Exploring the development of an open data platform for road safety KPIs

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Abstract

The European Commission (EC) has adopted the EU Road Safety Policy Framework 2021-2030, in which emphasis has placed on monitoring the road safety progress at EU level. In view of that, it has been suggested to measure a set of eight road safety Key Performance Indicators (KPIs). The EC has been trying in parallel to develop the European Open Science Cloud (EOSC) ever since 2016, which is an open environment for hosting and processing research data. The objective of this paper is to explore the development of a road safety KPIs data ecosystem that could be integrated in the Transport Research Cloud as a subset of the EOSC platform. The paper describes the necessary steps to be taken in order to make the KPIs data open, as well as the concept and the governance plan of an open platform for road safety KPIs (OPEN RSPI). This has been done with the aim to make the platform exploitable by both the EC and the EU countries. From the practical point of view, there has been conducted a review of the available road safety KPIs in the EU, duly respecting the EOSC principles and requirements applicable to open data. The emphasis is placed on the data management plan requirements, as a component of a findable, accessible, interoperable, and reusable (FAIR) ecosystem, which allows collecting, storing and reusing the KPIs data across all EU countries. Finally, the focus has been on the opportunities and barriers for data sharing, which arise from opening up the KPIs data that should be taken into consideration when developing a platform. The development of an open platform provides researchers, practitioners, and road safety stakeholders at all levels to more promptly identify those critical factors that are contributing to road accidents and strengthen the proactive road safety management.

Keywords: Road Safety; Key Performance Indicators; Open Data Platform; EOSC

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1. Introduction

At the beginning of the Second Decade of Action for Road Safety (proclaimed in the UN resolution Improving global road safety, A/RES/74/299, September 2020), the fact is that the world has not reached the target set in the previous road safety decade of action. According to the [1], the number of road fatalities reached 1.35 million in 2016. As for the European Union (EU), 22,660 people lost their lives on EU roads and around five times more suffered serious injuries with life-changing consequences, in 2019 [2]. This is an unacceptable and unnecessary human and social price to pay for mobility. In monetary terms alone, the yearly cost of road crashes in the EU has been estimated to around EUR 280 billion, which is equivalent to 2% of the GDP [3]. In order to better handle the road safety problem in the EU Member States (MS), the EC adopted the EU Road Safety Policy Framework 2021-2030, in which special emphasis has been placed on monitoring the road safety progress, at both national and EU level. To that end, a set of eight road safety Key Performance Indicators (KPIs) has been suggested to be collected under a common methodology by the EU MS, in order to better grasp different road safety issues and define the earlier goal-oriented actions for improving road safety.

In parallel, over the last years, digital technologies have been transforming the economy and society, affecting all sectors of activity, especially those of transport and mobility. With an aspiration to become a global "digital data hub" and a leading role-model for a society empowered by data, improving also the process of decision making in business and in the public sector, the EC adopted the European strategy for data in February 2020, emphasizing the importance of the "Single Market", which ensures the data flow within the EU and across the respective sectors. Building on the ongoing experience of the research community with regard to the European Open Science Cloud (EOSC), the EC will support the establishment of nine common European data spaces, including also a common European mobility data space. Such a data space will facilitate access to more data, and also pooling and sharing of data from the existing and future related databases. A few months later, the EC adopted also the Sustainable and Smart Mobility Strategy, in which special emphasis has been placed on developing the green, smart, and affordable mobility at EU level. This strategy lays the foundation for the EU transport system and how its green and digital transformation could be achieved. As outlined in the [4], the result will be a 90% cut in emissions by 2050, delivered by a smart, safe, accessible, and affordable transport system. Within this context, various milestones have been set out to show the European transport system's path towards achieving the objectives of a sustainable, smart, and resilient mobility, among which the outstanding automated mobility is to be deployed on a large scale, by 2030.

