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PRESORT

PRESORT

Improving the use of third-party data by NRAs

Report on WP5 Conclude

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Executive summary

The objective of PRESORT is to deliver an evidence-based decision support guide to enable National Road Authorities (NRAs) to make better decisions regarding **why and how** to acquire and use third-party transport data. The project is in response to the CEDR Transnational Road Research Programme Call 2022 – Data.

Based on our research, third-party data available in the market today covers many relevant topics from traffic flow and congestion to road surface conditions. It offers NRAs significant opportunities to improve their awareness of core business areas' performance. But before rushing into data procurement, it is essential that an NRA decides the problem to solve with data, then analyses their operating processes systematically and identifies gaps or other issues that are costly to fix with traditional data collection. Once these use cases are identified, we recommend an NRA engages in market collaboration to understand emerging offerings in the data market, as well as best practice of data procurement and usage among front-runner NRAs. A mindset change may be also needed to allow NRA to move from data ownership towards data licensing contracts and reciprocal data sharing within existing ecosystems. The mindset needs to change from procuring a physical sensor and maintaining it, to procuring data as a service.

This change does not come without risks, and so the process should include a comprehensive pilot / Proof-of-Concept through which NRA can ensure the technical compatibility, level of quality and commercial terms are feasible for scaling up data procurement and implementation. To make the most out of third-party data, NRAs should start early dialogue inside their organisation to identify all possible use-cases for data, and to prepare for the integration of new data in their legacy IT systems.

Once entering the actual procurement, an NRA must follow the common public procurement processes and rules defined by European and national legislation. There are alternative procurement models and according to our study, each of them may have a place depending on the type of data, market maturity and internal competences in the NRA. It is essential to include market dialogue in procurement to understand data availability and competitive situation, and thereby help design feasible technical requirements and commercial selection criteria and approximate the price of the desired data service.

This document is intended to provide step-by-step guidance for all phases of the process from pre-procurement studies to the actual procurement phase and follow-up activities during the contract period.

Report structure and intended readership

The report consists of three sections:

- Deliverable 5.1. Use case identification and validation framework
- Deliverable 5.2. Data Acquisition and Quality Assurance Guidelines
- Deliverable 5.3. Best Practices

The first section provides NRAs guidance on how to assess the possibility of using 3rd party data as an input in their core business processes, before the actual decision has been made for proceeding to data procurement. This section's intended readership consist of e.g. NRA's core business owners, strategists and senior management who are responsible for the development of internal processes and data driven decision making within the NRA.

The second section provides a practical guideline how to successfully perform a 3rd party data acquisition process following the related European and national legislations. Guidance is also provided on how to monitor the agreed service-level, data quality and other requirements during the production phase. This section is primarily for technical experts responsible for defining requirements/specifications as well as for procurement staff responsible for running the actual procurement process.

The third section provides practical examples from three implemented 3rd party data procurement processes on how NRA's have in practice designed their procurement process and how they have set the selection and quality criteria that have led to a successful outcome of the procurement. This section should be read together with section 2.

Sections follow their specific structure which is presented in the header of each slide to help readers to navigate through the material.

What is third-party data and why it is interesting for NRAs?

In all parts of society, digitalisation is developing fast as it can streamline processes and improve decision-making through processing vast datasets . National Road Authorities (NRAs) core businesses increasingly rely on collection, processing and use of data for meeting their goals for road user safety, traffic throughput and environmental impact. Traditionally, NRAs have fulfilled their data needs with “first-party data” i.e. data which the NRA collects using their own equipment or resources or by using parties that collect data for them (“second-party data”). However, as processes need more comprehensive and more and more data is needed to manage and operate roads, it is not cost-efficient to rely solely on internal data production.

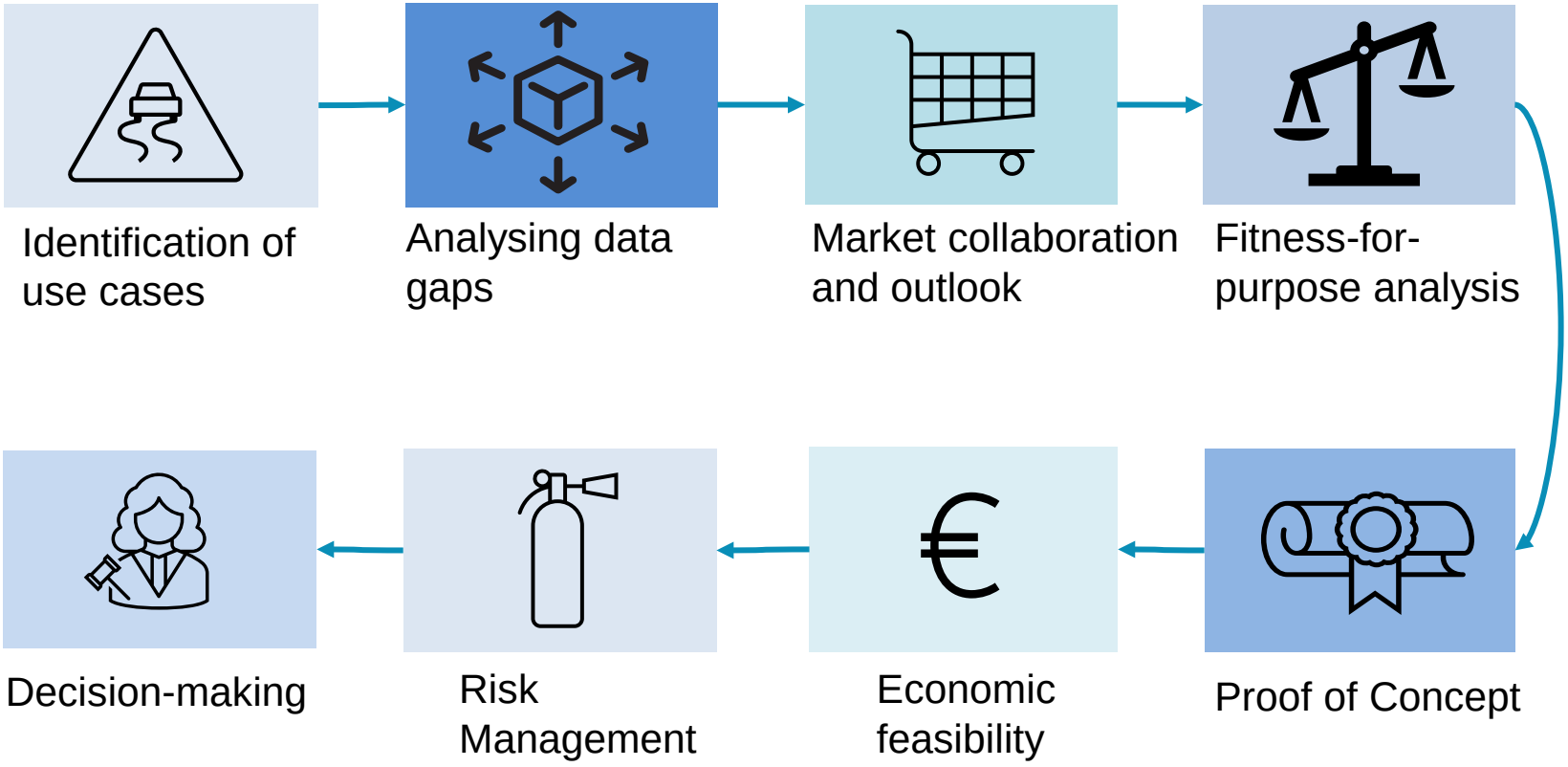
Meanwhile, today’s vehicles are becoming more and more connected and are capable of detecting vehicle, road and environmental conditions and communicating the detected data to other users. There is also data from companies who collect information for example from the smartphones of road users and GNSS data from fleet management providers. Such data, originally collected by different stakeholders for their own purposes can also be used by NRAs to fulfil the data gaps of their core businesses, and is called “third-party data”.

