY project necessitates strict restrictions on the disclosure of survey data. Making the survey data openly available poses significant security and privacy risks, as it could potentially compromise the confidentiality of respondents and reveal sensitive operational details of Passenger Information Units. Access to anonymised survey data will be granted on a case-by-case basis, subject to the approval of the Security Advisory Board of the TENACITY project. Interested readers and reviewers may request access by contacting the authors via email.

## Extended data

Zenodo: TENACITY, Navigating the challenges of passenger name record data and the way forward

DOI: <https://doi.org/10.5281/zenodo.12743146>

Aposkiti & Makri (2024).

This project contains the following underlying data:

Questionnaire

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## Acknowledgements

Dimitrios Stavropoulos, Ilias Stavropoulos, Dimitrios Fylladakis, Konstantinos Tiganis, Hellenic Police.

Writing - Review and Editing

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# Open Peer Review

Current Peer Review Status:      

## Version 2

Reviewer Report 30 August 2025

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**Asif Qumer Gill** 

University of Technology Sydney, Ultimo, Sydney, Australia

Based on the review of the revised version and also the previous revision and comments. There are major flaws that may be fixed via just revision.

1. Sample size of 14 is not adequate of making any kind of substantial claims. This has been acknowledged in the limitations, however, this is major limitation and undermine the meaningful quality of the contribution. Research may consider conducting additional research.
2. Similarly, limitations acknowledge the lack of bias testing. However, given the details about the data and how was it interpreted are not clear, thus, it is extremely difficult to establish the research contribution.
3. There needs to be a separate section on "Research Buckhound and Related Work" before the research method section. This is important to justify the need for research via comparison with similar or related studies.
4. An appropriate research design model and a set of hypothesis can be defined using some theoretical lens.

**Is the work clearly and accurately presented and does it engage with the current literature?**

Partly

**Is the study design appropriate and is the work technically sound?**

Partly

**Are sufficient details of methods and analysis provided to allow replication by others?**

Partly

**Are all the source data and materials underlying the results available?**

No

**If applicable, is the statistical analysis and its interpretation appropriate?**

No

**Are the conclusions drawn adequately supported by the results?**

Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Please see my earlier comments.

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.**

Reviewer Report 29 August 2025

<https://doi.org/10.21956/openreseurope.21857.r54577>

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**Elaine Fahey** 

The City Law School, City St. Georges, University of London, London, England, UK

The article is difficult to follow as to its aims and methods and employs a variety of headings that could be better explained. Although it was a deserving study to be undertaken for its public importance, the scientific presentation of the challenge to be studied and the outcomes of the empirical work were complex to understand. The disciplinary norms governing the analysis of the data were not clearly stated. It is difficult to see the legal research question to be studied. The study was a primarily empirical study of the use of PIU data. It was difficult to follow the thread of its logic and methods in the absence of any form of presentation of data intelligibly. The place of security institutes and the police force in the study was difficult to understand in the absence of significant ethical disclaimers that were not present despite its relative sensitivity. There was insufficient explanation of the elementary concept of the PIU, its work, its data sources and relationships between the units. The validation 'point' of the data needed clearer presentation.

The number of data units was important and more could be explained as to broader studies of such data, the units, their engagement eg in tables, graphs. The findings made drew attention to the question of the subjects and objects of the study which appeared to criticise the public overall and more work was needed on the framing of this finding. The use of term 'stakeholder' needed clarification which possibly needed more development throughout. Findings were expressed as results in a fashion that was difficult to comprehensive. The survey and its results could have been more clearly presented and explained. More was needed on the country of the PIUs responding and its relationship to the implementation of the PNR directive. There was limited engagement with EU institution reports on the implementation of the PNR directive. A distinction between

intra-EU and extra-EU data needed to be made. The paper appeared to emphasise more the extra-EU transfers and while eg important EDPS opinions were referenced. The piece was unduly descriptive overall despite reaching significant conclusions as to accountability and governance. The relationship between EU law and international law needed to be developed briefly to explain more accurately the source of the obligations, which is only tentatively sketched. Some countries had chosen not to have PNR agreements with the EU and this perhaps might assist the inquiry although it is still not clear to be the precise research question to be addressed.