Thus, based on the growing needs to facilitate data-sharing/reuse between governments, funding agencies, academic institutions, business sector and other stakeholders, the EC has initiated the development of the EOSC since 2016 [5], with the aim to link the existing infrastructures from research sectors and Member States in order to ensure sharing of research data [6]. The EOSC is the basis for a science, research and innovation data space that will bring together data resulting from research and deployment programmes and will be connected and fully articulated with the different sectoral data spaces [7], [8]. In order to achieve the strategic goals, the EOSC should also provide added value to other stakeholders beyond researchers, notably to data and service providers, as well as to funding organisations [8]. Within this context, the need for establishing a Transport Research Cloud (TRC) as a subset of the EOSC platform has already been declared [9], [6], which will provide researchers in the transport and logistics domain with access to open data sets relative to their research interests in a consistent manner. In accordance with the EOSC development, the transport research community has identified the gaps and interventions along the following six action lines which are required to fulfil the TRC vision: 1) Architecture; 2) Data; 3) Services; 4) Access and interface; 5) Rules of participation, and 6) Governance [10].

Within this context, the objective of the current paper is to explore the development of a road safety KPIs data ecosystem that could be integrated in the TRC as a subset of the EOSC platform. The paper describes the necessary steps to be taken in order to make the KPI data open, as well as the concept and the governance plan of an open platform for road safety KPIs (OPEN RSPIs). A review of the available road safety KPIs in the European countries has been performed, with due respect to the EOSC principles and requirements applicable to open data (Section 2). From the practical point of view, emphasis has been placed on the data management plan requirements, as a component of a findable, accessible, interoperable, and reusable (FAIR) ecosystem, which allows collecting, storing and reusing available KPIs data from all EU countries in order to measure the overall road safety progress in the coming decade. The open data platform for road safety KPIs and a proper governance plan are explored in Section 3. This has been done with the aim to make the platform exploitable by both the EC and the EU countries. Further on, an analysis of the needs, barriers and opportunities for data collecting and sharing is performed in Section 4. Finally, in Section 5, conclusions are drawn and pointers for future research are provided.

2. Road safety performance indicators in the EU

2.1. Development of scientific thinking on KPIs in the EU

The development of the scientific thinking on road safety performance indicators has been running very quickly over the last decade. Further on, with the development and comprehension of road safety issues, methods for comparing road safety situations in specific areas have been also developed. Efforts are being made today to improve the traditional monitoring method of road safety situation based on the monitoring of road accidents and their consequences. The development of the modern, more human method of road safety management is under way worldwide, based on the monitoring of a variety of safety (key) performance indicators. Monitoring of safety performance indicators (in addition to monitoring road user's attitudes) is one of the modern approaches having the highest potential for road safety improvement. Until now, in a not-so-insignificant number of countries, road safety management has been based only on road accidents and their consequences. From [11], via the most important projects dealing with the research of safety performance indicators in a territory, such as: SafetyNET (2004-2008), DaCoTA (2010-2013), SafeFITS (2018) up until the third Mobility Package Europe on the move – Sustainable Mobility for Europe: safe, connected, and clean [12], many individual studies and research have been carried out globally dealing with road safety performance indicators. KPIs can give a more complete picture of the level of road safety and detect the emergence of problems at an earlier stage [13]. Further on, a brief review of the literature has shown that the evolution of the idea of a road safety level assessment rate of a territory has been transformed into two phases [14]. Phase 1 includes studies estimating the road safety level on the basis of indicators of only one layer, while Phase 2 gathers together studies estimating the road safety level on the basis of indicators of various layers. The compromise between the need for as many indicators as possible and the real situation (availability of only a limited number of indicators for specific territories) eventually means identifying the most significant indicators (a comprehensive set of performance indicators).

2.2. KPI data collection progress in the EU

In the "Europe on the Move" package, published in May 2018, the EC put forward a new approach to the EU road safety policy, along with a medium-term Strategic Action Plan [15]. The Staff Working Document titled EU Road Safety Policy Framework 2021-2030 – Next steps towards "Vision Zero" recommended the establishment of a range of road safety KPIs, at the European level, that are directly related to the prevention of road deaths and serious injuries. The initial eight KPIs are presented in Table 1. For all of these KPIs, the EC has defined a general methodological consideration applicable to all the indicators. The EC funded project Baseline (see https://baseline.vias.be/) has further developed a set of common methodological guidelines for the data collection and estimation of the KPIs in the EU countries [16], including minimum data requirements, measurement procedure and data analysis requirements.

