



Overview of gaps and actions needed – Milestone 2.2

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- To be revised by partners involved in the preparation of the document
- For review/ approval by the Core Alignment Team
- For approval by the NAPCORE Steering Committee





Abbreviations

Abbreviation	Meaning
EAP	European Access Point
EC	European Commission
EU	European Union
EU-EIP	EU ITS Platform
CMC	Coordinated Metadata Catalogue
DATEX	The standard for the exchange of traffic related data
DCAT-AP	Data Catalogue Vocabulary – Application Profile
DR	Data registry
GA	Grade of Achievement
GDPR	General Data Protection Regulation
ITS	Intelligent Transport Systems
JSON	JavaScript Object Notation
JSON-LD	JavaScript Object Notation – Lightweight Linked Data format
KPI	Key Performance Indicator
LoS	Level of Service
MS	Member State / Microsoft Corporation
NAP	National Access Point
NAPCORE	National Access Point Coordination Organisation for Europe
NLKF	NAP Level Of Service KPI Framework
NUTS	Nomenclature of Territorial Units for Statistics
PUSH	Push technology or server push
RDF	Resource Description Framework
NLKF	NAP LoS KPI Framework
R&I	Research and innovation
RFC	Request for Comments



Work item 2.1.3: Overview of gaps and actions needed – Milestone 2.2



T	Task
XML	Extensible Markup Language
WG	Working Group





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1. Introduction

1.1. Scope & objectives

The second working group of the NAPCORE project (WG2 “Interoperability and level of service of NAPs”) aims to define minimum conditions and coordinate the development and evolution of European National Access Points (NAPs) by enhancing the compatibility and interoperability of their features (including access, management, and look & feel features). Moreover, it aims at harmonizing the Level of Service (LoS) of NAPs considering the currently adopted data standards and NAP architecture but also taking steps towards the maintenance and extension of this architecture. Interoperability demonstrators are also within the scope of WG2 aiming to describe and develop technical solutions enabling increased interoperability and improved NAP LoS. WG2 is structured around four tasks:

- *Task 2.1 “Level of service of NAPs”*: Focuses on the uniform description of NAP LoS.
- *Task 2.2 “Definition of requirements concerning data standards, reference profiles and metadata and support tools”*: Focuses on the improvement of data interoperability by defining common data standards, reference profiles, and metadata (including requirements for them).
- *Task 2.3 “NAP architecture”*: Focuses on the maintenance of NAP reference architecture and the assessment of its interoperability and harmonization needs. It also focuses on the identification of new requirements through the execution of use case analysis to ensure secure and private data exchange for all aspects of interoperability.
- *Task 2.4 “NAP service interoperability demonstrators”*: Aims to showcase experiences from and best approaches/practices on real-world use of NAP reference architecture to support the interoperability and continuity of ITS services.

The current report addresses the second milestone of WG2 (M2.2 “Overview of gaps and actions needed”), which is a part of the workload of Task 2.1. Specifically, M2.2 is the main output of Work Item 2.1.3 that aims to:

- Identification and listing of gaps and actions needed regarding interoperability (technical, legal, and organizational interoperability) and LoS for the adoption of NAPs by the different Member States.
- Develop recommendations for stepwise approach to support Member States in the road mapping into more complex NAP architectures.
- Development of a first layout of potential European NAP or federation of European NAPs (in cooperation with T2.4, WG1 and subWG4.4)

This milestone takes input from Work Item 2.1.1 (Milestone 2.1¹) where the main goal is to support the understanding of the current state of play within the European NAP ecosystem as well as the recording of existing best practices and common NAP features. It also makes use of the NAP LoS KPI framework (NLKF) for assessing the LoS of a NAP considering its adopted design.

Finally, this milestone sets the basis for the listing of gaps and actions recommended towards NAP interoperability and minimum LoS within NAPs, which is the focal point of Work Item 2.1.3. The goal is to establish a common minimum LoS for all NAPs, ensuring better service for NAP users through a harmonized list of features and improved performance. The actions and recommendations proposed to bridge the gaps between the current LoS and the common basic LoS will support NAP operators in achieving this goal.

¹ NAPCORE M2.1_Typology of NAPs based on the description of levels of service and assessment of associated costs and benefits



1.2. Approach

The current section provides an overview of the methodological approach adopted for the development of the Overview of Gaps and Actions needed. This approach constitutes a logical continuation of the workflow that has been adopted upfront in the execution of Task 2.1.

> Development of the NAP Level of Service KPI Framework (NLKF)

The initial action taken for kicking-off Task 2.1 was to gain an initial understanding of the current state of play of NAPs, considering their features. The context on which this endeavour was mainly based is a similar endeavour made by the European ITS Platform (EU-EIP) in the past, i.e., the so-called “NAP common features”. This framework has been processed with the aim of defining an initial list of features grouped into several categories associated with a different operational dimension of a NAP.

The second step involved the preparation of a survey oriented to assess whether the features identified and included in this list are supported by European NAPs and, in this respect, their level of commonness (including the collection of fruitful ideas and feedback from MSs about the clarity and completeness of asked questions). This survey has been prefilled by the MSs that are active in Task 2.1.

The third step involved the adaptation of the survey to the collected feedback and its full-scale activation with the aim of acquiring input from as many MSs as possible. The survey was circulated in both an off- and on-line questionnaire form to facilitate the acquisition of both quantitative and qualitative information (if deemed appropriate).

The fourth step included the analysis of the acquired information for defining a set of Key Performance Indicators targeting the assessment of the maturity level of a NAP from a LoS point of view. These KPIs were grouped into the same categories with NAP common features. Moreover, the acquired empirical evidence has helped us to pre-determine for each KPI a set of possible values. Each of these values is assigned with a specific score indicating a grade of achievement. Moreover, the acquired empirical evidence has helped us determine which of the possible values should be addressed as resembling a minimum acceptable grade of achievement.

In the fifth step, we introduced two different NAP types, namely “Metadata directories” and “Data platforms” and we have determined which KPIs are applicable to each of these two types.

In the sixth step, we have prepared and circulated a much shorter survey that aimed at gaining insight into the perceived importance of defined KPIs by all MSs. The acquired information let us develop a mathematical formula providing a weighted average of all KPIs for indicating a total grade of achievement for each NAP (respecting the perceived importance of each KPI).

The last step was to apply the resulting KPI framework to the NAP of eight countries, in order to test its usefulness, applicability, and validity. The entirety of the above steps has provided valuable feedback for the preparation of the report corresponding to Milestone 2.1 “Typology of NAPs based on the description of levels of service and assessment of associated costs and benefits”. These included the first release of the NLKF available for application and use by all other NAPs.

> NAP Level of Service self-assessment

The first release of NLKF allowed all NAP operator to perform a first self-assessment of NAPs. The goal of the NAP self-assessment exercise is primarily to “inspire” or “influence” the NAP roadmaps with the list of features and the comparison to a “European benchmark”.

In order to promote and facilitate its use by all NAPs, Task 2.1 decided to fully digitize and automate the process of collecting the KPI scores from each MS and computing its total grade of achievement.



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An on-line version of the NLKF was developed, including an analysis spreadsheet that translates automatically the answers provided by each MS to KPI values, through linguistic conditions, computes its total grade of achievement as well as other useful statistics (e.g., average values, more frequent values, percentiles), and provide relevant visualizations. This suite has been termed by our team as “NLKF tool”.

Task 2.1 organized a NAP LoS self-assessment workshop (31st March in Porto), dedicated to dissemination of the work that has been done so far, providing explanations (where needed), and applying the developed KPI framework in a wider range of MS.

After the workshop, more than 20 NAPs were self-assessed and each of the NAP operators received an individual analysis comparing the NAP LoS with the aggregated results. This analysis provided first insights on how each NAP LoS is positioned (the “gap”) compared with the European average.

> Identification of LoS insufficiencies and determination of gaps

As outlined in the previous subsection, the main objective of the current report is to identify LoS gaps and suggest actions that can help mitigate these gaps. **A gap means, in the context of this document, that the LoS of a certain NAP does not reach the minimum acceptable level.**

Therefore, an important output of this document is the **determination of the minimum acceptable (i.e., sufficient) level of NAP services**. This is the basis for the later search for the desired (i.e., required) level of NAP services, which can be identical or even higher than the minimum acceptable limit.

In this context, it is necessary to correct a partial terminological inaccuracy that has arisen in previous documents (including Milestone 2.1), when the qualitative levels of NAP services (maturity levels) were marked from “Beginner” (0-20% GA) to “Desired” (80-100% GA) as one of the outputs from the NLKF. The term “Desired” thus indicated the highest possible quality of service, which may not be equivalent to the realistic level that may be required for NAP services. For that reason, starting with this document, the mentioned highest qualitative level will be referred to as “Expert”. The term “Desired” will be reserved for later use in relation to the desired LoS.

In Section 2, several possible ways to define a LoS gap are investigated and analysed, including a review of potential references for a *minimum acceptable NAP LoS*. First approach is related to the requirements within the ITS Delegated Regulations, that may be addressed as binding for all Member States. In this context, non-satisfied requirements can be translated into gaps. Also, a statistical perspective for the minimum acceptable NAP LoS is investigated, in the second approach, involving the assessment of European NAP LoS averages or the analysis of disaggregated “insufficient” LoS. Finally, the third approach consists of a review of potential gaps derived from the “NAP reference architecture” (NAPCORE Task 2.3), looking at basic NAP functionalities. In this context, a gap may be identified if the value of a KPI included in the NLKF tool suggests that a basic functionality is not supported by a considerable number of NAPs.

After considering the three above-mentioned pathways, it deemed that at this stage, a statistical approach is the most expedient for identifying gaps towards the minimum acceptable European-wide NAP Level of Service. As it will be explained in greater detail in Section 2, of a particular use are statistics involving the number, the weighted number (by the importance of each KPI), and/or the percentage of Metadata directories, Data platforms, or any type of NAPs with insufficient LoS (resulting in the KPIs with non-acceptable values/levels). These quantities can be utilized by adopting two different approaches. The first involves the sorting of the KPIs with non-acceptable values/levels in descending order by the aforementioned quantities and the handling of the n top ranked (e.g., top ten) as “gap areas”. The second involves the grouping of the KPIs with non-acceptable values/levels through a



criterion, such as the intra-group difference of the aforementioned quantities. By that means, the groups corresponding to the worst performances can be addressed as the “gap areas”.