**Is the work clearly and accurately presented and does it engage with the current literature?**

Partly

**Is the study design appropriate and is the work technically sound?**

Partly

**Are sufficient details of methods and analysis provided to allow replication by others?**

No

**Are all the source data and materials underlying the results available?**

No

**If applicable, is the statistical analysis and its interpretation appropriate?**

I cannot comment. A qualified statistician is required.

**Are the conclusions drawn adequately supported by the results?**

Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** EU law, EU external relations, AFSJ, digital/ data governance

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Reviewer Report 28 August 2025

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**Laura Drechsler** 

Law, KU Leuven, Leuven, Flanders, Belgium

No further comments after the revision of the authors.

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Data protection law, border management law, fundamental rights, EU law

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

Reviewer Report 18 June 2025

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**Niovi Vavoula** 

University of Luxembourg, Esch-sur-Alzette, Luxembourg

The authors have provided a revised version of their article, which partly addresses the comments but it is still not ready for indexing. In particular, the sections on methodology, legal matters and recommendations are not taking into account in full the relevant literature and the CJEU judgment in *Ligue des Droits Humains*. The analysis is oriented towards improving effectiveness from a PIUs perspective without balancing with other considerations such as fundamental rights and free movement.

Please find below some detailed comments:

- The first sentence of the article is too complex, and I recommend dividing it in two. - 'More recently, these efforts include the Entry Exit System (EES)<sup>1</sup> and the European Travel Information and Authorisation System (ETIAS) which are not still in operation': These are not the only efforts in digitalised border management in recent years (e.g. Frontex and Eurosur as well as other IT systems).
- 'Advance Passenger Information (API) Directive' This Directive is now reformed, and it should be connected with PNR data. API is a sub-set of PNR data.
- 'In this context, the use of PNR data has been integral to the international cooperation efforts of the EU against terrorism and serious crime for nearly two decades with the implementation of the Passenger Name Records (PNR) Directive (EU) 2016/681 (henceforth "the Directive") being the cornerstone of them.' This is a shortcut, considering that the EU first entered into agreements with specific third countries and then looked into an EU PNR system. - 'transmission, collection, and processing of PNR data': by whom to whom?
- The authors could be more specific as to which aspects in the PNR data processing they refer. - What is the precise research question of the publication? - 'all PIUs participating in the TENACITY consortium and the EU PIUs': could the authors be more specific? How many PIUs were contacted? How many of these were not EU PIUs?
- 'To start with, despite the sample size offering a diverse mix of roles and functions, it can be considered as relatively small (14 PIUs).' how many PIUs were contacted? How? How much period was given for answers? What questions were answered? Yes or no, or for further

development? Was there a follow-up as regards the authorities that did not respond? Did they deny participation? - The word 'custodians' is unclear: do the authors mean data controllers? Do they mean something different?

- The authors state that the lack of non-standard format creates operational gaps. Could they offer some examples? Are data missing? - Is the lack of spontaneous transfers such a problem when there are so many requests for data transfers by PIUs?
- What is the solution to the increased requests from PIU-to-PIU transfer? To have specific conditions and rules to abide by? Is the increased number of requests disproportionate? - On the section on data quality there is some repetition that could be ironed out.
- 'Possible adoption of the EU Regulation (European Commission, 2022) 2019/818': this needs update. - On data analysis: what are the challenges on expanding PR collection/analysis to other modes of transport? The authors mention what the PIUs stated and seem to uncritically accept it, but it would be useful to have any counter-arguments e.g. wouldn't this tremendously increase the work of PIUs which already struggle? Would it affect free movement? E.g. such discussions have emerged in the context of the API proposal.
- When it comes to the legal matters the authors refer to the concerns raised by PIS on how transparent and reliable automated systems are. However, this is a major concern that needs to be mentioned earlier potentially on data analysis. Here it is only mentioned in relation to oversight, which is not really dealt with. What are the specific concerns with oversight? How should it take place? Later it is mentioned as a recommendation but again without engaging to potential biases/non-discrimination concerns.
- There is limited engagement with the judgment of the CJEU in Ligue des Droits Humains and the recommendations do not take the judgment in account.
- The methodology could be further clarified.