Table 1: The list of KPIs [15]

No.	Indicator	Definition
1	Speed	Percentage of vehicles travelling within the speed limit
2	Safety belt	Percentage of vehicle occupants using the safety belt or child restraint system correctly
3	Pr. equipment	Percentage of riders of powered two wheelers and bicycles wearing a protective helmet
4	Alcohol	Percentage of drivers driving within the legal limit for blood alcohol content (BAC)
5	Distraction	Percentage of drivers NOT using a handheld mobile device
6	Vehicle safety	Percentage of new passenger cars with a EuroNCAP safety rating equal or above a predefined threshold (e.g., 4-star)
7	Infrastructure	Percentage of distance driven on roads with a safety rating above an agreed threshold
8	Post- crash response	Time elapsed in minutes and seconds between the emergency call following a collision which resulted in personal injury, and the arrival of emergency services at the scene of the collision (to the value of the 95th percentile)

The so far progress towards collecting KPIs in the European countries is presented in Figure 1 and Figure 2, based on information gathered from 32 PIN countries [2] and *IRTAD Road Safety Annual Report 2020* [17]. Most countries collect and analyse data related to safety belts use (93.8%), speed (87.5%), alcohol (87.5%), protective equipment (84.4%), distraction (84.4%) and vehicle safety (56.3%). Only a few countries follow the KPIs related to infrastructure (34.4%) and post- crash response (37.5%). However, most countries apply different data collection methodologies, while the level of detail for each KPI and the frequency of data collection vary among the countries. With the methodological considerations adopted by the EC, which are also in line with recommendations of previous studies ([18], [19]), the various restraints can be overcome and the standardization of the suggested key indicators for international comparisons can be achieved.

However, although the EC selected only eight KPIs in the initial phase, it is extremely important to expand this list of KPIs (including vulnerable road users), in order to better monitor the road safety progress, set proper national

KPI targets, compare the countries as credibly as possible and galvanise the political will. Despite the fact that a road safety assessment level obtained on the basis of a narrower comprehensive set of KPIs can offer an adequate and efficient way of road safety monitoring [14], the road safety assessment performed on the basis of a broader set of KPIs will provide a more accurate identification of good and poor road safety performances, which is in line with the recommendations by [13].

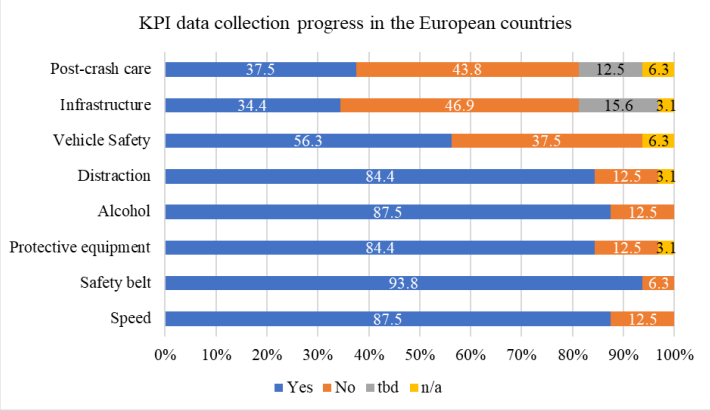
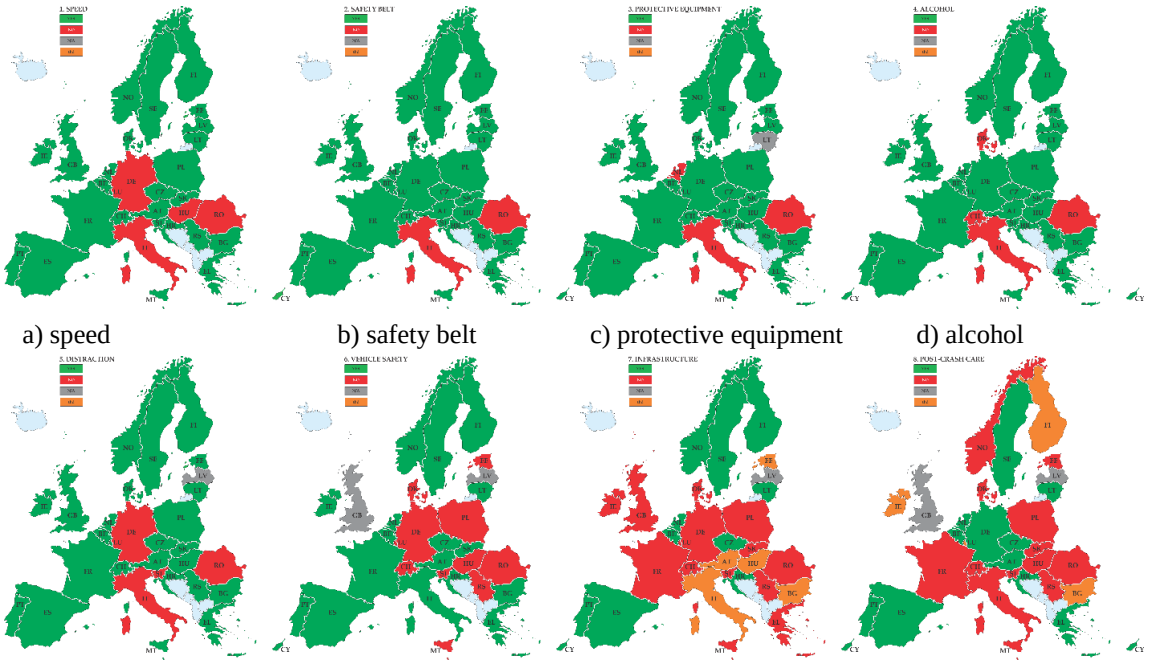