> Recommendations for stepwise approach towards an interoperable NAP landscape in Europe

In addition to the identification of gaps and listing of actions, to fulfil the other two main goals of work item 2.1.3, section 3 (Recommendations for stepwise approach towards an interoperable NAP landscape in Europe) was included. This section briefly reviews relevant initiatives working towards a more interoperable NAP landscape in Europe, such as the NAPCORE development of a harmonised NAP architecture and the studies related to the development two European platforms/services, namely the EC “European Access Point” and the EC “European Mobility Data Space”. Then, based on the current status of this initiatives a set of KPIs from the NLKF considered as “enablers” for the existence of these platforms were listed.

Finally, a set of recommendations, which are related to the actions identified under section 2, are provided, specifically the ones with NAPCORE and the proposed leading actor, with the view to enhance EU-wide interoperability of the NAP environment, allowing the consolidation of a harmonized NAP architecture.

2. Identification and listing of NAP LoS gaps

2.1. Definition of gaps

“Gap: an interval between two things.”

Task 2.1 focuses on the development and application of a uniform description of NAP LoS, as a way to promote harmonization of NAP developments and increase interoperability. Once the use of this common reference is in place, one can then identify and **list the “gaps” between the current and the minimum acceptable LoSs**. The analysis of these gaps, in their type, frequency and impact will allow a coordinated and efficient definition of actions recommended to contribute in closing these gaps.

The *minimum acceptable NAP Level of Service* can be derived from different approaches or references, in the text below we analyse 3 such approaches.

The first approach involves the investigation of the **Delegated Regulations supplementing the ITS Directive**, in order to identify legislative requirements that may be addressed as binding for all MSs. It is deemed that the Delegated Regulations supplementing the ITS Directive are documents providing requirements for the deployment of European-wide ITS services. In this context, non-satisfied requirements could be translated into missing aspect of a NAP: a gap.

A review of the current DRs shows that currently they do not provide strict requirements that can be easily used for this defining “gaps”. Any strict requirements included in these documents have already been considered by the NLKF tool (in the determination of the minimum acceptable grades of achievement per KPI).

The second approach adopts a statistical perspective to identify a minimum acceptable NAP LoS. This involves the analysis of the NAP self-assessment exercise based on the NAPCORE LoS KPI framework (NLKF) and derive a **“European NAP LoS average”** that will serve as a NAP LoS reference for acceptability. Additionally, this European average metric can then be further applied to a focused analysis of disaggregated “insufficient” levels of service per “feature” (or category) of the NLKF: “How many NAPs” do not achieve the European average LoS, “Which categories are underperforming or lack



of harmonization”, or “Which KPI has the biggest gap”. Such indicators can support the prioritization of actions toward specific KPI and or categories.

The third approach involves the definition of gaps considering the outcomes of Task 2.3 that runs in parallel to Task 2.1. Task 2.3’s main goal is the definition **NAP reference architecture**, including minimum NAP functionalities. In this context, a gap may be identified if the value of a KPI included in the NLKF tool suggests that a minimum acceptable functionality is not supported by a considerable number of NAPs.

The reference architecture constitutes several viewpoints and architectural products that set a blueprint for what shall be implemented in each platform acting as a NAP. It defines requirements, functions, processes, and interfaces for the NAPs to interoperate. The concept of LoS is focused on the evaluation of performance, while NAP functionality focuses more on the system structure. Both, the KPIs and functionality, are related, but matching of NAP functionality to KPI is not 1:1 exercise. During this review, the minimum acceptable NAP functionality definition has been a work in progress, with some relevant feedback to NAP LoS, but not addressing all of the KPIs.

Gap based on NAP LoS KPI Framework assessment results

Based on the review above, it is deemed that at this stage the statistical approach is the most expedient approach for identifying European wide LoS weaknesses. The next 2 subchapters describe the process of gap identification using the suggested statistical approach. Chapter 2.2 introduces the aforementioned “European LoS average”, presenting an overview of the current LoS Status across the European Member States, and highlights some relevant aspects that can be considered as gaps to be addressed at the feature category level. Chapter 2.4, on the other hand, addresses the gap identification at the single feature (KPI) level. It contains the explanation concerning the process of obtaining statistics involving the number, the weighted number (by the importance of each KPI), and/or the percentage of Metadata directories, Data platforms, or any type of NAPs with non-acceptable KPIs.

2.2. Identified gaps on feature category level

As previously mentioned, it is possible to identify “gaps” while analysing the EU-wide scenario of LoS, in the “feature category” level. For instance, an underperforming feature category could be considered as a gap to be tackled by the MSs. Therefore, in this subchapter, some results from the Level of Service self-assessment Workshop will be presented and analysed, with the view to highlight those “gaps”.

An overview of the current LoS Status across European Member States can be observed in Figure 1, which displays, through box plots, the distribution of the Grades of achievement (GA)² for each feature category and for the Total GA, as well as the average GA. The maturity levels (from “beginner” to “expert”) are also displayed using the colours in the background. For the sake of better understanding, the values included in the Box Plot are described below:

- Lower whisker – minimum GA considering all 20 NAPs;

² **Grade of Achievement** (i.e., scoring norm) is previously defined in M2.1 as a number in the scale from 0 to 100 where higher values means higher LoS in the appropriate Feature category. The GA of a “Features category” is derived from all relevant KPIs using a universal function processing KPI actual values and other features as a scaled weighted mean of the relative contributions to LoS for individual KPIs. As each KPI and therefore also each Feature category have their own grading scheme, the comparison of Feature categories is from a statistic point of view quantitatively not directly comparable, but gives a good qualitative impression of the maturity in the different Feature categories.



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- Lower hint – 25% GA quantile
- Median – GA median (50% quantile)
- Upper hint – 75% GA quantile
- Upper whisker – maximum GA considering all 20 NAPs

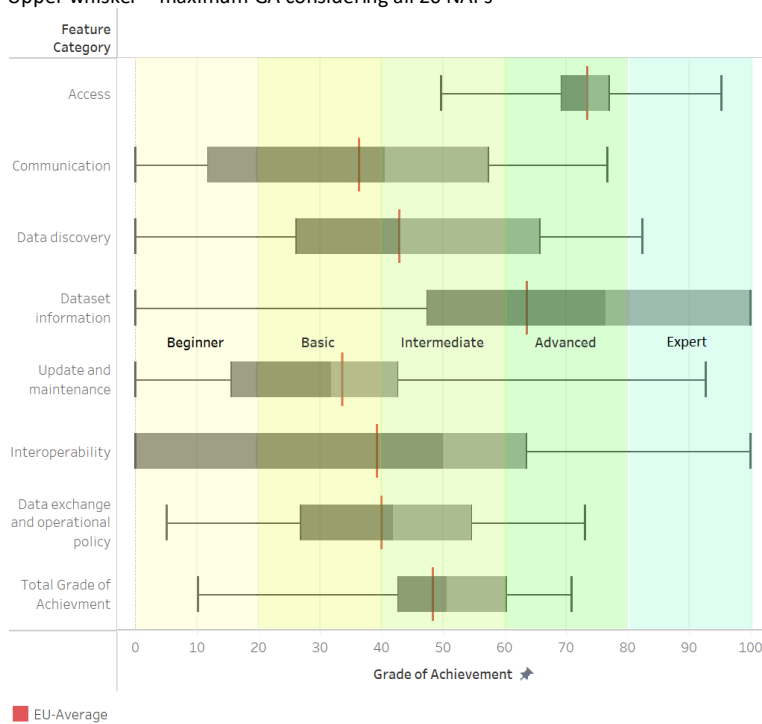


Figure 1 – NAP LoS self-assessment results: EU-wide distribution of GA per Feature + EU-Average

Maturity level is a qualitative assessment in the NLKF tool, using 5 classes, each for one fifth GA value scale. See Milestone 2.1/T2.1.2. After the terminology update (see above in Chap. 1.2), maturity levels are expressed by the values “Beginner”, “Basic”, “Intermediate”, “Advanced” and “Expert”.

It can be observed that the Feature “Access” presents higher grades of achievement and less variability with most MSs in the “advanced” maturity level. On the other hand, features “Communication”, “Update and maintenance” and “Interoperability” present average grades of achievements in the basic maturity level and significant variability among Member States. In addition to that, although the EU-average of the feature “Dataset information” presents an “advanced” maturity level, there is clearly a lack of harmonisation, given that the GA vary from 0 to 100.

Considering this approach, the variability observed in the grades of achievement of most of the feature categories, as well as the fact that several features present minimum GA values equal to zero, can be considered as lack of EU-wide NAP harmonisation, and hence a gap to be addressed by NAPCORE.

Another interesting observation is that the EU-average of the Total Grade of Achievement (see Figure 1), which is an estimation of the current EU-wide NAP LoS based on a weighting system (including both weights for individual KPIs and weights for the Feature categories – groups of KPIs, see M2.1/T2.1.2) applied to all features, is at the intermediate level of maturity (GA) is around 50. This provides an



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indicator for the current status of NAPs across Europe and can be used as input for other tasks within NAPCORE and also for comparison and improvement by NAP operators.

From another perspective,

Figure 2 - LoS Self-assessment results: Number of NAPs in each Level of Maturity

highlights the number of NAPs in each Level of Maturity (from “Beginner” to “Expert”), for each Feature Category, as well as for the Total GA.