By nature, third-party data is already there, so no NRA needs to invest in collection of data, even though investments may be needed to process it in a format that serves NRAs’ needs. An NRA may be the “secondary” user of data, or a user among a larger group of different users. This gives potential to improve data cost-efficiency compared to traditional data collection methods in NRAs. Another benefit is typically high network coverage, as the data collection is mobile (e.g. vehicles, mobile phones) rather than point-location. In addition, third-party data may provide an NRAs new insights to their core business problems that have not yet been seen as data was not visible .

Third-party data providers are typically private companies whose business is to sell collected and processed data to their clients, including NRAs. This guideline is intended to provide NRAs insights and guidance how to approach the world of third-party data and how to successfully obtain data to improve the quality of their core businesses.

Deliverable 5.1 Use Case Identification and Validation Framework

Step-by-step framework for use-case identification and validation



Methods and processes to identify use cases and third-party datasets

The NRAs' objectives and goals are usually defined in their strategy. Furthermore, NRA's operational processes then put the strategy into action, for example in traffic and asset management, and further provide insight from the daily operational activities about the business needs. The business needs might emerge when addressing an operational issue, a new legislation requirement or when analysing the Key Performance Indicators (KPI) of the processes.

The PRESORT project baseline report by Spillard & Stephenson (2024) studied the current use of third-party data. The results were driven by a questionnaire study with 35 respondents of which 20 were working for a NRA.

The results show that currently the most common use-cases among European NRAs for third-party data usage include:

- Traffic management
- Asset management
- Traffic safety improvement
- Construction

For NRAs seeking to improve their processes through use of new datasets, these use cases may be the first ones to look at. However, as each NRA is unique, we recommend a systematic analysis of all core businesses, their strategic goals and development needs to identify the most viable use-cases for the use of third-party data. This is because one data set may help many uses cases.

Methods and processes to identify use cases and third-party datasets

The following methodologies were identified as alternatives through which NRAs can identify the most prominent use cases within their core businesses. It is essential to **start from each NRA's real needs, to identify problems and only then seek novel solutions that may include the use of third-party datasets .**

SWOT analysis, i.e. Strengths, Weaknesses, Opportunities and Threats, can be used for example to find new opportunities or requirements for the third-party data use cases.

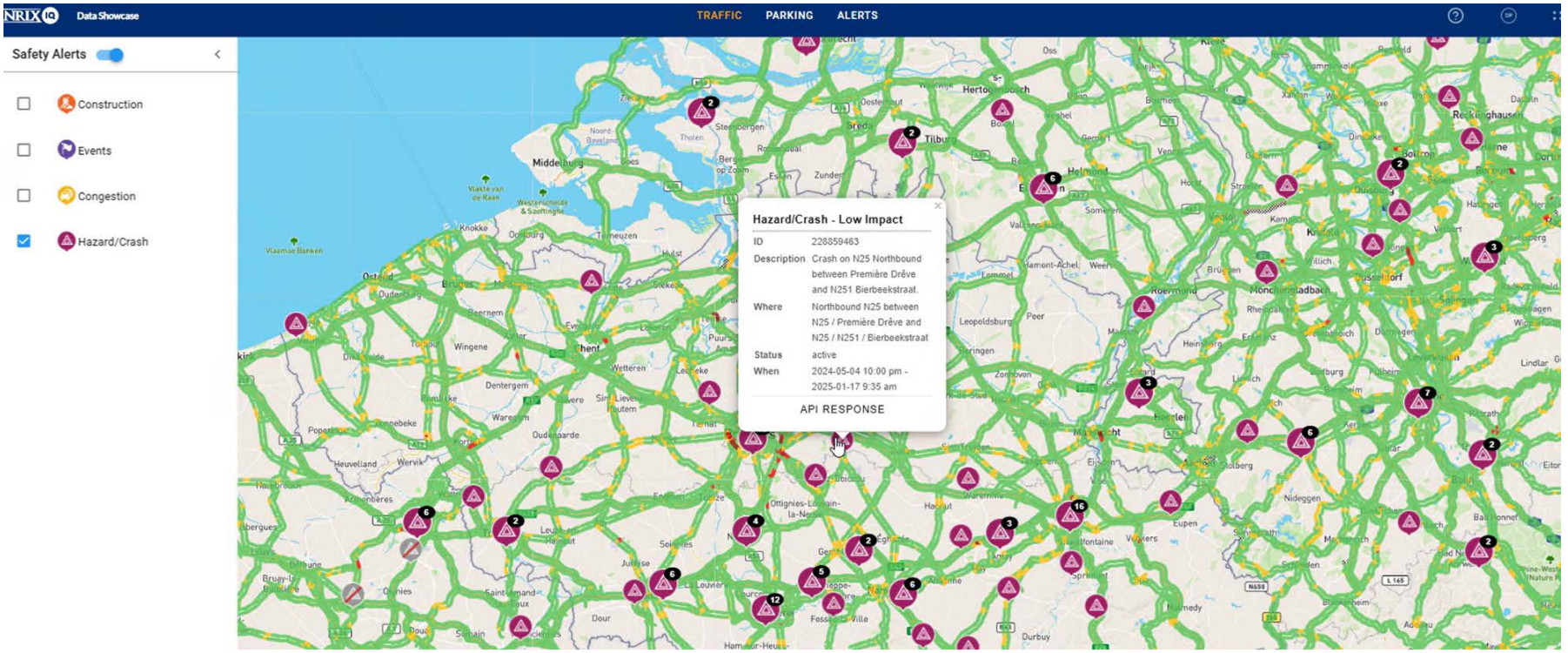
Benchmarking can be applied to recognise use cases by comparing road operation processes and KPIs with other road operators and industry best practice. Narrowing down to selected use cases and performance metrics may help to identify use cases and third-party datasets.

Data gap analysis, a process that identifies the current and desired state of the data and use cases, can be used to recognise potential use cases and datasets.

Market collaboration is a powerful tool to identify, pilot and create new use cases as it involves best expertise with real-world test cases. Market collaboration together with European partnerships, standardisation and legislation is discussed more in the Chapter 4.3 Market collaboration and lookout.

In the following slides we show examples highlighting the available third-party datasets in the market and the respective use-cases within European NRAs to meet specific outcomes.