**Is the work clearly and accurately presented and does it engage with the current literature?**

Partly

**Is the study design appropriate and is the work technically sound?**

Partly

**Are sufficient details of methods and analysis provided to allow replication by others?**

Partly

**Are all the source data and materials underlying the results available?**

Partly

**If applicable, is the statistical analysis and its interpretation appropriate?**

Partly

**Are the conclusions drawn adequately supported by the results?**

Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** EU Area of Freedom, Security and Justice and Cybersecurity

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

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**Version 1**

Reviewer Report 16 September 2024

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**Maria Tzanou**

The University of Sheffield, Sheffield, England, UK

**Summary of the article**

The article explores the challenges faced by Passenger Information Units (PIUs) regarding the collection, handling and use of Passenger Name Record (PNR) data following the implementation of the EU PNR Directive (EU) 2016/681. According to the authors, it employs a combination of research and survey methodologies to gather data from PIUs.

The study identifies two main obstacles faced by (PIUs): the absence of standardised practices and issues of data quality. It is also argued that fragmented implementation and regulatory barriers are important hindrances to the optimal utilisation of PNR data for counterterrorism and crime prevention efforts.

To address these challenges, the article proposes that technological tools, in particular automated processing could present a solution.

**Review**

Overall, the article makes a valuable contribution to ongoing debates on EU travel intelligence. In particular, the empirical research provides useful insights to the operational aspects of PIUs. The analysis would benefit from several suggestions that I discuss below. These comprise both analytical and methodological aspects of the discussion:

1. As the authors themselves admit, the methodology employed has some limitations. The most important of these are not explicitly acknowledged in the study nor any discussion is provided on how these could be mitigated or addressed. It is reported that 'Fourteen PIUs replied to the survey' and 'due to confidentiality considerations and the discretion required regarding the origins of responses, the authors have opted not to disclose whether the replies received originate from European Union Passenger Information Units (PIUs) or from third countries'. However, this makes it very difficult to assess whether the results reported are indeed robust and whether they represent the views of PIUs' across all the EU Member States. 14 responses appear limited for this type of research and the authors should have explained more clearly the representativeness of the sample and the results. Ideally, this would go further than stating that

'the survey results broadly align with the Commission's report. This is because it less clear what the contribution of this research/ survey has added to the Commission's findings.

2. While the confidentiality considerations and concerns are valid, the article would have made a better contribution if it chose to present some aggregated, anonymised, statistical data which support the arguments made therein. If this is not possible, the article could have at least included in the appendix the survey questions used to ensure that reviewers and readers could assess these.

3. It is argued that 'Inclusion criteria for the review encompass research studies, reports, and evaluations specifically focused on the implementation of the PNR Directive and Passenger Information Units (PIUs), incorporating both qualitative and quantitative methodologies such as surveys, interviews, case studies, and observational studies. Systematic reviews and meta-analyses that provide data on PIUs are also included.' And that 'Additionally, studies with significant methodological flaws or a high risk of bias, those not involving users or stakeholders of PIUs ...are excluded.'

It is not sufficiently clear where the included sources are provided (there is no further reference to these) and what is their purpose. The article could have provided a comprehensive review of the literature on the EU PNR Directive (including the relevant CJEU judgment, which is very relevant to these discussions). At the same time, it is not clear which sources were excluded and why. What studies have 'significant methodological flaws', who decided on this and on the basis of what criteria?

4. The full background regarding the adoption of the PNR Directive at the EU level could have been discussed in more depth. Instead the article does not mention anything about this context and only focuses on the 9/11 attacks and relevant measures. It seems, therefore to be missing out on particular 'European realities and needs' in this context. More importantly, it is not clear if these issues were surveyed among PIUs, for instance, do PIUs' related actors consider that the EU PNR Directive is achieving its objectives? The discussion would have benefitted significantly if it offered an analysis of these issues.

5. The discussion of the results of the survey could have been clearer. Below I discuss some cases/ examples which I consider important:

a) It is argued that 'the PIUs are facing data standardisation issues. First of all, it should not be taken for granted that all the actors involved in the PNR/API data transfer implement existing standards.'

It would be useful if the article explained further what these standardisation issues entail and which are not implemented. Would this be considered a case of non-compliance with the EU PNR Directive or not? There is no clear analysis provided on this.

b) Furthermore, it is mentioned that 'according to the survey, some air carriers may not support automated transmissions of PNR data, making it challenging for PIUs to collect comprehensive datasets. This lack of data from air carriers undermines the effectiveness of security measures and compromises the ability to identify unknown threats.' However, the fact that 'some air carriers do not support automated transmissions' does not mean that there is 'a lack of data'. This point should be clarified as it causes confusion regarding the exact nature of the issues identified by the survey.

c) It is argued that 'Yet, based on the answers received, even the data quality check conducted by the PIUs is challenging for them, as it has to be performed manually. The absence of automated

technological solutions to monitor the validity and quality of the data received causes a huge workload for the PIU personnel.'