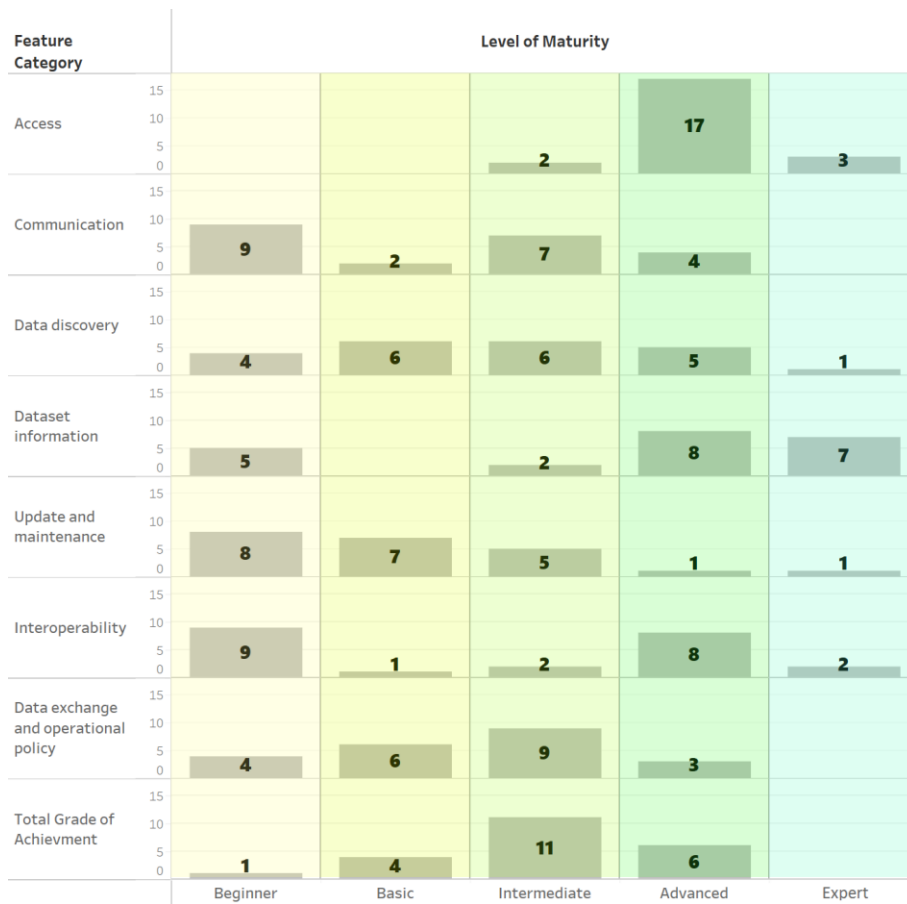


Figure 2 - LoS Self-assessment results: Number of NAPs in each Level of Maturity

The feature categories “Communication” and “Interoperability” have the largest number of NAPs within the beginner level of maturity, followed closely by “Update and Maintenance”. Therefore, to add to the lack of harmonisation, the fact that these features are underperforming can be also considered as a gap in order to achieve higher levels of service. Actions focused in fulfilling the gaps related to these specific categories would be adequate.

Although it was possible to observe a few 'gaps' by analysing the EU-wide LoS status per feature category, a more detailed analysis was considered necessary, given that it would allow for the



development of more specific recommendations for all potential actors within the NAP environment. In that sense, Chapter 2.3 addresses the identification of gaps concerning specific KPIs.

2.3. Evaluation methodology of single features

The NLKF defines a large number of single features, i.e., the KPIs within the different feature categories examined in chapter 2.2. For each KPI, a minimum acceptable LoS has been defined. The results of the NLKF self-assessment were used to identify NAP features, for which the current NAP functionalities³ are not satisfying.

When systematically working with NAPs, two types of NAPs are considered from the beginning (including Milestone 2.1):

- “Data directory”, respectively now a newly introduced designation “**Metadata directory**” – this is the NAP providing metadata (description of datasets and data sources in a predefined way) to an end user or data service provider. This type of NAP is not involved in the data exchange process between data providers and data consumers.
- “**Data Platform**” – this is the NAP providing real data or data services to data user or data services through the NAP (via download, API or other data transfer channels including data usage contracts).

Each NAP is evaluated in one category only, selected by the country (according to the NAP use plan). Data platform type includes all the Metadata directory features plus something more, see M2.1/T2.1.2. With regard to the NAP type, the relevance of specific KPIs is derived, as well as the weights of the KPIs used in the calculations.

This chapter presents the evaluation procedure – determination of assumptions, metrics and criteria for selecting features that need to be improved in order to eliminate/minimize gaps in individual NAPs.

> **Assumptions (input values) for evaluation**

Gaps in NAP functionalities are searched based on the KPIs established during the development of the NLKF method of NAP evaluation in task T2.1.2 in 2022.

Since KPIs are mainly of a qualitative nature, i.e., they are values on an ordinal scale or binary evaluation, it is not possible to determine the value of the deficiency itself, or distance from the minimum acceptable value, so the deviation in the KPI value cannot be quantified. However, a procedure was proposed where the knowledge of this deviation is not essential.

Minimum acceptable LoS value is based on the analysis of the first survey mentioned in chapter 1.2 – approach, during the development of the NLKF. As previously mentioned, while defining the possible values for each KPI, the empirical evidence allowed to determine which values should be addressed as resembling a minimum acceptable grade of achievement. These are being considered – for the current analysis – as the minimum acceptable values.

For gap assessment, a methodology is chosen that identifies KPIs with significant gaps, based on the following assumptions:

- a) **Occurrence of insufficient features** across NAPs in individual member states, i.e., when KPI value for a specific NAP is not reaching the minimum acceptable value. This is used to identify the features where many NAPs still have to catch up to the NAP minimum acceptable functionality.

³ The functionalities refer to NAP reference architecture



b) **Significance of relevant features**, i.e., weight of KPIs. This is used to identify the most important features for NAP harmonisation. The weighting of KPI features according to their relevance is based on expert assessment.

The aim of the gap assessment is to propose measures to eliminate/mitigate the gaps and not to propose such measures for every KPI. Therefore, the purpose of gap assessment is to focus on the most important gaps in the sense of high values concerning assumptions a) and b).

To calculate the **occurrence of insufficient KPI values (1st assumption – ad a)**, it is enough to evaluate in which case of NAP the value of the KPI is lower than the acceptable minimum.

The minimum acceptable KPI value for evaluation is based on the values set for evaluation in NAPCORE task T2.1.2 in 2022 by the task expert team. The minimum acceptable KPI values are described on Milestone 2.1, where they were marked as “must have” (see Milestone 2.1, the Tables 2 to 8). They are considered uniformly for both types of NAP, i.e., “Metadata directory” and “Data platform”, with the fact that some KPI indicators are irrelevant for the “Metadata directory” type due to the NAP functions (the relevancy is seen in Milestone 2.1, Tab. 10). It is possible that in the future, the minimum requirement for specific KPIs will be distinguished differently for these two types of NAP, but so far, such a distinction has not been found necessary. The difference in NAP type is expressed with different KPI weights and their relevance, see below.

Furthermore, the fact that **the minimum acceptable value must be nonzero** is taken into account, because otherwise it would not be possible to indicate a gap for the relevant KPI. Each KPI indicator was constructed in such a way that its certain level indicates the suitability of use for NAP. Thus, the lowest (usually zero) value must (considering the need to define such an indicator) always be insufficient. Therefore, for all KPI values, where until now a value of zero has been considered as the minimum for NAP evaluation, a value of 1 is now required as a criterion for finding gaps, i.e., as a minimum acceptable value. This change is justifiable, because while evaluating NAPs in NLKF the current NAP status was evaluated with a value of zero, now we need a higher goal for finding gaps in order to be able to improve anything.

The further adjustment of the minimum acceptable values is based on the **recommendations from Task 2.3**, from which the assessment results are available from May 2023 as part of the revision of the KPIs with the aim of improving them for future evaluations. The following modifications of the minimum acceptable values for 6 KPIs, all to a value of 2, are relevant for needs of this task:

- **KPI 2.1:** Is support to users to register and add data/metadata available? → Yes, on the site or can be downloaded in the local language + English;
- **KPI 3.1:** Can a user search for content on the NAP? → Text search based on harmonized metadata (free text + proposed keywords);
- **KPI 3.3:** Is machine-readable metadata provided by the NAP? → Yes, provision of machine-readable metadata as Linked Data (“RDF” that also can be expressed in JSON-LD, ...) in a self-describing format according to a harmonized metadata application profile;
- **KPI 5.1:** How has the NAP provided documentation and description of datasets? → Availability of links and supporting material (e.g., schemas), where necessary;
- **KPI 6.1:** Has the NAP adopted the Coordinated Metadata Catalogue? → Full adoption and compliance;
- **KPI 7.2:** Is it possible for the NAP to provide “Terms and Conditions for data re-use” defined by the data provider? → Detailed (where necessary – full sample contract conditions and/or standardized licenses framework).

The significance of the KPI (2nd assumption – ad b) is given by the weight of the KPI determined in the task T2.1.2 in 2022 (see the Milestone 2.1). For the needs of this task, it was not necessary to change the weights and they are kept fully equivalent to the evaluation in the NLKF method, where these weights were determined based on the setting by the expert team.





KPI weights are set in NLKF and also used here differently with regard to the type of NAP (“Metadata directory” and “Data platform”), because the priorities of individual KPIs are different for different types of NAP due to different functionalities. In addition, some KPIs are irrelevant for the “Data directory” type. The weight values are numerical between 0 and 1, with a higher value meaning a higher weight. The exact values and KPI relevancy to the NAP types are given in M2.1 (see Tab. 10).

> Evaluation metrics

To evaluate the NAP in relation to the assumptions above (ad a, b), the following 5 metrics were defined:

- **Metric 1:** count of NAPs with non-acceptable KPI; the output is a number of NAPs where the value of the relevant KPI does not reach acceptable minimum value;
- **Metric 2:** weighted count of NAPs with non-acceptable KPI; the output is the number of NAPs where the value of the respective KPI does not reach acceptable minimum value, multiplied by the weight of the respective KPI;
- **Metric 3:** % of NAPs with non-acceptable KPI; the output is the percentage of NAPs where the value of the relevant KPI does not reach acceptable minimum value;
- **Metric 4:** weighted % of NAPs with non-acceptable KPI; the output is the percentage of NAPs where the value of the respective KPI does not reach acceptable minimum value, multiplied by the weight of the respective KPI;
- **Metric 5:** KPI weight followed by related values for NAPs with non-acceptable KPIs; the output is the weight of the criterion itself, for which it is subsequently possible to monitor the respective values of metrics 1 to 4.