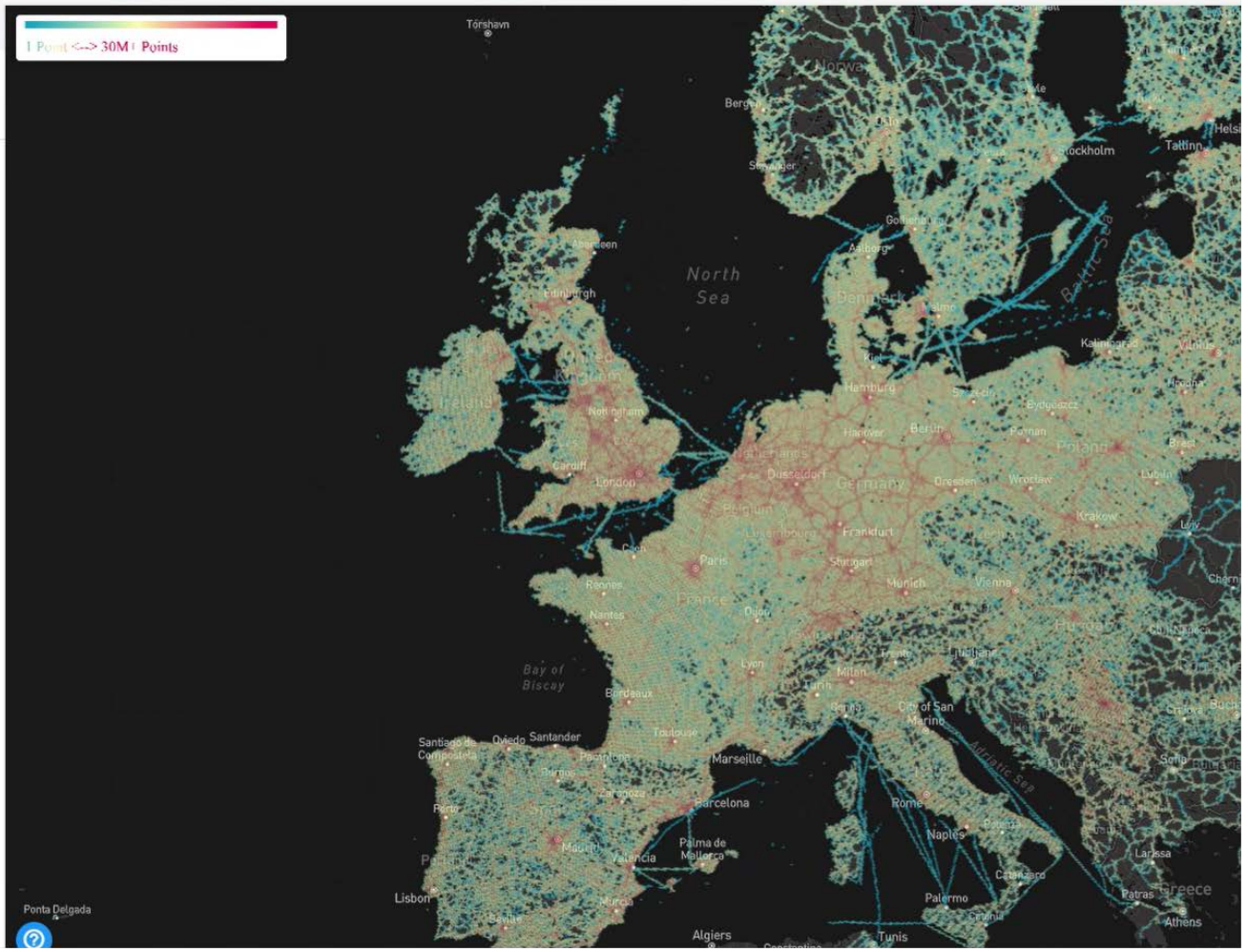
Example dataset



Supplier	INRIX
Location	Belgium
The data shows dangerous slow-downs measured from GNSS data as speeds suddenly drop due to queues – a low-cost alternative to loops, radar and CCTV.	

Outcome wanted: Safer roads and reduced secondary collisions

Example dataset



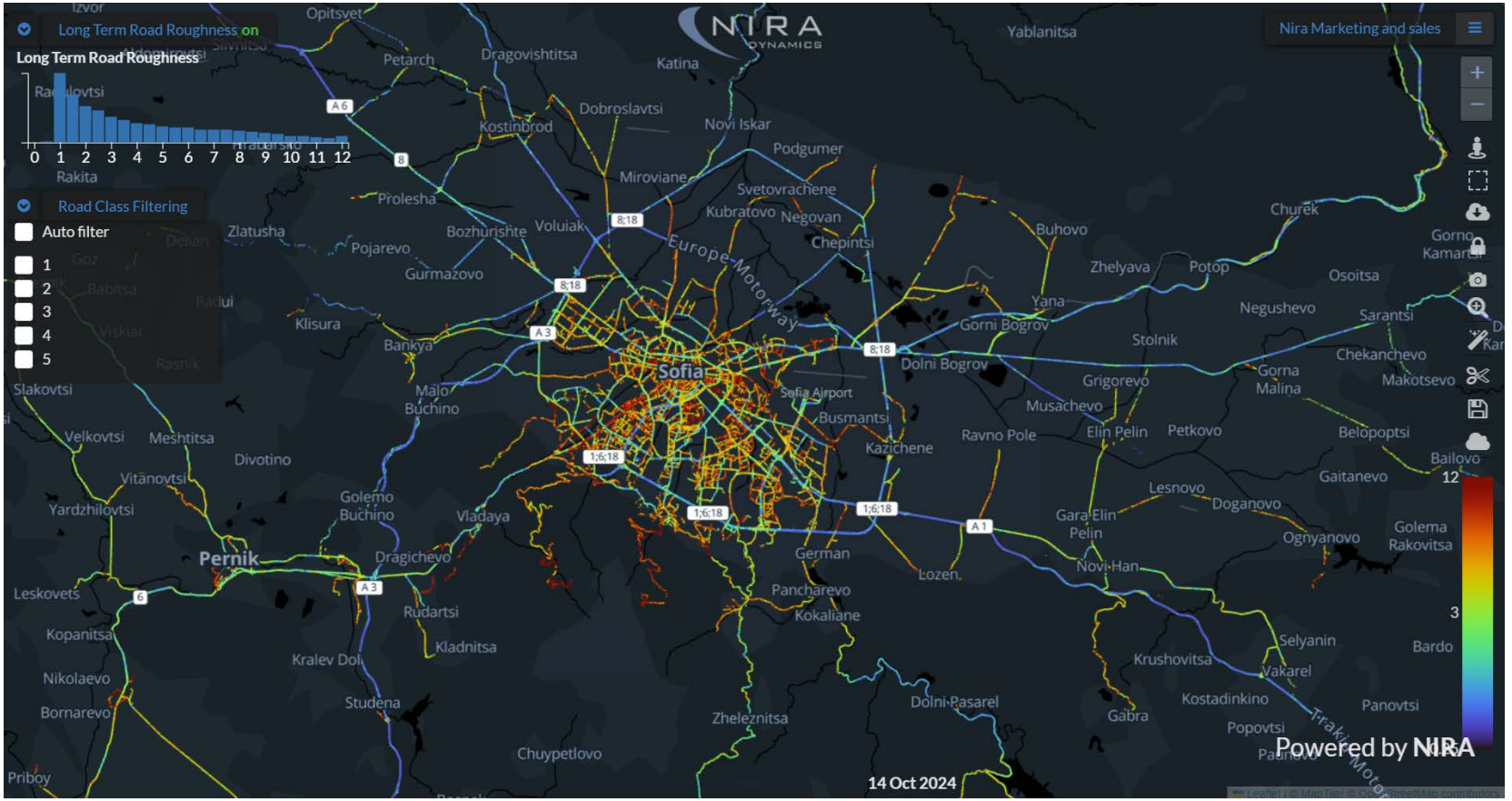
Supplier	INRIX
Location	Belgium

The data shows GPS points from roads and floating vehicles (point frequency varies) measuring speed and queues across all roads (NRA and city) to show interactions.

Here the data looks like it is better in the UK and Germany than France, but the data is not all measured at the same rate (some is 1 second, some 10 seconds), yet both are able to give accurate journey times.

Outcome wanted: better managed and monitored roads across boundaries

Example dataset



Supplier	Niradynamics
Location	Bulgaria
The data shows poor road roughness to target maintenance interventions, collected directly from Volkswagen group vehicles' suspension.	

Outcome wanted: Better asset management to optimise maintenance spend

Example dataset

Supplier	Webfleet
Location	Amsterdam
The data shows Co2 emissions.	