Figure 1: Progress towards collecting KPIs in the European countries



a) speed b) safety belt c) protective equipment d) alcohol

e) distraction f) vehicle safety g) infrastructure h) post-crash response

Figure 2: Availability maps of KPIs in the European countries

3. Open data platform for road safety KPIs

3.1. Concept

Over the recent years, the need for open data, unified standards and flexible infrastructures in the transport research area has been more relevant than ever, due to the great amount of different types of data collected by researchers, transport stakeholders, private companies and public authorities associated with the movement of freight/persons, as well as the increasing real-time data collection from vehicles, infrastructure and various applications. The current open science-based initiatives supported by the EC and their embedded services in transport research area have been summarized by [5]. One of the biggest initiatives to promote Open Science in transport research is the H2020 project BE OPEN, funded by the EC (https://beopen-project.eu/the-project). Within this context, the importance of collecting performance indicators has been also emphasized in [20], including them in the structure of the road safety management, as part of the platform for global road safety data analysis. The synthesis of the results of the [6] led to the formulation of ten recommendations grouped into five thematic areas, which are

considered essential for the development of a sustainable TRC, as a subset of the EOSC platform. In accordance with the EC's efforts to ensure collecting and monitoring of KPIs at the EU level, as useful tools for monitoring road safety progress, the need to define an open data platform for road safety KPIs (OPEN RSPIs) has been widely recognized.

Establishing the OPEN RSPIs as part of the TRC meets three strategic objectives relating to people, knowledge, and infrastructures, as defined in the Strategic Research and Innovation Agenda (SRIA) of the EOSC [21]. Despite the fact that the platform provides a "new normal" related to the open science practices and data stewardship, the greatest contribution is expected in developing a web of FAIR data and related services that are underpinning the in-depth research addressing major road safety challenges. Further on, the platform is compatible with the EOSC principles [21], as it includes a wide range of stakeholders, such as: research and science stakeholders, research-funding organisations, governmental road safety stakeholders and private sector (Principle (P) 1. Multi-stakeholderism). They are interested in the OPEN RSPIs data and are able to generate the value by using this platform. By defining the EU Road Safety Policy Framework 2021-2030, the EC stressed the importance of sharing KPIs data (P.2.Openness), in order to ensure transparency and inclusiveness of the joint work and to benefit from the widest possible input in its decision-making. Research, science, and governmental road safety stakeholders need to embrace the new approach, where knowledge is shared at all stages of the research lifecycle of KPIs (esp. raw/ study data), as opposed to the old way, where results are shared primarily through publications made available when the work has achieved a sufficient maturity level. Challenges related to the openness and P.3.FAIR principles have been overcome by the standardized methodology for collecting and monitoring KPIs, which improves the trust in and culture of sharing data. Based on that and with due respect to all the components of the FAIR ecosystem, the interconnectedness of people, services and content can be at a high level, and the emphasis placed on the data management plan. From the practical point of view, a federation of the existing and planned research data infrastructures (P.4. Federation of infrastructures), is quite sufficient for the functioning of the entire KPIs monitoring system. The challenge is to define the national road safety KPIs hub/ leading road safety stakeholder that will conduct the research and enter the (meta) data through the national e-infrastructure. By monitoring the KPIs data at the EU level, activities have grown in volume and complexity in many ways (reading, analysis, comparison, reporting, etc.) and (meta) data must be catalogues based on machine-readable metadata (P.5. machine-actionable).