As it can be seen, the metrics 2 and 4 allow combining both the assumptions, i.e., occurrence of gaps and the importance of KPIs, using a simple product.

For each of the metrics, it is possible to determine the **ranking of all assessed KPIs** according to significance, from the highest output value to the lowest. Each of the metrics can be applied separately to NAPs by type (Metadata directory, Data platform), or to all NAPs regardless of type (this means that KPI values for both NAP types are included in the calculation).

> Evaluation environment and criteria

The evaluation according to these metrics (ad a, b) can be performed automatically in the MS Excel environment, when the result is a compiled ranking of individual KPIs according to the relevant metric.

The results of the “Workshop NAP LoS self-assessment” (from March 31, 2023, organized in Portugal and on-line) were evaluated, are used for the evaluation. In this workshop, inputs from 22 NAPs from 20 member states were collected and all 45 KPIs determined for the NLKF method in task T2.1.2 were assessed. Table 1 shows an example of evaluation sorted out by Metric 4 for all NAPs regardless of type.

Table 1: MS Excel output sample – gap indication sorted out by Metric 4 (weighted % of NAPs with non-acceptable KPI) for all NAPs regardless of type

#	KPI no.	KPI name	Weighted % of NAPs below minimum acceptable LoS	% of NAPs below minimum acceptable LoS	Count of NAPs assessed	KPI weights*	KPI weights #*	KPI value acceptable limits*
1	3.3	Machine-readable metadata	43.7	82	22	0.6; 0.5	18; 21	2; 2
2	6.1	Metadata catalogue	38.1	64	22	0.6; 0.6	12; 14	2; 2
3	1.15	Data security and access restrictions for downloading	36.7	69	13	N/A; 0.5	N/A; 17	N/A; 2



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4	1.14	Data security and access restrictions for uploading	34.8	50	8	N/A; 0.7	N/A; 7	N/A; 2
5	7.2	Data reuse – data provider	26.6	64	22	0.4; 0.4	24; 26	2; 2
6	2.6	Contact means	25.4	50	22	0.5; 0.5	22; 20	3; 3
7	5.1	Documentation & description of datasets	25.3	45	22	0.6; 0.5	15; 16	2; 2
8	4.3	Monitoring and evaluation	25.0	73	22	0.3; 0.4	31; 30	1; 1
9	1.12	Procedure for publication of metadata or data on the NAP	24.8	37	19	0.7; 0.7	6; 8	1; 1
10	7.3	Operational procedure information	23.9	77	22	0.3; 0.3	29; 37	1; 1

..... ranking; * ... two values: the first is for "Metadata directory" NAP type; the second for "Data platform"

The following **criteria** were finally chosen as **objective and significant for this task** (with the aim of focusing on the most important gaps in the sense of high values ad a, b):

- **Criterion A:** Metric 4 (weighted % of NAPs with non-acceptable KPI) for all NAPs regardless of type, using the 9 highest rated KPIs according to this criterion;
- **Criterion B:** Metric 4 (weighted % of NAPs with non-acceptable KPI) for the NAPs of the "Metadata directory" type, adding KPIs from the 9 highest-rated KPIs according to this criterion, which have not yet been selected by the previous criterion A;
- **Criterion C:** Metric 5 (KPI weight) for all NAPs regardless of type, adding KPIs from the 9 highest-rated KPIs according to this criterion, which have not yet been selected by the previous criteria A+B and which are (in Metric 1) in at least 2 NAPs classified as non-acceptable.

The above criteria are the result of the consensus agreement of the expert team. The choice of Metric 4 for Criteria A and B makes it possible to work with the proportion of NAPs with unsatisfactory status, which should be independent of the number of participants of the workshop that provided the source data. Criterion B allows adding features related to the "Metadata directory" NAP type, which are features that any NAP should contain. The choice of Metric 5 supported by Metric 1 for criterion C makes it possible not to forget important features where partial (though not massive) deficiencies were observed. The choice of the number of top-ranked KPIs at the value of 9 for all three criteria depends on the rate of decline in the criteria values, and also on the expected number of analysis results.

> **Conclusions to the evaluation methodology**

Two assumptions (a, b) have been defined to select the gap features – occurrence of insufficient NAP features and feature significance (KPI weight). Then, **five metrics** (1 to 5) for the gaps evaluation have been created using both the assumptions a) and b) and **three criteria** (A to C) have been selected for the use of the metrics. **The results** are described in the following chapter 2.4.

2.4. Identified gaps of single features

For identification of the gaps of single features, we are using 3 criteria (A, B, C) found in the previous Chap. 2.3 as objective and significant for this task. The result of the application these three criteria means that **the following KPI features with gaps are identified** to be assessed (detailed information including metrics of chosen gaps/KPIs follows later in this chapter):

For **Criterion A**, these are the following 9 KPI features that need to be improved (sorted by the appropriate Metric 4 from the most important to the less important):

- **KPI 3.3:** Machine-readable metadata
- **KPI 6.1:** Metadata catalogue
- **KPI 1.15:** Data security and access restrictions for downloading



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- **KPI 1.14:** Data security and access restrictions for uploading
- **KPI 7.2:** Data reuse – data provider
- **KPI 2.6:** Contact means
- **KPI 5.1:** Documentation & description of datasets
- **KPI 4.3:** Monitoring and evaluation (*this KPI is not seen as crucial for this task, see below*)
- **KPI 1.12:** Procedure for publication of metadata or data on the NAP

For **Criterion B**, these are the following 4 additional KPI features that need to be improved (sorted by the appropriate Metric 4 from the most important to the less important):

- **KPI 4.2:** Content and metadata
- **KPI 7.3:** Operational procedure information
- **KPI 6.2:** Harvesting functionalities
- **KPI 1.16:** Indication of data modification

For **Criterion C**, these are the following 2 additional KPI features that need to be improved (sorted by the appropriate Metric 5 using Metric 1 from the most important to the least important):

- **KPI 3.1:** Search functionalities
- **KPI 3.2:** Search results

The result therefore means finding 15 KPI features where there are significant gaps in the NAPs. Actions are being sought for these KPIs to eliminate/mitigate gaps (see chapter 2.5). Finally, only **14 KPIs are considered for possible actions**, because KPI 4.3 is not seen as crucial to the interoperability of NAPs.

> Deeper description of identifying the gaps

The **Criterion A** is using Metric 4, according to chapter 2.3, i.e., the combination of both assumptions a) and b) (mathematically: multiplication of insufficient features occurrence and KPI weight) and leads to the Top 9 ranking of gap features shown in the following Table 2. Therefore, the percentage of NAPs below the minimum LoS was multiplied with the weight of the KPI feature. This means that those features have a high weight (i.e. importance) and are not reached by a large number of NAPs.

Therefore, it is important to find out how these gaps can be bridged soon. For the features highlighted in blue (i.e., those 14 KPIs mentioned above), possible actions to eliminate/mitigate the gaps will be discussed in chapter 2.5. A more detailed description of the features including the grading scale can also be found there. The greyed feature (KPI 4.3) was considered as not important for interoperability reasons and will not be examined further.

Table 2: Top 9 KPIs regarding the weighted percentage of NAPs below the minimum LoS (Criterion A, Metric 4).

KPI name (no.)	NAP weighted percentage below minimum acceptable LoS ⁽¹⁾	Count of NAPs below minimum acceptable LoS	Count of NAPs assessed
Machine-readable metadata (3.3)	44	18	22
Metadata catalogue (6.1)	38	14	22
Data security and access restrictions for downloading (1.15)	37	9	13
Data security and access restrictions for uploading (1.14)	35	4	8
Data reuse – data provider (7.2)	27	14	22



Contact means (2.6)	25	11	22
Documentation & description of datasets (5.1)	25	10	22
Monitoring and evaluation (4.3)	25	16	22
Procedure for publication of meta-data or data on the NAP (1.12)	25	7	19

⁽¹⁾ [Count of NAPs below minimum acceptable LoS] divided by [Count of NAPs assessed] multiplied with [KPI weight]*100

The Table 2 above shows the results for Criterion A, i.e. for all NAPs regardless of NAP type. Similar principle has been used to add the 4 more KPI features mentioned above (i.e. KPI 4.2, 7.3, 6.2 and 1.16) using **Criterion B** according to chapter 2.3, i.e. the same Metric 4 but for the NAPs of the “**Metadata directory**” type only, see the blue-coloured items in the following Table 3. The orange-coloured items are the features that are already selected within the Criterion A. The greyed feature (KPI 4.3) was previously considered as not important for interoperability reasons and will not be examined further.

Table 3: Top 9 KPIs regarding the weighted percentage of NAPs below the minimum LoS (Criterion B, Metric 4).

KPI name (no.)	NAP weighted percentage below minimum acceptable LoS ⁽¹⁾	Count of NAPs below minimum acceptable LoS	Count of NAPs assessed
Machine-readable metadata (3.3)	49	8	9
Content and metadata (4.2)	36	7	9
Metadata catalogue (6.1)	34	5	9
Operational procedure information (7.3)	29	8	9
Monitoring and evaluation (4.3)	27	8	9
Harvesting functionalities (6.2)	27	6	9
Contact means (2.6)	27	5	9
Documentation & description of datasets (5.1)	26	4	9
Indication of data modification (1.16)	23	3	5

⁽¹⁾ [Count of NAPs below minimum acceptable LoS] divided by [Count of NAPs assessed] multiplied with [KPI weight]*100

Besides the weighted percentage of NAPs not reaching the minimum LoS, the features which have been ranked the most important were assessed (**Criterion C**, according to chapter 2.3). Table 4 shows the Top 3 that is relevant according to the criterion definition and the results (other features from the Top 9 are still selected within the criteria A and B or are not relevant because of the Criterion C definition). As the features “Search functionalities” and “Search results” are not implemented with the minimum LoS for at least two NAPs (as defined in Criterion C), they will also be discussed further.