Outcome wanted: Less impact on the environment –showing where congestion impacts people

Example dataset

DESTINATIONS / ORIGINS

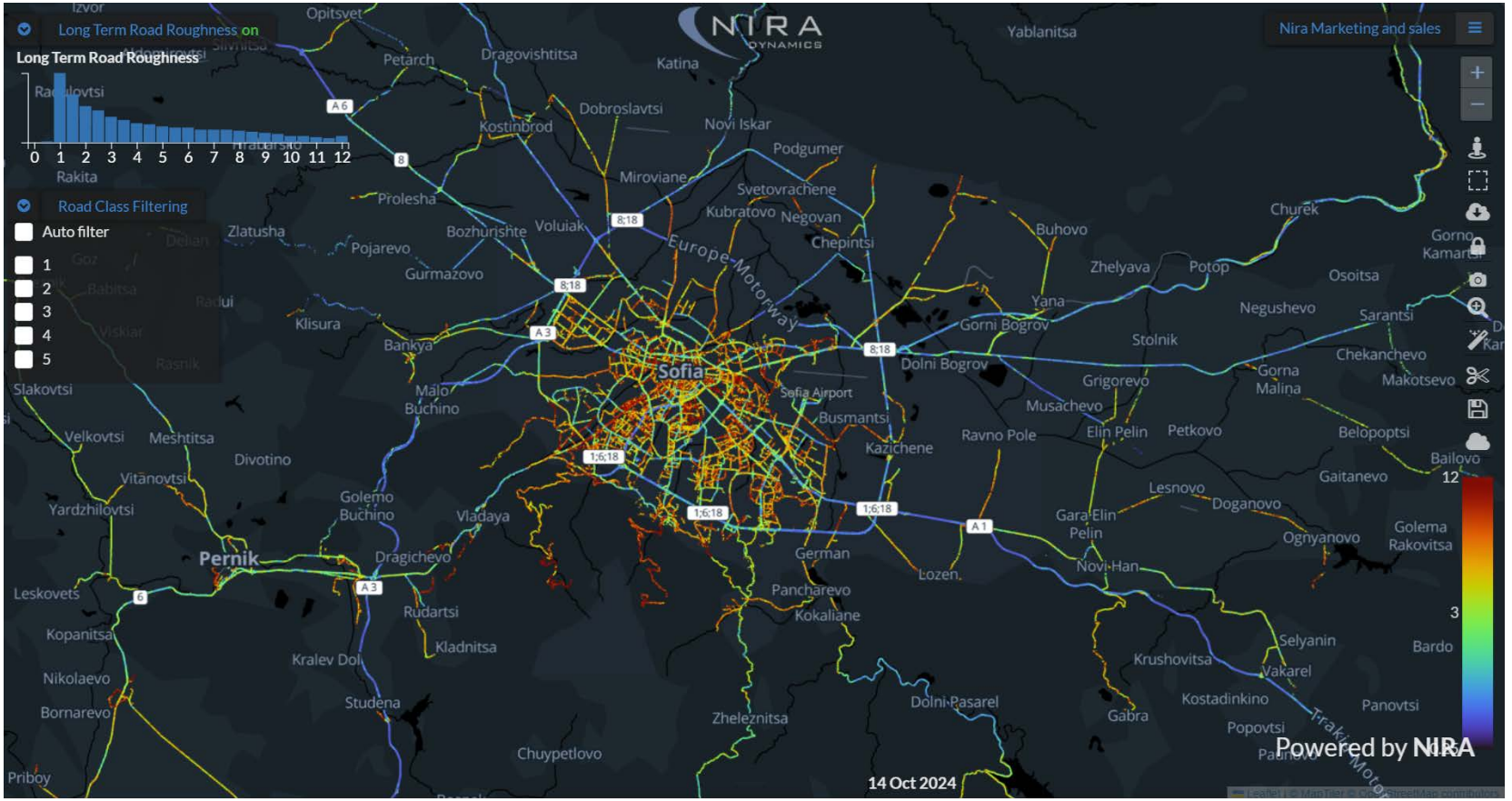
	Mitte	Friedri...	Prenzl...	Pankow	Weiße...	Heiner...	Alt-Ho...	Lichte...	Fennpf...	Marzahn	Friedri...	Rumm...	Alt-Tre...
Mitte	111851	22476	20115	2060	2785	454	2648	3962	1263	2878	1419	1125	2167
Friedrichshain	38812	51996	16851	1391	3124	317	3204	8242	2509	4040	2329	4232	4660
Prenzlauer Berg	44980	21757	60553	6917	10176	1360	4296	5391	2575	3865	1078	1291	1894
Pankow	6799	2796	10108	12833	3986	1611	1441	1069	365	1037	372	284	285
Weißensee	8143	4997	12271	3121	17483	2709	5805	2326	1047	2716	702	770	277
Heinersdorf	1617	519	1833	1835	3252	3289	903	494	124	556	103	108	44
Alt-Hohenschö...	6231	5485	5694	1510	6708	832	19681	6028	2704	7897	1937	776	381
Lichtenberg	6833	8165	4395	524	1628	257	3887	13879	3539	5526	2846	2077	650
Fennpfuhl	3027	3116	3675	440	1024	94	2353	3705	3623	2095	708	384	306
Marzahn	7489	6235	4584	1012	3538	325	7912	7202	2637	48841	4811	1987	529
Friedrichsfelde	3652	4028	1390	255	692	139	1552	3967	771	4126	9216	3378	484
Rummelsburg	5094	6996	1712	276	567	42	938	3106	636	2311	2189	6252	1010
Alt-Treptow	2866	4051	1092	138	261	28	271	459	149	453	269	545	3175
Kreuzberg	29689	13109	6209	918	1214	147	1124	1805	524	1231	826	946	2389
Tiergarten	15596	2431	1523	304	338	47	311	401	142	410	167	216	253
Moabit	19611	3569	3816	995	969	123	548	736	257	584	358	379	428
Wedding	8106	2018	3053	1172	911	158	415	476	188	521	233	199	204
Reinickendorf	6773	2256	3121	1822	1139	226	652	685	217	673	302	269	371
Gesundbrunnen	12193	3506	6499	2138	1593	250	574	860	302	783	304	321	295
Niederschönha...	4717	1768	4398	6244	1699	682	783	652	230	511	225	193	252
Französisch Bu...	2790	1198	3400	4938	1860	1026	1235	1377	295	763	230	132	204
Stadtrandsiedl...	461	189	532	193	1114	281	514	101	32	289	32	34	17
Blankenburg	1059	535	1135	1177	1000	1227	803	392	71	586	51	31	118
Neu-Hohensch...	2812	1581	2311	573	2921	577	4647	1582	623	4248	783	308	75
Malchow	163	118	239	49	432	61	186	70	26	109	27	11	11
Wartenberg	351	292	205	48	452	125	747	242	103	429	21	13	6
Falkenberg	265	88	231	63	434	22	431	216	31	847	44	29	5
Hellersdorf	2066	2043	1519	255	1018	104	1834	2084	927	9514	1539	746	197
Mahlsdorf	4565	3673	1480	301	614	54	1497	3143	382	4968	1541	780	288

Colored Matrix showing all the relations between regions in form of raw trips data.

Supplier	Tom Tom
Location	Berlin
The data shows an OD matrix for Berlin area.	

Outcome wanted:
Better mobility planning – who travels where and when ?