This discussion is confusing as it confounds data quality issues with processing issues/ limitations of the data faced by PIUs. The latter concern the processing/ handling of the data and not data quality itself under which it is discussed.

d) It is argued that 'The capabilities of the PIUs are also affected by the practice of 'broken travels'. Broken travels include multi-stage routes that combine many different modes of transport and is a technique highly preferred by terrorists for entering EU (Hornak, 2015). By collecting and handling passengers' data only from air carriers, the PIUs can have only a limited intelligence picture of the cross-border movements, which constitutes an important security gap.'

It is unclear whether this is a limitation of the EU Directive itself or whether it is an issue of implementation. In any case, the article would benefit by providing evidence supported by the survey responses on these matters.

6. The proposed recommendations could have been more expanded and comprehensive- around one paragraph for each identified does not seem to provide sufficient depth or breadth to the discussion. The development of automated tools is proposed as a recommendation for many of the issues identified without any further discussion of the capabilities, limitations and potential risks of such mechanisms (including those identified by the CJEU).

**Is the work clearly and accurately presented and does it engage with the current literature?**

Partly

**Is the study design appropriate and is the work technically sound?**

Partly

**Are sufficient details of methods and analysis provided to allow replication by others?**

No

**Are all the source data and materials underlying the results available?**

No

**If applicable, is the statistical analysis and its interpretation appropriate?**

Not applicable

**Are the conclusions drawn adequately supported by the results?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** data protection, privacy, fundamental rights, EU Law

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Author Response 28 Apr 2025

**Christiana Aposkiti**

Thank you for your feedback.

1. In response to your comments regarding the limitations of the methodology, we have revised the article to more explicitly acknowledge the constraints of our research, particularly regarding the sample size and the anonymous nature of the survey. We now provide a detailed explanation of the representativeness of the sample, highlighting the diverse roles of the respondents and how this diversity helps mitigate the impact of the limited number of responses. We have also added suggestions for future research, including the potential to use interviews or workshops to gather more in-depth data and increase participation.
1. Thank you. Indeed, the questionnaire is included under the "Extended data" sub chapter.
1. The focus of our article is on presenting the findings from a survey conducted with EU Passenger Information Units (PIUs) as part of the TENACITY project. Our primary methodology involved direct stakeholder input via surveys, rather than a comprehensive systematic literature review. To address your comment we clarified in the text that no specific studies were excluded from our analysis based on methodological flaws or risk of bias. Instead, our inclusion criteria primarily focused on the direct relevance of studies and reports to the implementation of the PNR Directive and the operations of PIUs, incorporating both qualitative and quantitative methodologies.
1. We acknowledge the importance of discussing the broader context of the PNR Directive's adoption and its alignment with European realities and needs. However, our research was intentionally scoped to focus on the operational effectiveness of the Directive, specifically addressing challenges faced by Passenger Information Units (PIUs) in their daily activities, particularly concerning technological and procedural aspects. A detailed examination of the historical and political motivations behind the Directive's adoption, as well as its overarching policy objectives, fell outside the scope of this study. That said, a few additions on EU historical context have been added. In addition, we did provide PIUs with the opportunity to highlight challenges beyond the technological and procedural domains, and these findings have been included in the article. While some PIUs commented on operational gaps related to the Directive's implementation, their responses primarily reflected practical challenges rather than evaluations of the Directive's broader objectives. We will clarify this point in the text to ensure that the study's scope and its focus on operational issues are clearly communicated to readers.
1. A) In the article we specifically highlight that: Some air carriers may not support automated transmissions of PNR data, making it challenging for PIUs to collect comprehensive datasets. This undermines the effectiveness of security measures and hampers the ability to identify unknown threats. The EDIFACT PNRGOV standard is a message standard, not a content standard, leading to potential variations in data formats or duplications, complicating data management. These examples illustrate the operational challenges stemming from inconsistent implementation of standards. While these issues do not necessarily constitute non-compliance with the EU PNR Directive, they expose gaps in the uniform application of the standards necessary for optimal functioning. We will ensure this explanation is further emphasised to

enhance clarity for readers. B) C) D): relevant sections have been adjusted.