Table 4: Top 3 KPIs regarding their absolute weight (Criterion C, Metric 5)

KPI name (no.)	KPI weights ⁽²⁾	Count of NAPs below minimum acceptable LoS	Count of NAPs assessed
Online availability (1.1)	0.86; 0.90	0	22
Search functionalities (3.1)	0.77; 0.77	4	22
Search results (3.2)	0.77; 0.74	3	22

⁽²⁾ weights for the two categories “Metadata directory” and “Data platform”





2.5. Possible actions to close the gaps

The following tables suggest a list of actions that can be taken to eliminate/mitigate the gaps mentioned in the previous chapter 2.4, i.e., **14 KPI features** listed at the beginning of the chapter 2.4 and blue-coloured in the Table 2, Table 3 and Table 4 are considered for possible actions. These actions are listed below in the tables sorted according to the Feature categories’ respective KPIs’ numbering because of better navigation in the details (while the importance is seen in the previous chapter including the metric). The tables below also show specific KPI values, where the red colour indicates an unacceptable value and the green colour an acceptable value.

These actions are derived by the Task2.1.3 expert group and classified into organizational and technical levels. The **organizational** level typically encompasses actions that are based on the attainment of a common European ground, the promotion of technical achievements, the provision of guidelines and best practices, the development of governance processes, and/or the acquisition of the required resources to support further uptake. On the **technical** level, actions may either be relevant for the NAPCORE project and its working program with providing input to other WGs (beyond WG2) for the adaptation of technical artefacts under development to NAP's LoS requirements (e.g. new standards, profiles, quality assessment frameworks). On the other hand, technical actions can be meant for European NAPs individually and include the development of procedures, frameworks, functionalities, and/or documentation aimed at increasing NAP's LoS across Europe. This also encompasses actions involving the implementation of key NAPCORE outputs by Member States (e.g., mobilityDCAT-AP). In general, a legal level of actions could be introduced to enforce or support the implementation of organizational or technical developments. This possibility has not been assessed in greater detail.

Further to the above, the suggested actions are further classified via the following considerations:

- NAPCORE/European/national level: assessment of whether an action should be taken within NAPCORE, at the European or national level (or both).
- Short-term/Long-term: assessment of whether an action should be taken on a relatively short time horizon or in the long run.
- One-time/recurring: assessment of whether an action should be taken once or on a repeated basis until a minimum acceptable state is achieved.

Procedure for publication of metadata or data on the NAP		KPI 1.12: Not featured by 7 of 21 NAPs
<p>KPI definition: Data providers need to register to add data/metadata</p> <p>Possible KPI values:</p> <ul style="list-style-type: none"> • N/A: No data/metadata provided via NAP interface; • 0: Data resource metadata and producers' data is added by site maintainers; • 1: The producers are inputting data themselves; • 2: The producers are inputting data + the content of the data is verified manually in some random samples by the NAP; • 3: The producers are inputting data + content of the data is verified (partially) automatically by the NAP 		
Organizational actions	<ul style="list-style-type: none"> • NAPCORE should agree on a common procedure how (meta)data can be supplied by data providers. (What kind of verification or quality check is useful/necessary?) This would help service providers to know what to expect from the (meta)data on any NAP. 	<ul style="list-style-type: none"> • NAPCORE level • Long term • One time
Technical actions	<ul style="list-style-type: none"> • Development of a metadata quality and completeness check framework to facilitate the decentralization of metadata creation and maintenance burden. The development of this framework should rely on existing best practices. 	<ul style="list-style-type: none"> • NAPCORE level • Long term • One time





	<ul style="list-style-type: none"> Development of an efficient metadata verification procedure that may be based on either: <ol style="list-style-type: none"> manual inspection procedure by NAP operator or by data provider, or automated inspection procedure at NAP. . By that means, the role of NAP operators may more closely resemble the role of a supervisory/auditing authority. Note: verification procedure to be based on DCAT-AP 	<ul style="list-style-type: none"> European level Long term One time
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Data security and access restrictions for uploading and downloading		
KPI 1.14/1.15: Not featured by 4 of 8 NAPs (up) / 9 of 13 NAPs (down)		
<p>KPI definition: (1.14) When uploading data as a provider, several security mechanisms could be in place to ensure the trust in the data or restrict the access; (1.15) When accessing data as a consumer, several security mechanisms could be in place to ensure the trust in the data or restrict the access</p> <p>Possible KPI values:</p> <ul style="list-style-type: none"> N/A: No data can be (1.14) uploaded / (1.15) accessed via NAP interface; 0: No security or authentication mechanisms in place; Value+1 for each of the following options: <ul style="list-style-type: none"> a. Transport security (https); b. Authentication by IP filter (access based on IP address of the (1.14) provider / (1.15) consumer); c. Basic authentication according to RFC 7617; d. Digest authentication according to RFC 7616; e. Authentication by url parameters; f. Authentication by client certificate (private keys, certificates) (1.15) Note: For open data access, option (a) is the ideal but for PUSH data you shall need more Acceptable minimum: 2 		
Organizational actions	<ul style="list-style-type: none"> Agree on an EU-wide common user authentication mechanism as a feature part of the NAP Reference Architecture. 	<ul style="list-style-type: none"> European level Short/long term One time
Technical actions	<ul style="list-style-type: none"> NAP operator to implement sufficient security mechanisms able to authenticate the users. (KPI only applicable for exchange of content data, not for metadata.) 	<ul style="list-style-type: none"> National level Short/long term One time

Commented [GD1]: I expect this to be a huge challenge. NAPCORE cannot take care of this...

Indication of data modification		
KPI 1.16: Not featured by 8 NAPs		
<p>KPI definition: When accessing the data stored at NAP (snapshots / static datasets), indication of the change of the dataset in comparison to previous access is needed to save bandwidth; Note: information about the data modification can also be as metadata i.e. this KPI could also be applied to the "Metadata directory" NAP type</p> <p>Possible KPI values:</p> <ul style="list-style-type: none"> N/A: No data provided via NAP interface resp. no metadata used for the information about data modification; 0: No change/modification information is provided; 1: Webserver uses either if-modified-since or if-none-match (etag) headers; 2: Webserver uses both if-modified-since and if-none-match (etag) headers 		
Organizational actions	<ul style="list-style-type: none"> NAPCORE should agree on a common procedure how data modifications are displayed in DCAT-AP and dealt with at server level. 	<ul style="list-style-type: none"> NAPCORE level Long term One time
Technical actions	<ul style="list-style-type: none"> To investigate how metadata concept can support monitoring of indication of data modification and to implement server-side indications of data modification. 	<ul style="list-style-type: none"> European level Long term One time

Contact means		
KPI 2.6: Not featured by 11 of 22 NAPs		
<p>KPI definition: Provision of contact means to data consumers on the NAP website</p> <p>Possible KPI values:</p>		



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	<ul style="list-style-type: none"> • 0: No contact is available; • 1: Contact details of NAP operator are published; • 2: Contact details of NAP operator and some data providers are published; • 3: Contact details of NAP operator and all data providers are published; • 4: More than one contact means is provided 	
Organizational actions	<ul style="list-style-type: none"> • Include contact of NAP operator and of the data providers as part of the NAP Reference Architecture. 	<ul style="list-style-type: none"> • NAPCORE level • Short term • One time
Technical actions	<ul style="list-style-type: none"> • NAPCORE to make the provision of data providers and NAP operator (of a minimum) contact details mandatory in mobilityDCAT-AP 	<ul style="list-style-type: none"> • NAPCORE level • Short term • One time

Search functionalities		KPI 3.1: Not featured by 4 of 22 NAPs
<p>KPI definition: Search functionalities</p> <p>Possible KPI values:</p> <ul style="list-style-type: none"> • 0: Not available discovery services; • 1: Available discovery services not necessarily based on harmonized metadata; • Value+1 for each of the following options: <ul style="list-style-type: none"> ○ a. text search based on harmonized metadata (free text); ○ b. text search based on harmonized metadata (proposed keywords); ○ c. search options AND, OR, wild card (*), range (from... to...) available; ○ d. enumeration search based on harmonized metadata; ○ e. map-based search; ○ f. other location-based search (e.g., NUTS-Code); ○ g. option to save search pattern or settings • Acceptable minimum: 2 		
Organizational actions	<ul style="list-style-type: none"> • Propose keywords and harmonised naming conventions for the datasets 	<ul style="list-style-type: none"> • NAPCORE level • Short term • One time
	<ul style="list-style-type: none"> • Propose a roadmap from the simple search functionality to minimum search functionality (the metadata guideline) 	<ul style="list-style-type: none"> • European level • Short term • One time
Technical actions	<ul style="list-style-type: none"> • NAP operators to implement search functionalities with basic search options 	<ul style="list-style-type: none"> • National level • Short term • One time

Search results		KPI 3.2: Not featured by 3 of 22 NAPs
<p>KPI definition: Display of search results</p> <p>Possible KPI values:</p> <ul style="list-style-type: none"> • 0: No display of search results; • 1: List of search results; • Value+1 for each of the following options: <ul style="list-style-type: none"> ○ a. options to filter and sort search results ○ b. Map-based presentation of search results • Acceptable minimum: 1 		
Organizational actions	<ul style="list-style-type: none"> • NAPCORE guideline on how to make search results available to users 	<ul style="list-style-type: none"> • NAPCORE level • Short term • One time
Technical actions	<ul style="list-style-type: none"> • NAP operators to implement search functionalities displaying search results in different ways 	<ul style="list-style-type: none"> • National level • Short term • One time

Machine-readable metadata	KPI 3.3: Not featured by 18 of 22 NAPs
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<p>KPI definition: Provision of machine-readable metadata</p> <p>Possible KPI values:</p> <ul style="list-style-type: none"> • 0: Not available machine-readable metadata; • 1: Provision of machine-readable metadata in a self-describing format (JSON, XML, ...); • 2: Provision of machine-readable metadata as Linked Data ("RDF" that also can be expressed in JSON-LD, ...) in a self-describing format according to harmonized metadata application profile 		
Organizational actions	<ul style="list-style-type: none"> • To define the governance and (long term) maintenance of mobilityDCAT-AP 	<ul style="list-style-type: none"> • European level • Short term • One time
	<ul style="list-style-type: none"> • To educate potential NAP users (data providers and data users) in the application of DCAT-AP, through European wide training programs. (guidelines) 	<ul style="list-style-type: none"> • European /national level • Long term • Recurring
Technical actions	<ul style="list-style-type: none"> • NAPCORE to develop and publish (European) mobilityDCAT-AP 	<ul style="list-style-type: none"> • NAPCORE level • Short term • One time
	<ul style="list-style-type: none"> • Provide mobilityDCAT-AP validator / test centre (for creation and validation of mobilityDCAT-AP compliant records) 	<ul style="list-style-type: none"> • NAPCORE level • Short term • One time
	<ul style="list-style-type: none"> • Implementation of DCAT-AP in NAP 	<ul style="list-style-type: none"> • National level • Long term • One time