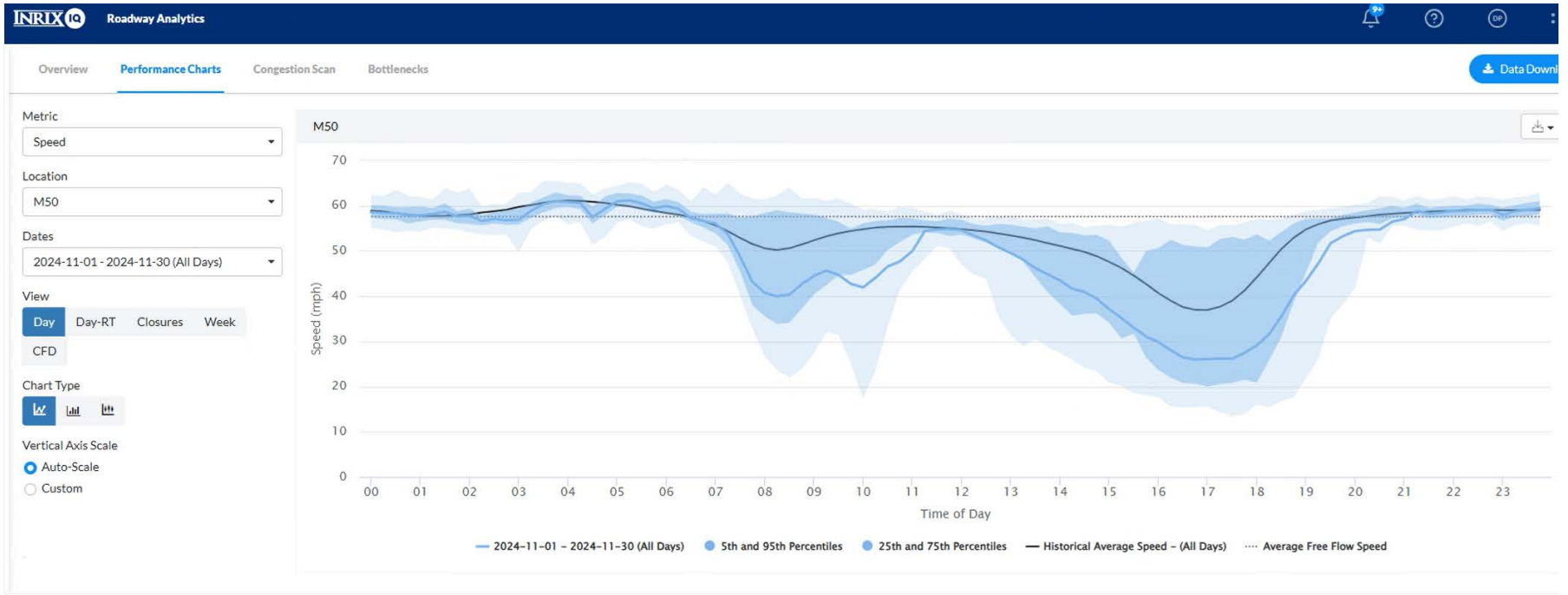
Example dataset



Supplier	Webfleet
Location	Amsterdam
The data shows road roughness.	

Outcome wanted:
Better asset management leading to optimal spend on maintenance

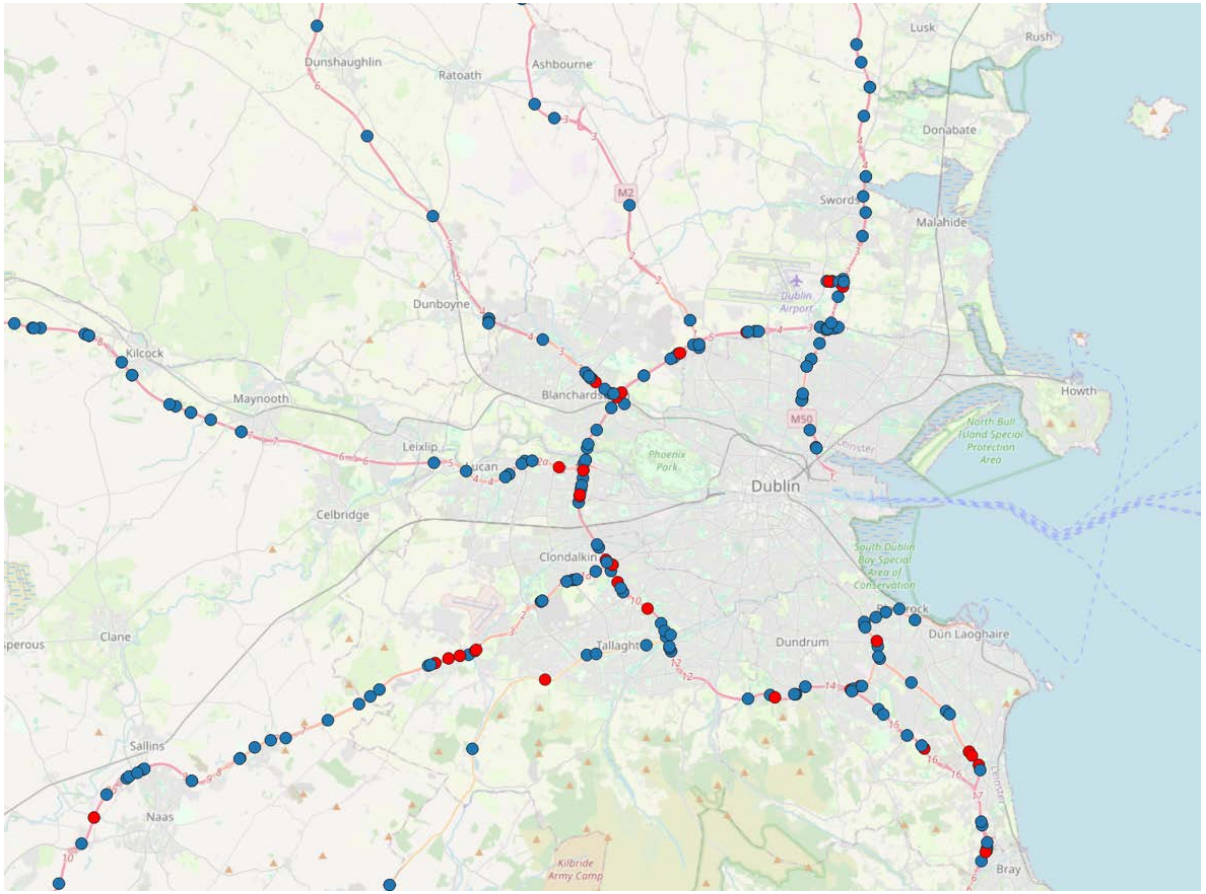
Example dataset



Supplier	INRIX
Location	Dublin
The data shows performance of a link by time of day to identify where performance interventions are needed.	