1. The development of automated tools was emphasised as a key recommendation because it directly addresses the operational challenges identified by PIUs, such as the heavy manual workload and issues with data quality validation. While further discussion of the technological and legal aspects would be valuable, this remains a potential area for future research rather than the focus of the current study. To clarify our intent and improve transparency, we will revise the recommendations section to better articulate that these suggestions are intended as initial, practical steps to enhance PIU operations, rather than exhaustive analyses of their broader implications.

**Competing Interests:** No competing interests were disclosed.

Reviewer Report 11 September 2024

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**Elif Mendos Kuşkonmaz** 

University of Essex, Colchester, England, UK

### General Comment

The work promises to contribute to the research conducted on the practices of PIUs. Generally, the literature from legal and other disciplines on PNR schemes thus far engages with theoretical questions (Amoore, 2009 [Ref-1]; Mitsilegas, 2010 [Ref-4]) or the inquiries around the implementation of the EU PNR Directive in certain jurisdictions (Irion et al., 2021 [Ref-3]; Olsen and Wiesener, 2021 [Ref-5]). As far as I am aware, one article published in English covers the practices of several EU PIUs carried out by Glouftikos and Leese, to which the authors refer. In light of this, the authors raise a valid question focusing on the PIUs and employ a suitable method (e.g., a survey) to answer that question. They are explicit about the limits of the chosen method. The work follows a logical structure and partly relies on sources to substantiate the points raised. In the end, the authors make several recommendations to inform PNR schemes based on the survey results.

Although the survey results and recommendations promise to instigate policy change, the work might need further development in light of the review questions. Below, I made recommendations based on questions 1, 3, and 6.

### **Q1: "Is the work clearly and accurately presented and does it engage with the current literature?"**

I answered this question 'partly' because I think the authors could enrich their explanation of the place of the work against the existing literature with more specific examples. The authors express that "[T]he document seeks to contribute to the existing literature concerning travel intelligence

within the European Union, which currently remains somewhat limited in scope and depth". In addition to this brief statement and a few academic references, specifically on PNR schemes, the work could engage with the literature more comprehensively by citing the literature, what it covers and why the perspective of the existing works is limited to a few words. The authors cite the recent work by Glouftzikos and Leese and the 2010 article questioning the legality of the EU PNR Directive by de Hert and Papakonstantinou. Still, they do not directly consider where their work fits within the existing literature. Being more explicit in terms of the existing gap in the literature and the work's contribution to fill that gap with further references to the existing works could strengthen its engagement with the literature further.

**Q2: "Are sufficient details of methods and analysis provided to allow replication by others?"**

I answered this question 'partly' because I think the methods section could be revised to bring more precision. Under this section, the authors mention that "[i]nclusion criteria for the review encompass research studies, reports, and evaluations specifically focused on the implementation of the PNR Directive and Passenger Information Units (PIUs),..". The work could benefit from explaining more clearly the review the authors conducted as a method because it is not directly clear what this review refers to, given that the work is overall based on a survey.

**Q6: "Are the conclusions drawn adequately supported by the results?"**

I answered this question 'partly' because the recommendations do not sufficiently address the legal matters arising from the survey results. This is clear when the recommendations do not refer to the PIUs' concerns over data retention. Also, some recommendations overlook the general issues arising from the existing (and also pending) CJEU case law.