Content and metadata		KPI 4.2: Not featured by 11 NAPs
<p>KPI definition: NAP content and metadata</p> <p>Possible KPI values:</p> <ul style="list-style-type: none"> • 0: Not established processes for maintenance data and metadata on a regular basis, and checking links; • 1: Established common responsibilities and procedures for the NAP content and metadata maintaining and up to dating on a regular basis between NAP operators, data suppliers and data publishers: Keeping the data up-to date by systematically assessing data quality. For static data – once a year, dynamic data – on demand, metadata – once a year; checking the functioning of links (from and to datasets) once per six months; • 2: Established common responsibilities and procedures for the NAP content and metadata maintaining and up to dating on a regular basis between NAP operators, data suppliers and data publishers: Keeping the data up-to date by systematically assessing data quality for static data – every six months, dynamic data – continuously, metadata – once per six months; checking the functioning of links (from and to datasets) – once per three months 		
Organizational actions	<ul style="list-style-type: none"> • Agree on an EU-wide commonly accepted procedure for content and metadata quality assessment and maintenance 	<ul style="list-style-type: none"> • European level • Long term • One time
	<ul style="list-style-type: none"> • Define and implement processes and responsibilities for data quality assessment and maintenance 	<ul style="list-style-type: none"> • National level • Long term • One time
Technical actions	<ul style="list-style-type: none"> • NAPCORE to further develop a common data quality framework for assessment. 	<ul style="list-style-type: none"> • NAPCORE level • Long term • One time

Documentation & description of datasets		KPI 5.1: Not featured by 10 of 22 NAPs
<p>KPI definition: Documentation & description of datasets</p> <p>Possible KPI values:</p> <ul style="list-style-type: none"> • 0: Lack of dataset documentation and description; • 1: High-level description of datasets on the site (e.g., in the metadata page); • 2: Availability of links and supporting material (e.g., schemas), where necessary 		
Organizational actions	<ul style="list-style-type: none"> • NAP operators to provide guidelines on how to describe and document datasets published on NAPs 	<ul style="list-style-type: none"> • NAPCORE level • Short term • One time
	<ul style="list-style-type: none"> • NAPCORE should agree on a common framework how to describe datasets and when possible or available provide templates or examples. 	<ul style="list-style-type: none"> • NAPCORE level • Short term • One time



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Technical actions	<ul style="list-style-type: none"> To carry out an assessment of what is not included in the Metadata Catalogue/mobility DCAT-AP (and cannot be included due to complexity...) and indicate those aspects as relevant for the technical description of the datasets 	<ul style="list-style-type: none"> European level Long term One time
	<ul style="list-style-type: none"> NAP to require data providers to provide documentation describing datasets according to provided framework or template. 	<ul style="list-style-type: none"> National level Short term Recurring

Metadata catalogue		KPI 6.1: Not featured by 14 of 22 NAPs
<p>KPI definition: Adoption of Coordinated Metadata Catalogue</p> <p>Possible KPI values:</p> <ul style="list-style-type: none"> 0: No adoption; 1: Partial adoption (e.g., available metadata deviate to some extent from the suggestions of CMC); 2: Full adoption and compliance 		
Organizational actions	<ul style="list-style-type: none"> NAP Operators provide guidelines / support to data providers about the adoption and use of standardized metadata Promote a R&I call to further research, develop and test the adoption of mobilityDCAT-AP 	<ul style="list-style-type: none"> NAPCORE/National level Short term Recurring European level Short term One time
Technical actions	<ul style="list-style-type: none"> NAP Operators to implement mobilityDCAT-AP 	<ul style="list-style-type: none"> National level Short term One time

Harvesting functionalities		KPI 6.2: Not featured by 14 of 22 NAPs
<p>KPI definition: Support of harvesting functionalities</p> <p>Possible KPI values:</p> <ul style="list-style-type: none"> 0: Absence of harvesting functionalities; 1: Support of harvesting functionalities (e.g., the NAP can index datasets of other data portals and platforms); 2: Support of two-way harvesting functionalities (e.g., the NAP can index datasets of other data portals and platforms AND the datasets of the same NAP can be indexed in other portals or platforms) 		
Organizational actions	<ul style="list-style-type: none"> NAPCORE to create a guideline for harvesting metadata from and to the NAP. Promote and investigate the adoption of mobilityDCAT-AP (supporting harvesting functionalities) by data providers and NAPs 	<ul style="list-style-type: none"> NAPCORE level Long term One time European level Short term Recurring
Technical actions	<ul style="list-style-type: none"> Implement harvesting functionality (checks, crosschecks, updates, etc) 	<ul style="list-style-type: none"> National level Short term One time

Data reuse – data provider		KPI 7.2: Not featured by 14 of 22 NAPs
<p>KPI definition: Possibility of NAP to provide Terms and Conditions for data reuse defined by the data provider</p> <p>Possible KPI values:</p> <ul style="list-style-type: none"> 0: No provision; 1: Descriptive (brief text description); 2: Detailed (where necessary – full sample contract conditions and/or standardized licenses framework); Note: i.e., terms and conditions that depend on data provider who is the data owner 		
Organizational actions	<ul style="list-style-type: none"> NAPCORE should agree on a common framework how to describe terms and conditions and when possible or available provide templates or examples. 	<ul style="list-style-type: none"> NAPCORE level Long term One time
Technical actions	-	

Operational procedure information		KPI 7.3: Not featured by 17 of 22 NAPs
	<p>This project has received funding from the European Commission’s Directorate General for Transport and Mobility under Grant Agreement no. MOVE/B4/SUB/2020-123/SI2.85223 18</p>	



<p>KPI definition: Provision of operational procedure information (information about the processes in the NAP, e.g., how a potential data provider/consumer becomes accredited, the compliance assessment, how the data is provided, what is a contact point where to discuss the technical issues etc.)</p> <p>Possible KPI values:</p> <ul style="list-style-type: none"> • 0: No; • 1: Yes 		
<p>Organizational actions</p>	<ul style="list-style-type: none"> • NAPCORE to provide a template for NAP Operators on governance aspects, requirements concerning processes and responsibilities for data quality assessment and maintenance should be harmonized among the NAP Operators. 	<ul style="list-style-type: none"> • NAPCORE level • Long term • One time
	<ul style="list-style-type: none"> • NAP Operators to apply EU template to their local situation and create own national documentations for governance, registration process, data provision, etc. 	<ul style="list-style-type: none"> • National level • Long term • One time
<p>Technical actions</p>	<ul style="list-style-type: none"> • Publish documentations on the NAP website 	<ul style="list-style-type: none"> • National level • Long term • One time

> Summary

In total, there are **36 suggested actions/measures** for improving the NAPs in relation to KPIs from the NLKF. Actions for the KPIs 1.14/1.15 are implemented jointly, for other KPIs they are defined separately.

Most of them are organizational actions (21) and slightly less technical (15). The majority of actions are oriented to the NAPCORE (16) or European level (9), 9 measures are at the national level, and for two measures this status cannot be clearly distinguished. The actions are classified almost equally to short-term (18) and long-term (16), and for two measures this status cannot be clearly distinguished. The vast majority of actions (32) are one-time, only 4 measures are intended for a repeated/recurring process (related to the KPIs 3.3, 5.1, 6.1 and 7.2).

In one case (specifically for KPIs 3.1 and 3.2), the same (duplicate) action is proposed, which is considered as two actions in the above summary, as it may mean similar but different activities in the context of the specific different KPIs.



3. Recommendations for stepwise approach towards an interoperable NAP landscape in Europe

This chapter presents an overview of some of the current works towards a more interoperable NAP landscape in Europe, such as the development of a harmonised NAP architecture and the outlines of two European approaches (namely the European Access Point and the Mobility Data Space). Then, a set of KPIs from the NLKF considered as “enablers” for the existence of these platforms are listed.

Furthermore, based on this list and on the actions drafted in section 2, several recommendations towards NAP interoperability are provided at the end of this section, specifically focused on the ones where NAPCORE the leading actor is.

3.1. NAP landscape of European mobility data exchange initiatives

> NAPCORE NAP reference Architecture

NAP Reference Architecture is a part of a larger European ITS Architecture framework called FRAME created in the series of European projects⁴. The architecture is a concept and methodology. High level ITS architecture can be represented in a number of so called “Views” which are each focusing on a specific aspect of the IT System described by the architecture, and all together are forming a sufficient detailed description to be able to setup and most possibly operate the defined ITS System.

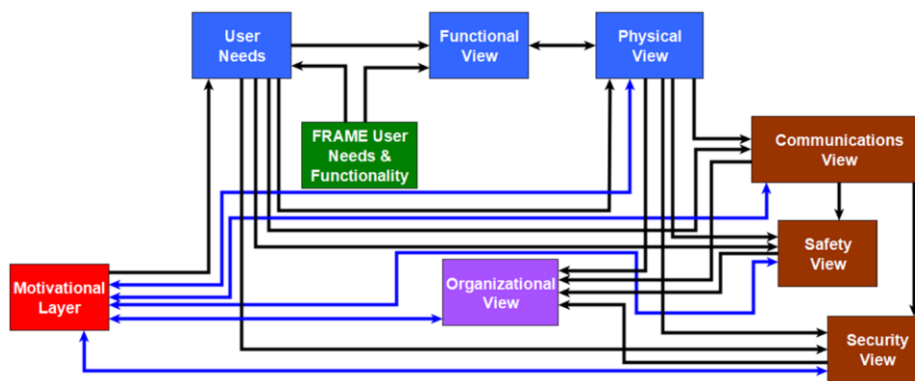


Figure 3 - FRAME Views and concept

The architecture views are enablers for successful planning, implementation and operation of an IT system. The IT practitioner, however, uses products of such views e.g. project description, requirements, organizational issues, component and interface specification, risk and cost benefit analyses and others.