Outcome wanted: Safer roads and better customer service for toll customers

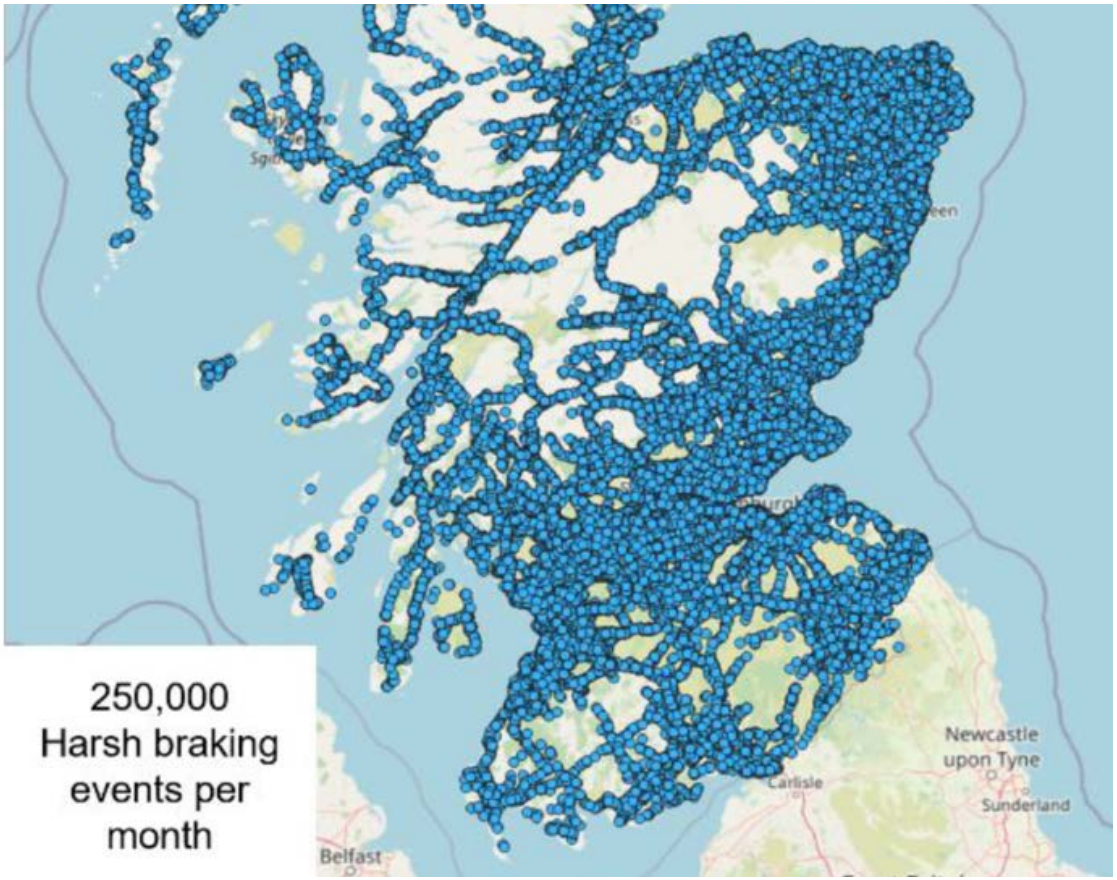
Example dataset



Supplier	Vesos
Location	Ireland
The data shows collisions and breakdowns on M50 using processed and filtered eCall data, showing locations of air bag activations.	

Outcome wanted: Safer roads, quicker incident response

Example dataset



Supplier	AISIN
Location	Scotland
The data shows harsh braking events.	

Outcome wanted:
Safer roads

Example dataset

3 months **harsh braking** data to identify clusters

- 100 000 km road network
- 6 million vehicle traces
- 134 million hours of driving
- 2 million harsh braking events

Real collisions in following 9 months

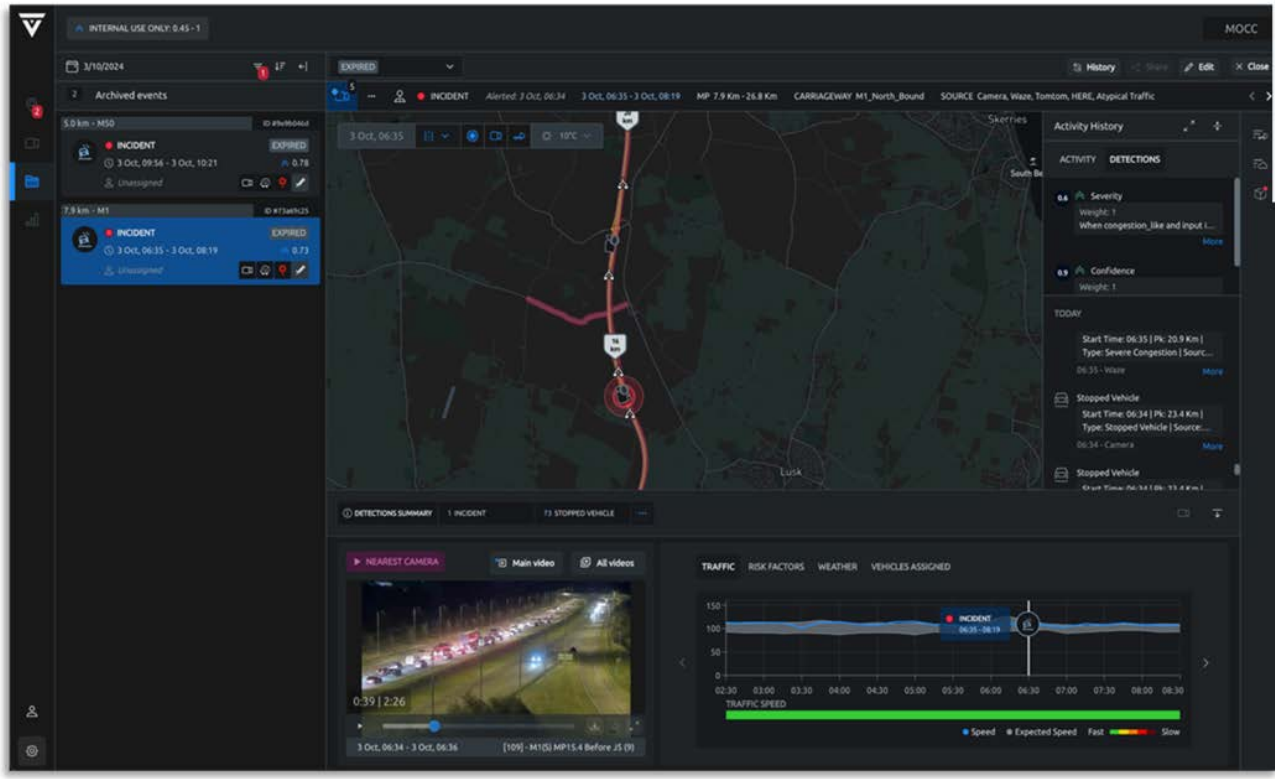
38 738 crashes reported

RoadTrace

Supplier	AISIN
Location	England
The data shows predicted collisions. See: https://lcrig.org.uk/wp-content/uploads/2024/09/ITS-Paper-Dubai-2024-RoadSense-AISIN-RoadTrace-FINAL.pdf	

Outcome wanted: Safer roads

Example dataset – fusing data sources



Supplier	Valerann
Location	M1, Ireland
The data shows 5 different sources fused into a single alert. Improves response times to events. See: https://www.valerann.com/news/transforming-irelands-road-network-with-ai-powered-data-fusion	

Outcome wanted: Safer roads, quicker incident response

Gaps Analysis

According to the gap analysis in Presort Workpackage 3, third-party data providers have a strong desire for a more collaborative and informed relationship with NRAs. The key points for NRAs mentioned by many third-party data providers include the following (Soni & Oskina 2024):

Embrace a mindset change: NRAs should move away from a perception of sensor and data ownership towards a model of data collaboration and sharing. This would encourage greater integration of third-party data into NRA operations.

Enhance data literacy: Data providers urge NRAs to prioritize education and training on data , ensuring a thorough understanding of data potential and analytical capabilities to guide data procurement and utilization.

Outcome-oriented approach: NRAs should focus on achieving desired outcomes, such as improved safety and traffic management, rather than replicating existing processes, to facilitate innovation and use of new technologies.

Promote inter-NRA collaboration: NRAs should foster collaboration among themselves and with local authorities to ensure consistent data coverage across all roads, regardless of ownership. Third party data is seamless.