In terms of conclusions, the authors provide several recommendations regarding the survey results. As the authors mention, the recommendations generally encompass technological solutions. I want to highlight that so-called technological issues can have direct or indirect legal consequences under EU law. On the one hand, I understand that the objective of the work needs to cover addressing legal issues arising from PNR processing under EU law. On the other hand, the authors recognise that Based on the survey results, the present section presents a series of recommendations to fill the capability gaps of the PIUs that pertain to the technological, political, *legal sphere*" [emphasis added]. There is, however, little recognition of the legal limits and standards of what the PIUs can do. For example, the authors recommend the development of automated tools and refer specifically to machine learning algorithms ["By leveraging advanced machine learning algorithms and data analytics, these tools can analyse historical hits or encounters, as well as feedback and validation from the PIU's operators, thereby generating more accurate and effective targeting rule suggestions over time"]. I would like to note here that following the CJEU's *Le Ligue des droits humains* decision, which the authors recognise under the heading on legal matters, there is a discussion among the legal scholars about whether the CJEU's analysis of machine learning algorithms could be interpreted as a prohibition of those algorithms where they are detrimental to individuals right to effective remedy (See: CJEU, *Ligue des droits humains*, para. 195. See also: Rotenberg, 2022 [Ref-6]). Moreover, the recommendation of making certain passenger data mandatory does not consider what this would mean their collection would come under the Law Enforcement Directive instead of the GDPR (CJEU, *Ligue des droits humains*, para. 81). Finally, the recommendation on expanding the PIUs' mandate to other modes of transfer does not indicate if this would include intra-EU routes but assuming that the authors consider those routes as well, the legal implications of this expansion – which the CJEU touched upon in *Ligue des droits humains*, are left out (Brouwer, 2023 [Ref-2]). This oversight does not address the fundamental rights protection afforded to individuals with respect to the processing

of PNR data – a point that the authors make an effort to recognise (“The identification of key challenges confronting PIUs serves as an initial step in this trajectory, paving the way for informed enhancements and ensuring the continued efficacy of travel intelligence initiatives *in full respect of fundamental rights*”), but do not at the end consider in their recommendations.

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4. Extraterritorial Immigration Control. 2010. [Publisher Full Text](#)
5. Olsen H, Wiesener C: Beyond data protection concerns – the European passenger name record system. *Law, Innovation and Technology*. 2021; **13** (2): 398-421 [Publisher Full Text](#)
6. Rotenberg M: CJEU PNR Decision Unplugs the ‘Black Box’. *European Data Protection Law Review*. 2022; **8** (3): 431-435 [Publisher Full Text](#)

**Is the work clearly and accurately presented and does it engage with the current literature?**

Partly

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Partly

**Are all the source data and materials underlying the results available?**

No

**If applicable, is the statistical analysis and its interpretation appropriate?**

I cannot comment. A qualified statistician is required.

**Are the conclusions drawn adequately supported by the results?**

Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Government Data Processing, Automated Decision Making Systems, Data Transfers, PNR Processing and Transfers

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Author Response 28 Apr 2025

### Christiana Aposkiti

Thank you for your feedback.

1. The relevant section has been adjusted. The main scope of the article is to present the findings from the survey.
1. The relevant section has been adjusted. Every document we reviewed is added as a source to the document.
1. The main purpose of the article is to present the findings of the study conducted with the aim of identifying the challenges of the PIUs. The recommendations are additional information that occurred from the survey results and are based on PIUs needs, being the result participants. Thus, the article evolves around the PIUs point of view and needs and does not move to a research about the legal implications the implementation of these recommendations would have as it has been considered a topic for future research based on the findings presented in the current article. This is also clarified in the section 'Conclusion' (i.e.g, 'The identification of key challenges confronting PIUs serves as an initial step in this trajectory, paving the way for informed enhancements and ensuring the continued efficacy of travel intelligence initiatives in full respect of fundamental rights').

**Competing Interests:** No competing interests were disclosed.

Reviewer Report 29 August 2024

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**Laura Drechsler**

Law, KU Leuven, Leuven, Flanders, Belgium

**Abdullah Elbi**

Law, KU Leuven, Leuven, Flanders, Belgium

### **1. Summary**

The article "Navigating the challenges of passenger name record data and the way forward" by Christiana Aposkiti and Freideriki Makri analyses the operational challenges faced by Passenger Information Units (PIUs) within the EU in implementing the PNR Directive (EU) 2016/681. Through a survey conducted among PIUs from within and outside the EU, the study identifies two primary obstacles: the lack of standardized practices among stakeholders and the poor quality of PNR data. The authors note that these issues hinder the effective use of PNR data to ensure some of the security objectives of the EU, such as counter-terrorism and crime prevention. The authors

conclude by proposing several recommendations, such as mandatory collection of specific data elements, and the automation of data quality controls to enhance the capabilities of PIUs. As the authors point out themselves, the study is limited by the unavailability of open data and the absence of a formal bias assessment. The conclusions drawn by the authors are generally supported by the survey results and relevant studies conducted by European Commission and academics, particularly in identifying the key challenges related to data quality and standardization.