The EOSC system consists of three layers: 1) the federating core (or the EOSC-Core), (2) the federation of existing and planned research data infrastructures, and (3) the EOSC-Exchange that builds on the EOSC-Core to ensure a rich set of services (common and thematic), exploiting FAIR data and encouraging its reuse. More specifically, the EOSC-Exchange allows the research communities, industry, public agencies, and others to connect via EOSC-Core functions and share their data and services. In accordance with the EOSC structure, an open data platform for road safety KPIs engagement of the wider public/ government sector and private sectors in the EOSC has been proposed (Figure 3), adhering to the predefined Rules of Participation [22]. As shown in Figure 3, the platform proposed can be exploited by both the EC/DG Move and the MS in order to monitor road safety progress, identify and exchange best practices through cross-country comparisons, as well as to identify major road safety problems. The governance plan implies a proxy at the national level (Route 1) between the EOSC-TRC and the leading government road safety stakeholder, which is responsible for KPIs measurement, collecting and monitoring at national level, as well as for national research and science stakeholders or private sector. In addition, the leading government road safety stakeholder and research stakeholders may engage in the EOSC via one or more umbrella organizations (Route 2), (i.e., ECTRI, FEHRL, etc.), addressing different layers of the EOSC, primarily the providers of the EOSC-Core and those enabling the EOSC-Exchange. Initially, both routes are acceptable since umbrella organizations are expected to bring their members closer to the EOSC and align their needs with EOSC principles. But in the long- term and within a context of established open science culture, Route 1 is indeed the most appropriate.

No matter which route is used for communication with the EOSC, all Member States need to define comprehensive methodology for collecting and monitoring KPIs at national level, which is completely in line with the EC minimum methodological requirements. Nevertheless, this methodology should define a leading road safety stakeholder for collecting KPIs (e.g. ministry of transport or leading traffic safety agency), the list of KPIs (in line with EC recommendations) and a list of additional safety performance indicators (e.g. related to vulnerable road users), a sustainable funding source for periodic, long-term monitoring of indicators, as well as mechanisms for reporting to the parliament, citizens, etc.

Being able to recognize the importance and generate the proposed platform value, as part of the EOSC- TRC, the governance plan implies direct involvement of the EC/DG Move, as a focal point for KPIs management at EU level. This concept encloses a strong collaboration with national road safety stakeholders, a comprehensive road

safety management plan and the exchange of best practices at EU level. For this purpose, the following should be enabled as a minimum by the OPEN RSPIs platform:

- Entering (meta) data of KPIs according to the EOSC- TRC requirements- EU level and EU MS level;
- Data management that provides monitoring/ cross- country comparisons for each KPI individually- EU level;
- Calculation of the key performance index and cross- country comparison- EU level;
- Identification of the most significant KPIs in a territory- EU level;
- Star rating of KPIs (incl. a larger number of indicators) and star rating of road user's behaviour- EU level;
- Generation of results and reports according to the selection criteria of the EC/DG Move and leading road safety stakeholder- EU level and EU MS level;
- Generation of results and reports according to the selection criteria of the academic and research stakeholders,
- Other attributes that can contribute to improving road safety.