The NAP reference architecture created in the project FRAME-NEXT detailed all the above-mentioned views. In order to align the created NAP architecture with the expectations of NAPCORE participants, the KPI definitions were transformed into objects of the Architecture (landing in some of the views) and their necessity discussed with stakeholders. Based on this work, the minimum acceptable functionality of NAP has been prepared and used to change minimum acceptable LoS of particular KPIs

⁴ KAREN, FRAME, FRAME-S, FRAME-NET, E-FRAME and FRAME-NEXT.



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(see Chap. 2.3). At the moment (summer 2023) the task 2.3 continue on harmonization work, by updating the FRAME NAP reference architecture by the findings from KPI transformation.

> EC European Access Point

Currently, there is an ongoing discussion on whether there should be a European Access Point for all the data categories required by the Delegated Regulations. As there are no specific guidelines concerning the concept of such a platform, task 2.4 from NAPCORE is elaborating a White Paper addressing the vision of NAPCORE with regard to several aspects that surround the EAP topic, such as the format (approach) and the associated responsibilities. The current vision is that the EAP should be an advanced repository of links including metadata (i.e., Metadata directory), with automatic interoperable harvesting and exchange tools. To that end, a set of minimum functionalities – which are related to the aforementioned features and KPIs (from the NLKF) – would be required. The EAP in this regard is an extension of national NAPs allowing to search and find for ITS data sources / services at one place, building upon existing NAPs and further fostering their interoperability.

Furthermore, regardless of the development of a European Access Point for all data from the NAPs, the EC already established that – by 2027 – there should be an EAP for Alternative Fuels data. Bearing that in mind, several requirements must be considered in order to allow for the existence of this access point. One of the main requirements, which has already been considered in task 2.4 (work item 2.4.6 – Alternative Fuels Demonstrator), is the provision machine to machine access interface for data. While listing the 'enabler' KPIs, it is essential to take this into account as well.

> EC European Mobility Data Space

The EU Commission wants to facilitate the exchange and (re)use of data to use their full potential. To realize this, in the European Strategy for Data (2020) the EU Commission announced its intention to build Common European Data Spaces for different strategic sectors. Those data spaces should all be interoperable and linked to each other. One of these data spaces will be for mobility data, the European Mobility Data Space (EMDS).

The OpenDEI project has defined Design Principles for Data Spaces (<https://design-principles-for-data-spaces.org/>, 2022) which are used by the EU-funded Data Spaces Support Centre (<https://dssc.eu/>) and various Preparatory Actions for Data Spaces in different sectors, including the Preparatory Action for a Data Space for Mobility (PrepDSpace4Mobility, <https://mobilitydataspace-csa.eu/>) Coordination and Support Action.

The Design Principles for Data Spaces propose data space building blocks (cf. **Error! Reference source not found.**) which are grouped in four categories: interoperability, trust, data value and governance.

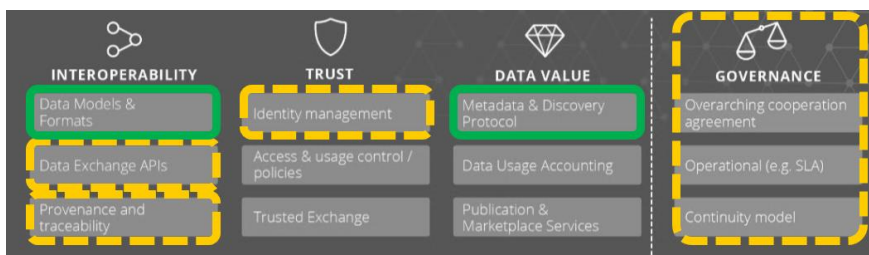


Figure 4 - OpenDEI building blocks for Data Spaces (from Nagel and Lycklama, 2021) and their relevance for the NAPs (solid green: current NAPCORE activities, high relevance; dashed yellow: potential future relevance).



Topic of an upcoming project with the aim of deploying the EMDS, funded by the EU Commission will be to identify which building blocks need to be implemented and how.

In the paper “Possible Roles of National Access Points in the European Mobility Data Space”, Bücking et al. (2023)⁵ have shown that the current interoperability efforts within NAPCORE already contribute to certain building blocks within the vision of the EMDS (solid green rectangles in Figure 3). Further building blocks are deemed beneficial, but have not been tackled yet by NAPCORE (dashed yellow).

3.2. Overview of crucial features (KPI) towards European initiatives interoperability

The current mobility data exchange landscape in Europe is characterised by the NAPs mandated by the Delegated Regulations. As described above, the planned evolution with an EAP could enhance the landscape. The future vision of an EMDS enables even more advanced mobility data exchange. All those future evolutions have further interoperability requirements on different levels. Based on expert assessment of T2.1.3 team the following KPIs, at a particular LoS, may be listed as the interoperable mobility data exchange landscape enablers, i.e. supporting further NAP harmonisation with a special focus on EAP and EMDS. It should be noted that this list is independent of the KPI selection in the Chapter 2 and independent on selection in the Chapter 3.3 (ordered by KPI number):

- **On-line availability (KPI 1.1):** On-line availability of NAPs constitutes a prerequisite for the interoperable NAP landscape including a technical feasibility of the EAP concept (i.e., if NAPs are not available on-line, it is impossible for the EAP to harvest any link or provided dataset description).
- **Support of commonly used languages (KPI 1.8):** Since EAP is expected to integrate content from various NAPs, it is essential that the content of NAPs is available in commonly used languages (at least English is needed). Otherwise, the harvested, i.e., referenced, content will be difficult to be searched, discovered, managed, and displayed.
- **Security – Technical (KPI 1.9):** The use of security certificates should be a basic requirement for ensuring data integrity on a transport layer, ensuring that the connection of the endpoints is secure, and endpoints are who they claim to be. This topic is important for EAP as well as an EMDS.
- **Security – Providers verification (KPI 1.10):** It is essential to ensure the trustworthiness of the content shared via NAP or EAP. This could be done by verifying data providers at the NAP level. Once NAP datasets come from verified data providers, it is easier for data users to get confidence. As the data space concepts are made for decentralized data exchange, an identity management should also be part of the EMDS. It will also be the basis for enabling provenance and traceability features.
- **Metadata access restrictions (KPI 1.13):** The metadata of individual NAPs should be easily accessible and retrievable (without unnecessary restrictions) in order to facilitate their discoverability by the harvesting functionalities of the EAP.
- **Data security and access restrictions for uploading (KPI 1.14):** The protection of data uploading through security and authentication mechanisms acts as an additional layer of enhancing the trustworthiness of the datasets available on European NAPs. This will also be fundamental to becoming part of an EMDS.
- **Data security and access restrictions for downloading (KPI 1.15):** Security requirements serve the need of integrity and availability. This does not only hold for uploading but also for downloading. The known data space concepts also include the concept of data sovereignty. If this is also to be included in an EMDS, it will be essential that data are not tampered with, and the data consumer is sufficiently identified.
- **Indication of data modification (KPI 1.16):** Indication of data modifications at a server level provide a facility to automatically disregard any downloads of unchanged content and to save bandwidth and processing power at data consumer’s side. For static resources, this indication in metadata helps data

⁵ Bücking, M., H. Drees, O. Gavaud, D. A. Gruber, T. Hoffmann, E. Thelisson, A. van Veenendaal: Possible Roles of National Access Points in the European Mobility Data Space, in: Network industries quarterly, Vol. 25, No. 2, Florence School of Regulation, 2023.

<https://hdl.handle.net/1814/75776>



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users and service providers to easily understand from the EAP interface whether a dataset is regularly updated (or not).

- **API usage for data transfer (KPI 1.18):** EAP and EMDS are expected to be beneficial for global service providers. APIs by providing standardized interfaces enable automated data transferring and consumption. In case of a harmonised API across NAPs, service providers may easily subscribe to the data and integrate them into their various applications and services empowering the continuity of travel and traffic information services across Europe.
- **Support to users to register and add data/metadata (KPI 2.1):** By providing support to users for registering to NAPs and adding data and metadata, the amount and completeness of data streams made available through NAPs (and therefore through the EAP or EMDS) is expected to be augmented.
- **Contact means (KPI 2.6):** The provision of contact details of data providers to potential data users allows data users to reach out for support and assistance regarding aspects, such as data access, terms and conditions for data re-use, and others. This feature is important for global data users and service providers, because they can easily identify with whom to get in touch for requesting additional information and clarifications. In addition, global data users and service providers can report any issues related to quality and accuracy of data directly to their providers (without engaging EAP operator and individual NAP operators).
- **Machine-readable metadata (KPI 3.3):** Machine-readable metadata constitutes a fundamental prerequisite for enabling the technical feasibility of harvesting data from individual NAPs. This will also be a prerequisite for any EAP or EMDS approach.
- **NAP content and metadata (KPI 4.2):** By establishing content and metadata maintenance procedures at the NAP level, the up-to-dateness and validity of information provided through the EAP is safeguarded.
- **Documentation & description of datasets (KPI 5.1):** The documentation of datasets provides valuable information regarding their content and structure. This feature helps data users and service providers to comprehend the nature of the data and if the corresponding data is relevant. Taking into account that nature of datasets varies from a MS to a MS, the provision of documentation becomes increasingly important.
- **Classification of datasets (KPI 5.2):** The classification of datasets based on common attributes and commonly agreed conventions is particularly useful for enabling the quick and unambiguous understanding of their functional scope.
- **Metadata Catalogue (KPI 6.1):** The adoption of a Coordinated Metadata Catalogue is important due to its ability to ensure consistency and interoperability across diverse datasets of various NAPs within the EAP or within an EMDS. In addition, this feature allows data users to quickly identify relevant datasets based on specific criteria. Moreover, it supports collaboration and data sharing among different stakeholders by providing a common metadata structure.
- **Harvesting functionalities (KPI 6.2):** Two-way metadata harvesting functionalities (including the ability of NAPs to expose/export metadata) is a prerequisite for the technical feasibility of the EAP, assuming its operation as a metadata harvesting node, and will also be used within an EMDS.
- **Data reuse – NAP (KPI 7.1):** The provision of terms and conditions for reusing any information provided by individual NAPs enables their legally compliant and ethical republication by the EAP.
- **Data reuse – data provider (KPI 7.2):** The provision of terms and conditions for reusing information and data resources made available by individual data providers establishes clear guidelines and expectations for data users regarding the proper reusage and attribution of the data obtained from the EAP. In this context, it is preferable for data providers to make use of universal data licensing frameworks and models. Attaching terms and conditions or even usage policies to single data offers will be necessary in an EMDS if data sovereignty concepts are to be implemented.
- **Operational procedure information (KPI 7.3):** In a decentralized data ecosystem like an EMDS, information on operational procedures is necessary for everyone who wants to participate.
- **Dataset indicators (KPI 7.4):** The provision of indicators and related to extent to which European datasets comply with the requirements set out in the DRs supplementing the ITS Directive acts as an additional layer of enhancing their trustworthiness.
- **Association of published datasets with DRs (KPI 7.6):** The association of datasets with European-wide conventions, such as the DRs supplementing the ITS Directive and their specific data categories, acts as an additional layer of enabling the quick and unambiguous understanding of their functional scope.
- **Quality indicators for datasets (KPI 7.7):** Quality indicators serve as specific measures that assess the reliability, accuracy, completeness, and consistency of the data resource that are made accessible