Streamline data access: NRAs should facilitate faster and easier access to their own data for third-party providers. This includes reducing bureaucratic hurdles and ensuring data is available in a timely manner.

Consider alternative infrastructure models: NRAs should be open to exploring alternative infrastructure , such as cloud-based platforms and Software-as-a-Service (SaaS) solutions. This would allow them to leverage third-party expertise and technology without significant upfront investment.

Gaps Analysis

Participate in reciprocal data sharing: NRAs should actively participate in reciprocal data sharing with third-party providers and other NRAs. This would create a richer data ecosystem, benefiting all stakeholders.

Prioritize quality and relevance: NRAs should focus on procuring high-quality data that is relevant to their specific use cases rather than simply accumulating large volumes of data. This would ensure that data is used effectively and efficiently.

Clear Communication and Collaboration: Data providers call for enhanced communication channels with NRAs, allowing for a seamless exchange of feedback and requirements. This would facilitate the development of customized data solutions that precisely address NRA's needs.

Robust Data Quality Assurance: Providers advocate a collaborative approach to data quality control, with NRAs actively participating in validation processes. They recognize the need for NRAs to trust the quality of third-party data, so avoiding redundant efforts to recreate existing data sets.

Fair and Transparent Marketplace: Data providers envision a data marketplace that caters to diverse NRA needs, offering a wide range of data products and services. They emphasize the importance of flexible licensing that allows for data sharing and collaboration among public sector entities.

Gaps Analysis

For a successful collaboration between NRAs and third-party data providers and fully utilize the potential of third-party data within NRAs, several key strategies can be employed (Soni & Oskina 2024):

Establish a Shared Vision: NRAs and third-party data providers should align their visions, recognizing the value of specific datasets in relation to data quality. This shared understanding will facilitate a more effective partnership.

Invest in Staff Education: Educating staff in digitization will help them understand the potential value of data sharing and encourage adoption across the organization.

Foster Collaboration and Innovation: Regular collaborative workshops and mutual learning meetings will facilitate the exchange of ideas, the exploration of synergies, and the gradual introduction of innovative solutions.

Prioritise Data Coverage: Given that certain critical data (e.g., traffic rules, infrastructure access, road work planning) can only be provided by road authorities, cooperation between NRAs and third-party data providers is crucial to ensure comprehensive data coverage.

Adopt a Use-Case-Centred Approach: Focusing on specific use cases allows NRAs to assess existing data within their organization and identify gaps that third-party data providers can fill. As NRAs transition towards becoming digital road operators, addressing these gaps becomes a natural part of their development process.

Strategically Integrate AI and Sensors: While AI shows promise, a gradual approach that combines AI with sensors initially is more prudent. This allows for careful monitoring, evaluation, and the gradual replacement of outdated methods with more effective ones.

Address Data Quality Concerns: NRAs should be mindful of potential data quality issues in less populated regions, where third-party data providers often operate. Integrating this understanding into their data vision and collaborating with third-party data providers to identify necessary improvements will ensure data reliability.

Develop Standardized Frameworks and Agreements: The development of standardized frameworks and collaborative agreements will be crucial for addressing data quality, privacy, and compatibility concerns, ensuring the seamless integration of third-party data into the transportation sector.

Gaps Analysis - summary

It is obvious that any gaps to be addressed depend on the specifics of the use case. Thereby a **use case specific approach** is recommended, even though some gaps may be of a generic nature covering most or all use cases.

A general recommendation is to **establish and maintain a common European overview** among NRAs and service providers of available and desired data and its characteristics (standards, quality, etc.) for various use cases. This would benefit all stakeholders and be a sound framework for both cooperation and sustainable market competition.

Another general recommendation relates to the importance of **addressing data quality**. Consistent and high enough data quality is a prerequisite for effective and beneficial NRA and other services as well as for data users' trust and is crucial by vehicle manufacturers (Kulmala et al. 2023). Data quality management and assurance procedures should be taken into use and enforced. This is essential also for road network operation and traffic management (Rossi 2024).

European NRAs have long seen the need to **move from reactive to proactive traffic management** and especially incident management. CEDR's PRIMA (Pro-Active Incident Management) recognised the need for NRAs to use 3rd party and especially in-vehicle data for facilitating pro-active incident management (Taylor et al., 2015). The further developed data analytics and Artificial Intelligence (AI) accelerates this development (ERTICO 2024). A clear recommendation is to develop pro-active traffic and incident management in cooperation between road operators, traffic managers and service providers.

Market Collaboration and outlook

The main aim and benefits for NRAs of market collaboration and lookout is to **create continuous feedback for knowledge exchange and value creation** on viable business use cases and third-party datasets. The framework presented in this chapter of use case identification and validation framework can be mostly supported through market collaboration, e.g. gaps analyses in NRAs and data literacy, building trust and business models.

The PRESORT results in Soni & Oskina (2024) mention a gap in understanding and collaboration between NRAs and third-party data providers which requires **Openness to innovation, clear communication, and collaborative learning** could help in resolving issues related to collaboration. Furthermore, "the market for third-party data can be volatile, with unclear business models and costs making it difficult for NRAs to assess the long-term value and sustainability of data providers."

Feedback enables the NRAs to **find and track data sources and technological advancements**, e.g. how well the available data formats and geographical coverage align with the readiness of NRAs. Testing, validating and benchmarking of datasets provide further insight into quality and suitability for the business case.

An ecosystem of public and private partners enables innovation and business model trials as well as support problem solving in complex environment. Any interoperability issues or legislative uncertainties, that can be tied to business models and standards, can be advanced in collaborative environment.

Market Collaboration and outlook

The European ecosystems, working groups, associations and data platforms provide a great opportunity for the NRAs to engage in market collaboration and lookout of use cases and third-party data. These forementioned European collaboration networks regarding third-party data were also discussed in the previous PRESORT project results, e.g. Spillard & Stephenson (2024).

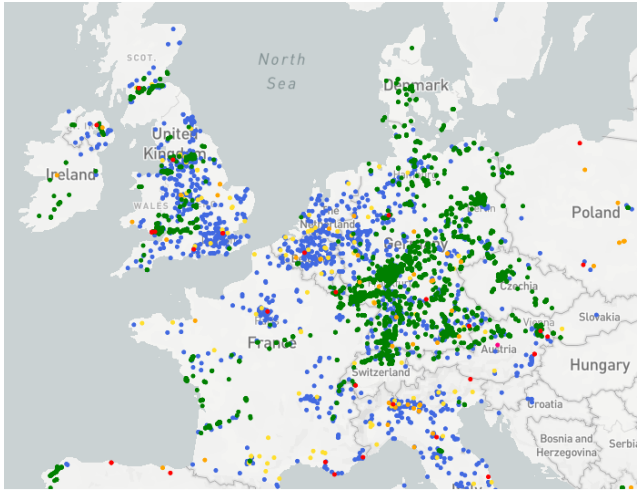
Forum	Description
Data For Road Safety (DFRS)	safety-related traffic information ecosystem and data aggregation platform established by EU member states, public authorities, and some industry players to provide a contractual infrastructure for the exchange of safety-related traffic information.
Traveller Information Services Association (TISA)	a non-profit organisation with the aim of creating an international framework for the coordinated development of future traffic and traveller information standards and services, membership of TISA is open to all public and private organisations with an interest in traffic and traveller information and that support the objectives of the Association.
C-Roads Platform	brings authorities and operators together to harmonise the deployment of C-ITS across Europe. Objectives include the effective exchange of data.
TN-ITS innovation platform (by Ertico)	multi-stakeholder innovation platform that creates a data chain mechanism for trusted authoritative spatial road data changes, between road authorities and map makers & services providers.