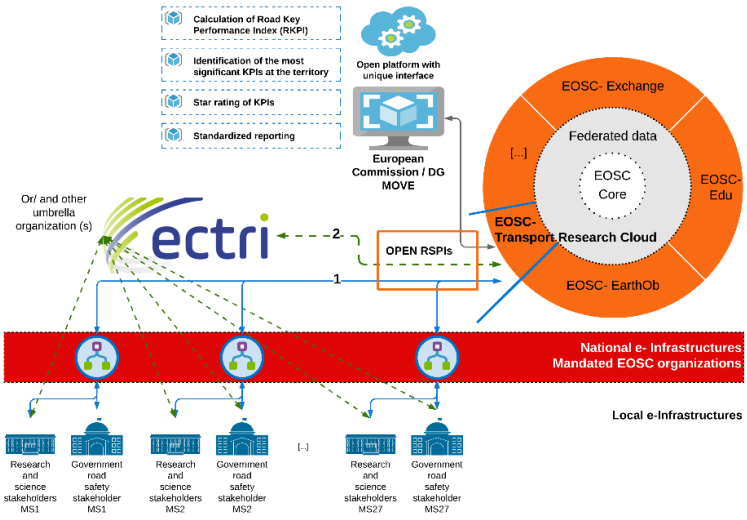


Figure 3: Concept of the open data platform for road safety KPIs (OPEN RSPIs), based on [10]

The collection of KPI data is mainly conducted under contracts paid by taxpayer funds or under a publicly funded initiative/project, constituting them a public good, which should be open, easily accessible and reusable. This, however, depends largely on the culture and existing practices of data sharing, safeguarding measures and mechanisms to protect sensitive data. The results of [6] indicate that a culture and practices of data sharing still need to be developed in the area of transport research. In the case of the KPIs, a mitigating circumstance is that there is already a standardized methodology for their collection and reporting at EU level, which can lead more easily to the development of the OPEN RSPIs platform as a "go to" place for comprehensive road safety research. Thus, the establishment of the open data platform for road safety KPIs will contribute to building a research road safety environment that will promote the Open Science and increase the trust and reproducibility of research outcomes. Finally, the platform will contribute to achieving the EOSC development goals, which are defined in the Strategic Research and Innovation Agenda, implementation stage 2 and stage 3.

3.2. FAIRness of road safety KPIs data

In accordance with the recommendations from [23], MS should ensure: 1) data management planning, as a standard scientific practice early in the research process, when data are generated or collected, including the requirement of data management plans, and 2) research data resulting from publicly funded research being findable, accessible, interoperable and reusable ('FAIR principles') within a secure and trusted environment, through digital infrastructures. Further on, [24] summarized 14 recommendations for FAIR Open transport research data. These recommendations suggest actions, not only to single researchers, but also to the transport research community as a whole. Within this context, all potential types of road safety KPI data [original research data obtained by observations, as the most common category of KPIs data; operational data (e.g., data from public authorities) and data from published research in transport (journals, deliverables, etc.)], should follow the FAIR principles, being 'as open as possible, as closed as necessary'.

The implementation of the FAIR principles relies on the following essential components: policies, data management plans, identifiers, standards, and repositories [25]. In the context of an open KPI data ecosystem, data policies could be issued by the EC/DG Move, leading road safety stakeholders at EU MS level, as well as by research and other related stakeholders. Additionally, Data Management Plans (DMP), which will articulate all

relevant information concerning the generation or collection of publicly funded research data [25], will hold valuable information on the data and related outputs, should also be ensured and structured in a machine actionable way. Based on the above needs and the ARGOS of OpenAIRE, a structure of a DMP for KPI data is suggested:

- title, description, and language (*define title, briefly describe the context and purpose of a DMP, language*),
- visibility (*KPIs data are public data and should be fully visible*),
- researchers and organization (*list all researchers and organizations*),
- funding organizations, grants, projects (*Phase 1- KPIs data collection can most often be funded by the EC through certain projects at the EU level; Phase 2- research funded by a government, when the conditions for sustainable monitoring of KPIs are provided; projects funded from multiple sources*),
- license (*selecting the most appropriate license from the Creative Commons licenses; permit the widest reuse*),
- dataset info (*data types; file formats; data production methods (observers, smart cameras, and solutions, etc.); expected size of the data; metadata; persistent identifiers for raw data, institutions, researchers, funders, etc.; search keywords; data openly available (ZENODO or OpenAIRE); briefly describe the KPIs collection methodology; vocabularies of meta (data); re-using a policy and the "embargo" period; and other specifications which can be useful for data reusing*).