Overall, the article provides valuable insights into the challenges faced by PIUs in managing PNR data, and the recommendations offered have the potential to inform future policy and practice. It is generally well-structured and engages with relevant literature in the field of travel intelligence and PNR data usage. Yet, the analysis of the legal aspects of PNR data use should be further refined as the current framing of relevant legal provisions as mere hindrances for PIUs misses their function as key guardrails which support the use of PNR technology in a responsible way to ensure the security objectives of the EU while respecting the fundamental rights of individuals. The following sub-sections will provide concrete recommendations with regard to the legal aspects (section II) and the methodology (section III) together with some general remarks (section IV).

## **2. Legal aspects**

The main issue for the discussion of the legal aspects is the superficiality in which the CJEU case C-817/19 is discussed. This case was the most relevant legal development for PNR data use in the EU in the last years, and it is much more nuanced than appears from the text of the article. This lack of nuance is especially reflected in the conclusion of the authors that cast all regulation as a barrier without distinction or much explanation (e.g. p. 1 or p. 6). The regulation of PNR data use can be criticized but the arguments of the authors would be stronger if they were further substantiated than the labelling as a barrier.

Some of the insights of Case C-817/19 seem particularly pertinent for the discussion of the paper: (1) Due to the impact of PNR data use on individuals that are not suspected of any crime, the CJEU requires "strict" necessity and proportionality for the retention of PNR data, which is for example reflected in the interpretation of the retention periods noted by the authors. The reasoning is based on the need to balance the fundamental rights of individuals, such as privacy and personal data protection, with public interests. This balance could be more discussed and reflected on by the authors as it is key to the whole regulation of PNR in the EU. (2) For the CJEU a key factor in assessing the balance is to distinguish between applying the PNR Directive to intra-EU versus extra-EU flights. Member States must justify the application of PNR data collection to intra-EU flights with clear evidence that such measures are necessary and proportionate. This is a point that would be interesting if the authors could reflect upon. (3) The judgment in Case C-817/19 also makes important findings on the use of automated or AI tools in the context of PNR data, e.g. by finding a need to have effective human intervention, ensure to a certain extent transparency of the systems used and requirements on data quality. This could be further reflected in the text as it links to some of the arguments the authors are making.

A further interesting development to study is the opinion of the European Data protection Supervisor (EDPS) on the draft agreement for PNR data exchanges with Canada, which highlights some key EU legal requirements for PNR data use (see EDPS, 'Opinion 15/2024 on the signing and

conclusion of an Agreement between the EU and Canada on the transfer of Passenger Name Record (PNR) data' (29 April 2024).

Finally the references on the legal aspects of PNR data could be expanded. We would consider in particular following sources as potential useful material.:

- EDPS Opinions on recent PNR agreements (next to the one for Canada noted above):
  - Norway- [https://www.edps.europa.eu/system/files/2023-10/2023-0903\\_opinion\\_en.pdf](https://www.edps.europa.eu/system/files/2023-10/2023-0903_opinion_en.pdf)
  - Iceland - [https://www.edps.europa.eu/system/files/2023-02/2022-1325\\_d0385\\_opinion\\_e-signed\\_en.pdf](https://www.edps.europa.eu/system/files/2023-02/2022-1325_d0385_opinion_e-signed_en.pdf)
  - Switzerland- [https://www.edps.europa.eu/system/files/2023-10/2023-0920\\_opinion\\_en.pdf](https://www.edps.europa.eu/system/files/2023-10/2023-0920_opinion_en.pdf)
- Vogiatzoglou, P., et al., 2020, [Ref-1]
- Thönnies, Christian; Vavoula, Niovi, 2023 [Ref-2].
- Gerards, Janneke, 2023 [Ref-3].

### **3. Methodological aspects**

The study design, which involves a survey of PIUs, is appropriate for gathering insights into the operational challenges they face. However, due to the lack of detailed descriptions of the survey methodology, such as the number of questions asked, or the criteria used to analyze the responses, the outcome is not verifiable or very clear for readers. Including these details would significantly improve the transparency and replicability of the study. From a readers perspective, it would also be very helpful to see some outcomes of the survey partially as charts or graphs (or in another form of visualization) after anonymization respecting the security objectives of the project partners. Additionally, as also noted by authors the absence of a formal risk of bias assessment might weaken the robustness of the findings.