through the EAP. By establishing and providing common quality indicators, the EAP can ensure that the provided data meets certain standards and criteria. This feature is particularly important for global service providers, providing them a unified view of the aforementioned data attributes and enabling them to deliver consistent, reliable, and high-quality services to the end users.

This list of KPIs was created independently from the identified gaps in chapter 2.4. However, it can be seen that there is a large overlap between the identified gaps from the assessment of the NAPs and the identified KPIs which are important for European approaches towards interoperability. This proves that the current activities are going in the right direction and in addition, it allows a rough prioritisation and leads to a sequence of actions.

3.3. Prioritization of actions for key actors

For the NAPCORE project and a potential successor project, it is beneficial to make an estimation of the priorities of the different identified actions to be done in the next years. The initial idea of having a clear prioritization of what to do in a clear order turned out to be difficult to define.

As an alternative, the identified actions with a clear assignment for NAPCORE are clustered to four higher goals:

- > **Improve metadata of data offers**
- > **Improve contact details and terms and conditions of data offers**
- > **Improve data quality of data offers**
- > **Align user experience of data consumers**

The assigned actions within the clusters are ordered according to an estimation of how quick they can be completed (also considering the short-term/long-term classification from chapter 2.5). With a prioritization of those goals, a detailed sequence of actions can be further defined in the future.

> Improve metadata of data offers

1. NAPCORE to develop and publish (European) mobilityDCAT-AP (**KPI 3.3**)
2. NAP Operators provide guidelines / support to data providers about the adoption and use of standardized metadata (**KPI 6.1**)
3. Propose keywords and harmonised naming conventions for the datasets (**KPI 3.1**)
4. NAPCORE should agree on a common framework how to describe datasets and when possible or available provide templates or examples. (**KPI 5.1**)
5. Development of a metadata quality and completeness check framework to facilitate the decentralization of metadata creation and maintenance burden. The development of this framework should rely on existing best practices. (**KPI 1.12**)
6. Provide mobilityDCAT-AP validator / test centre (for creation and validation of mobilityDCAT-AP compliant records) (**KPI 3.3**)

> Improve contact details and terms and conditions of data offers

1. NAPCORE to make the provision of data providers and NAP operator (of a minimum) contact details mandatory in mobilityDCAT-AP (**KPI 2.6**)
2. Include contact of NAP operator and of the data providers as part of the NAP Reference Architecture. (**KPI 2.6**)





3. NAPCORE should agree on a common framework how to describe terms and conditions and when possible or available provide templates or examples. **(KPI 7.2)**

> Improve data quality of data offers

1. NAPCORE to provide a template for NAP Operators on governance aspects, requirements concerning processes and responsibilities for data quality assessment and maintenance should be harmonized among the NAP Operators. **(KPI 7.3)**
2. NAPCORE should agree on a common procedure how data can be supplied by data providers. (What kind of verification or quality check is useful/necessary?) This would help service providers to know what to expect from the (meta)data on any NAP. **(KPI 1.12)**
3. NAPCORE to further develop a common data quality framework for assessment. **(KPI 4.2)**

> Align user experience of data consumers

1. NAPCORE should agree on a common procedure how data modifications are displayed in DCAT-AP and dealt with at server level. **(KPI 1.16)**
2. NAPCORE guideline on how to make search results available to users **(KPI 3.2)**
3. NAPCORE to create a guideline for harvesting metadata from and to the NAP. **(KPI 6.2)**

As this report aims to indicate where the main gaps are when it comes to the NAPs' LoS and what could be done to fulfil those gaps, it is also important to focus on the NAP operators' perspective, as they are the actual implementers. Therefore, of the actions proposed in section 2.5, we gathered the ones that should be taken at a national level (or the ones where it was not easy to distinguish between national or European/NAPCORE levels), which would probably be handled by the NAP operators. A set of 11 actions derived from this analysis, most of which are technical and related to the implementations of specific features in the NAPs. The technical actions are highlighted in Table 5.

Table 5 - Technical actions to be carried out in a national level

Action	Estimated temporal segmentation	Recurrence
Implement sufficient security mechanisms able to authenticate the users. (KPI only applicable for exchange of content data, not for metadata.)	Short term	One time
Implement search functionalities with basic search options	Short term	One time
Implement search functionalities displaying search results in different ways	Short term	One time
Implement harvesting functionality (checks, crosschecks, updates, etc)	Short term	One time
Require data providers to provide documentation describing datasets according to provided framework or template.	Short term	Recurring
Provide guidelines / support to data providers about the adoption and use of standardized metadata	Short term	Recurring
Implement DCAT-AP in the NAP	Long term	One time
Provide guidelines on how to describe and document datasets published on NAPs	Long term	One time

This set of actions is a relevant input as it underlines the main points to be tackled by the NAP operators given the current state of practice of NAPs' LoS. While most actions refer to actual implementations of



Work item 2.1.3: Overview of gaps and actions needed – Milestone 2.2



specific features/functionalities (which could be done at once), others focus on providing guidelines or establishing requirements for data providers. Since that some of those actions might be implemented sooner than others, the idea is that this summarized set of actions can be incorporated into the NB's plans for improving their NAPs and that the short/long-term division may help to draw a roadmap for such an upgrade.

Furthermore, three organisational actions were also drafted for the national level:

- To educate potential NAP users (data providers and data users) in the application of DCAT-AP, through European wide training programs. (guidelines)
- Define and implement processes and responsibilities for data quality assessment and maintenance.
- NAP Operators to apply EU template to their local situation and create own national documentations for governance, registration process, data provision, etc.

Those do not refer specifically to features/functionalities of a NAP, but rather to setting up (or reviewing) relevant processes that are currently lacking. They could either be carried out by the NAP operators or other organisations from the National Bodies. Although they were all defined as long-term actions and – hence – will probably not be handled immediately, it is important to keep them in mind while elaborating a long-term strategy for enhancing the NAPs and the mobility data ecosystem as a whole.



4. Concluding remarks

The approach used for this work was made possible by the NAP Level of Service KPI Framework – a tool developed and published in Milestone 2.1 – “Typology of NAPs based on the description of levels of service and assessment of associated costs and benefits”. Such a tool was turned into a questionnaire and applied for 22 NAPs from 20 different MS, during the WG2 Workshop. The outcomes of the workshop allowed noting gaps and drafting actions in order to enhance LoS and interoperability among European NAPs.

At first, gaps were identified at the feature category level, after assessing some statistics regarding the European Aggregated measures. Categories that lack harmonisation or showed lower maturity levels were classified as gaps to be further looked into.

Then, a deeper analysis was carried out for the single features, so that more practical actions could be recommended. For that approach, the fact that there are several countries that do not meet the values defined as "minimum" in the NLKF (by expert judgement) was seen as an impeditive for improving NAP LoS, and therefore as gaps to be tackled by MS.

Bearing in mind that there is a large number of KPIs in each feature category, the ones that corresponded to the "most relevant gaps" were derived from: 1) occurrence of insufficient features; 2) significance of insufficient features. This allowed for establishing a set of metrics that later corresponded to the criteria utilized for the listing the KPIs related to the identified gaps.

Then, individualized actions were defined for each of these KPIs. The actions were divided into three "types": organisational, legal, and technical. For each of these "types", actions could be done in European or National level, short or long term and one-time or recurring.

Furthermore, after providing a brief overview on the current development and future possibilities for the EU-wide scenario of mobility data exchange, a set of recommendations were elaborated with the view to enable approaches on European level that could enhance interoperability in the NAP Landscape considering future European developments.

Still considering possibilities for enabling a more interoperable NAP ecosystem, the report addressed the challenge of defining clear priorities for the NAPCORE project and its potential successor. Instead of a linear prioritization, the identified actions are clustered into four higher goals: improving metadata of data offers, enhancing contact details and terms of data offers, improving data quality, and aligning the user experience of data consumers. Within group, specific actions are assigned and ordered based on their estimated completion time, considering short-term and long-term classifications. The detailed sequence of actions for each goal is outlined. Additionally, the report emphasizes the importance of focusing on the perspective of NAP operators, who are the actual implementers. Eleven technical actions at the national level are derived from this analysis, emphasizing security mechanisms, search functionalities, harvesting functionality, and guidelines for data providers. The report suggests that this set of actions serves as a valuable input for NAP operators to enhance the current state of NAPs' LoS, providing a roadmap for short and long-term improvements.

To realise the vision of exchanging mobility data interoperable through the NAPs across Europe, it will be essential that all Member States and the European Commission commit to a commonly defined target vision and pursue this vision with joint forces. The single steps towards this target vision will have to be defined carefully and clearly. Although some of the actions are already being tackled by NAPCORE, the proposed prioritization of actions is a reference to continue the work or the starting point for new European or National initiatives.