Disciplinary interoperability frameworks are essential to the implementation of the FAIR principles and are organized in four layers: technical, semantic, organizational, and legal [26]. Interoperability frameworks that define community practices for data sharing, metadata standards, tools and infrastructure play a fundamental role [6]. With the development of the proposed OPEN RSPIs platform, having a unique interface and enabling a triangle knowledge exchange such as: 1) the EOSC/TRC and the EC/DG MOVE; 2) the EOSC/TRC and leading road safety stakeholders at EU Member State level, and 3) the EOSC/TRC and academic stakeholders, it will be possible to ensure the interconnectedness of people, services, and content. The challenges can occur in the semantic layer, when it comes to differences in the definitions of certain indicators (e.g. different legal requirements on helmet use by cyclists, applicable legal provisions relating to the maximum permitted BAC, definition of KPIs related to vehicle safety and infrastructure). However, these challenges can be faced properly by explaining in detail the differences and specifics of the various indicators in the metadata provided.

In open science, data must also be shared in such a way that both humans and machines are able to access, understand, and reuse them [27]. A key issue of the reusability of KPIs dataset is the availability of high-quality metadata, which will provide precise information on data collection procedure and methodology, data process, data owners, access to data, etc. From the point of view of data, the biggest challenge can be the preparation of raw data due to the size and complexity of the KPIs datasets. By using the proposed platform, it is possible to overcome this problem by providing the unique interface and strong data entry instructions for the leading road safety stakeholder at the EU MS level. Through this interface, raw data will be entered in a unique way, which will enable easier data processing (and even data aggregation, if necessary). From the metadata point of view, the biggest challenge will be the preparation of metadata due to low familiarity with data sharing practices. In order to improve the culture of data sharing, it will be useful to define a metadata template for KPI data, with all required elements, including training/ education programs for representatives of the leading road safety stakeholder, researchers, etc.

Finally, the most common type of reporting KPIs data is the publication of reports, journal articles, conference papers, dissertations, proceedings, databases (study data), etc. To provide a higher level of interoperability and reuse, the OPEN RSPIs platform should enable exporting or generating standardized reports which will be published by the EC/DG Move or the leading road safety stakeholders of the EU MS. For this reason, it will be necessary to define some standardized datasets, such as: a KPIs dataset for the EC/DG Move analyses and reports, a KPIs dataset for the EU Member States' analyses and reports and a dataset for the final report, estimation of the road key performance index, cross- country comparisons and further analyses.

4. Opportunities and barriers to road safety KPIs data collecting and sharing

The use of to- date scientific and technological achievements in the field of information and communication technologies, cloud computing, artificial intelligence (AI) and Internet of Things (IoT) can improve significantly road safety across Europe for all road users. This requires mass involvement of public decision-makers, research and scientific community, vehicle manufacturers and suppliers, traffic information service providers, etc. Such a level of coordination and participation will be necessary for the provision of the pace and the critical mass of road safety data required for a comprehensive and in-depth analysis of road safety situation in a territory, detection of emergence problems at an earlier stage, evaluation of road safety measures, exchange of best knowledge, etc. Under this assumption, it is possible to generate large amounts of KPIs data, obtained from various projects,

naturalistic driving studies, field operational tests, smart cameras, advanced smart solutions in urban area, smart in-car solutions, etc.

Moreover, the AI technology is expected to contribute to the improvement of the safety level of vehicles, drivers, and roads [28]. But, during the transition period, from traditional to connected and automated mobility, when both human drivers and self-driving cars will co-exist on the roads, the number of accidents may not change or may actually increase [29]. Automated process of KPIs data collection by using the AI, communication between the vehicle, infrastructure, and driver (i.e., V2X) and the IoT system, will enable the management of the road safety performance generally, management of driver's behaviour and identification of the most common risky behaviour, which can lead to a reduction of harmful impacts of traffic in the said transition period. Organization of periodical, multi- day training courses (or a series of workshops/ webinars) for road safety stakeholders in the EU MS, in cooperation with the representatives of the EC/DG Move, the representatives of the EOSC, academia sector and traffic information service providers, will have a great potential for improvement of the culture of data sharing and interoperability, with a high level of trust and security. Developing the next generation of FAIR professionals and professionals for the management of KPIs data should be a priority at all levels of road safety management, which is in line with the recommendations in [30].