The paper occasionally makes findings where it is not clear on what they are based (e.g. result of the survey, theme identified from the literature...). For example on top of p. 6 the authors note 'The absence of automated technological solutions to monitor the validity and quality of the data received causes a huge workload for the PIU personnel' but it is not clear if this is something the authors concluded from the survey or existing literature. Furthermore, considering the whole PNR discussion, e.g. in Case C-817/19 by the CJEU, it seems that to a certain extent PIUs are using automated solutions. It is therefore not clear whether the authors want to argue that there are no such tools available or that existing tools are not sufficient or reliable enough for this specific task. This could benefit from further elaboration.

Finally, there is some uncertainty about the anonymity of the data. The authors note that 'The participation to the survey was anonymous in order to protect the privacy and personal data of the respondent' (p. 3) but they also acknowledge the collection of written informed consents at the end of the study *with* 'All participants provided written informed consent by signing an information sheet and consent form for participation in the survey conducted as part of the TENACITY project' (p. 8). It would be beneficial if the authors could clarify whether this latter consent was consent from a research ethics perspective or consent for the purposes of data protection. If it was consent from a data protection perspective, the authors should clarify whether the data was then perhaps pseudonymous instead of anonymous. This will also help potential readers to understand the methodology of the survey better.

There are also some small formal issues that could benefit from addressing, such as a couple of typos. Furthermore, it would be great for the readability of the text if the authors could make sure that all acronyms are defined at the first use, e.g. on p. 4 the acronyms of IATA and ICAO.

#### **4. Other comments**

The Introduction starts by introducing 9/11 as a cause for legislative efforts on PNR data in the US. This paragraph is not linked well to the rest of the introduction and the focus of the paper which is PNR data use in an EU context. It could be beneficial to the flow of the text to clearer link this first paragraph of the text to the rest, for example by discussing the effects of the US changes on the European legislative landscape or political efforts. It could also help to link to concrete EU developments or events (e.g., migration influx or terrorist attacks etc.). For example, the API Directive was also a response to the 2004 Madrid terrorist attack. The introduction further mentions EES and ETIAS as border management tools but misses to distinguish them from the use of PNR/API, which makes it difficult to understand their role in the discussions of the paper. Finally, it might be worth further expanding on the background of the PNR Directive itself, which had not had the easiest legislative journey with several earlier attempts to legislate in that area failing (e.g. in 2007).

In the recommendation section, the first and second recommendation are rather similar. It would be beneficial to the reader to either further clarify how they differ or combine them into one longer recommendation. The third recommendation ('A recommendation stemming from...') is formulated in a very passive manner and might be more powerful if rephrased. The discussion of this recommendation would also benefit from a (brief) investigation of the impact of the AI Act with its potential rules on the suggested mechanisms for real-time feedback and validation.

#### **References**

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**Is the work clearly and accurately presented and does it engage with the current literature?**

Yes

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Partly

**Are all the source data and materials underlying the results available?**

No

**If applicable, is the statistical analysis and its interpretation appropriate?**

Not applicable

**Are the conclusions drawn adequately supported by the results?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Data protection law, border management law, fundamental rights, EU law

**We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.**

Author Response 28 Apr 2025

**Christiana Aposkiti**

Thank you for your feedback. Legal aspects

- We recognize the importance of providing a more nuanced discussion of Case C-817/19 and its implications for the regulation and use of PNR data in the EU. In response to your comments, we have revised the section on legal matters to address your comments. Additionally, we have incorporated references to recent EDPS opinions and relevant legal scholarship to strengthen the discussion and provide further context.
- Language has been adjusted in the relevant sections
- We have expanded the legal aspects section to include a more detailed discussion of the key points raised by the judgment. While these additions aim to provide a more comprehensive reflection on the legal aspects, we note that a detailed legal analysis of Case C-817/19 is outside the primary scope of this study, which focuses on the operational challenges faced by PIUs.

Methodological aspects

- The number of questions is added in the section methodology.
- Graphs were added and can be found in the extended data section.
- The absence of a formal risk or bias assessment is mentioned as one of the key limitations of the research.
- When a finding is based on existing literature instead of the survey, the reference is cited within the text. If a finding is not followed by a citation then it occurred solely from the survey.
- The 'Consent to participate' section has been adjusted accordingly.

Other comments Relevant sections have been adjusted.

**Competing Interests:** No competing interests were disclosed.