However, the numerous challenges that can hinder the reuse of KPI data are listed in [6], among which the following ones stand out: data storage, fragmentation of data ownership, a lack of interoperability between datasets and platforms, etc. In addition to these challenges, the following challenges have emerged onto the surface, relating directly to the KPI data: funding and sustainability of collecting KPIs data, data quality, diversity of definitions of a wider list of road safety indicators and several ethical issues arising from opening up the raw/ survey KPIs data, such as: personal or privacy sensitivity and intellectual property rights. The list of unique KPIs proposed by the EC has a high potential in the "open science era" because the definition and methods of collecting all the KPIs are standardized. This allows for a rather fast development of the OPEN RSPIs platform and practical implementation across the EU. However, the sustainability depends on national funding models and willingness to pay for the development of a comprehensive system of KPIs management. To facilitate the work on KPIs data collection, the EC should offer financial support to the Member States, set ambitious national KPI targets and define recommendations for financing and potential benefits of data management (i.e., sustainable business models that generates the value of the platform and funding sources for the stakeholders which, having recognized this value, provide long term funding of the platform), which are necessary for the viability of the OPEN RSPIs platform. Currently, data quality can be improved by organizing several training courses for leading road safety stakeholders and by defining national comprehensive methodology for collecting and monitoring the KPIs at the EU Member States level. In the near future, automated process of KPIs data collection, accompanied by advanced smart solutions in urban areas, smart in-car solutions, etc. can significantly improve data quality, by taking into account that data providers may be unwilling to use cloud services for fear of data breaches or unauthorized access. Eventually, the ethical issues can be overcome by means of the proposed unique interface within the OPEN RSPIs platform, which requires the entry of aggregate data for each KPI individually. It should be stressed, also, that technology offers some solutions to these concerns which could be exploited, such as tools helping researchers or data providers to publish data containing sensitive information by ensuring GDPR compliance (e.g., Amnesia tool [24]). All other potential restrictions should be listed in the DMP, until a clear legal framework supporting data security, data protection and privacy has been developed.

5. Conclusions

In order to have a better understanding of the road safety problem and define the earlier goal-oriented actions for improving road safety, the EC has set eight road safety KPIs, which should be measured across the EU Member States. The standardized KPIs can help decision makers at all levels monitor the progress towards achieving the road safety targets. Simultaneously, the development of a TRC as a subset of an EOSC platform, provides the conditions for comprehensive management of the KPIs data. Through the paper, guidelines are given for development of an open data platform for road safety KPIs that could be integrated in the TRC. More precisely, the paper describes the necessary steps to be taken in order to make the KPIs data open, as well as the concept and the governance plan of an open platform for road safety KPIs (OPEN RSPIs). This has been done with the aim to make the platform exploitable by both the EC and the EU countries. Within this context, the FAIRness of road safety KPIs data are highlighted, and emphasis is placed on the requirements for a proper data management plan, which allows to collect, store and reuse available KPIs data from all EU countries. Finally, opportunities, and challenges to road safety KPIs data collecting, and sharing have been emphasized, too.

The development of the OPEN RSPIs platform enables comprehensive and periodic monitoring and management of the KPIs at the EU level, sets ambitious national KPI targets, a more accurate identification of good and poor

road safety points, identification of the critical factors leading to road accidents, as well as strengthening the proactive road safety management. In order to make the transition period (from traditional to connected and automated mobility) as safe and efficient as possible, the development of the star rating for assessing road safety performance of a territory should be a possible game-changer for systematic management of road user's behaviour, especially in case of automated process of KPIs data collection by using the AI, V2X communication and the IoT system. From the open data point of view, the OPEN RSPIs platform ensures high level of openness, integrity, fairness, interconnectedness of people, services, and the content, as well as the reproducibility and reuse of KPIs data. By using to-date scientific achievements in road safety management, as well as technological achievements in the field of information and communication technologies, the development of the OPEN RSPIs platform does not require large resources (architecture, infrastructure, services, and other requirements) and could be a very useful tool in the hands of the EC/DG Move and national road safety stakeholders.

Finally, it is essential that the EU Member States accept and support the development of systematic monitoring of the KPIs and define sustainable national funding models. At the initial stage, the EC should encourage and offer financial support to the Member States. After the initial stage, the EC should define recommendations for financing and potential benefits of data management (provide value to end users), educate the stakeholders and set national KPI targets, include strict monitoring of road safety situation, etc.

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