Example: Data for Road Safety ecosystem

The Delegated Regulation of European Commission (886/2013) establishes the specifications necessary to ensure compatibility, interoperability and continuity for the deployment and operational use of data and procedures for the provision, where possible, of road safety-related minimum universal traffic information free of charge to users on a Union level.

Based on the work of Data Task Force, the European Ministers of Transport together with industry players established the Data for Road Safety ecosystem in 2020 to cater for the requirements of the Delegated Regulation and to facilitate the use of in-vehicle data for the creation of Safety Related Traffic Information (SRTI).

Data is exchanged within the SRTI Ecosystem for the sole purpose of road safety, without any financial compensation between the parties and within the agreed data privacy policy following the principle of reciprocity.



A snapshot of SRTI event information shared through the Post Luxembourg live data stream

Multi Party Agreement is in place to set the terms and conditions for data exchange in detail.

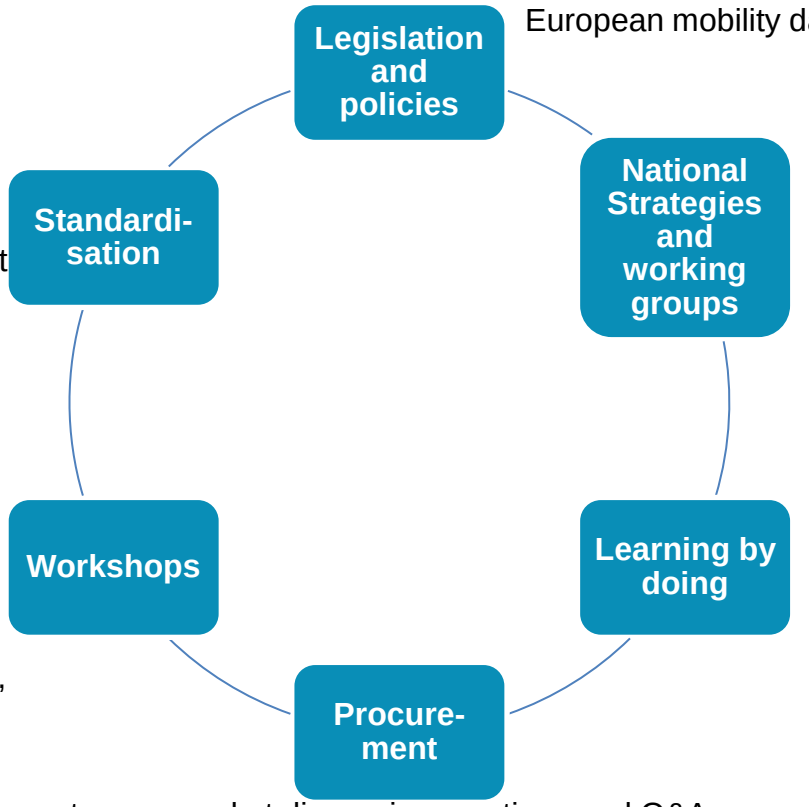
Currently there are many industrial players active in the ecosystem. Including ACEA, Geotab, Mercedes-Benz, Nira Dynamics, BMW, Inrix, Ford, Volkswagen, Tomtom, HERE and Volvo cars, and the count is increasing. Many European Road Operators and authorities are also active members as well as cooperative organisations such as CEDR and Ertico.

data for road safety

Market Collaboration and outlook

Provides an in-depth view on the technical details and harmonisation of the subject matter in a market collaboration. Depending on the use case and NRA interest, they may benefit on taking part on the standardisation development process.

Create an important foundation for the European collaboration and common European mobility data space.



National public-private working groups provide a great market collaboration platform for the different stakeholders. National level rule books have been established for fair and transparent (third-party) data marketplace collaboration and data exchange.

Common method to gather information and knowledge in the transport and mobility sector research studies. By engaging these workshops, especially those that relate to the most interesting business cases for the NRA in question, may provide valuable insight from other NRAs and private stakeholders.

One of the most successful ways to provide use case implementation with proven value. Proof of Concept and pilot implementation provide a great market collaborative opportunity for the NRAs to test and prove use case value and third-party data. Evaluation of the trials results help also to gain lessons learned on business models and market engagement.

During procurement, open market discussion meetings and Q&A feedback provide valuable input for the NRA public and private sector stakeholders. This is especially the case when implementing innovative procurement strategies and Public Private Partnerships that require negotiations and agreements regarding the market collaboration.

Fitness for purpose analysis

In the use-case centred approach, an NRA will have initially identified their internal processes (e.g. traffic management, asset management, safety improvements) where filling certain data gaps with new data could improve the process' outcomes or its cost-efficiency. Through market collaboration, the NRA will have become aware of 3rd party datasets that could possibly be used to fill in these identified gaps.

At this point the NRA should prepare a fitness for purpose analysis, which should **result in a certainty that the data in question is actually capable of being used for the intended purpose and deliver the outcomes desired**. The requirements for the data are use case specific and therefore it is essential to first approach the suitability case-by-case. As it is advisable to utilise purchased data as widely as possible in several use cases, the **requirements across use-cases should be collated at later stages.**

There are two most important aspects in fitness for purpose analysis.

1. the quality of data (in broad terms) is high enough to fulfil the requirements in NRA's processes
2. the licencing terms for the 3rd party data allow NRA to use the data to the intended purpose.

Fitness for purpose analysis - quality

What is data quality?

The EU EIP Activity 4.1 (Quality of European ITS services) has defined “data quality” as follows.

> Right information at the right time in terms of time and correctness of the content

Data quality criteria have been discussed in several projects and initiatives, and different criteria have been defined.

A well-thought and comprehensive list of quality criteria has been defined and validated in the EU EIP –project. The quality criteria proposed by the project for status-oriented information (e.g. travel time, weather) are presented in the adjacent table.

Criteria type	Quality criteria	Definition
Level of service criteria	Geographical coverage	Percentage of the road network covered by the service
	Availability	Percentage of the time the service is available
Level of Quality criteria	Reporting period	The time interval for refreshing/updating the status reports
	Timeliness (update)	The average age of the sensor data used in the most recent reporting period
	Latency	The time between the calculation of the reporting data and the moment the information is provided by the content access point
	Error rate	Percentage of the published status reports which show excessive deviations of a reported quantity versus the actual value, e.g. 5 % of reports with deviation >20%.
	Report coverage	The percentage of reporting locations for which a status report is received in any given reporting period

Table. EU EIP Quality criteria for status-oriented information (Kulmala et. al. 2019)

Fitness for purpose analysis – quality requirements

Choosing the right approach

NRA should define the essential quality criteria and their respective minimum requirements arising from the use-cases and outcomes desired . In the setting of the minimum quality criteria, an **NRA should dig into the processes' real needs, and derive the minimum quality requirements from there.**

Existing information sources and their quality may not be the best reference point in this, as it may lead to requirements that 3rd party data sources cannot fulfil. Typically 3rd party data providers use other types of sources such as vehicles and it makes sense to allow a small amount of quality deviations compared to the most accurate monitoring systems such as road weather stations that are very accurate in measuring weather phenomena but are only point based and very costly to maintain or increase their coverage.

A good way to set a certain acceptable level of measurement error is to use Error rate as quality criteria. In the EUEIP Error rate definition, one sets an acceptable level of deviation (e.g. 20% difference to ground truth) and states that only certain share of measurements (e.g. 5%) are accepted to exceed this threshold.

Error rate

5 % — Maximum share of "false" measurements

20 % — Threshold for accepted deviation from ground truth

Fitness for purpose analysis – known quality challenges

Traffic volume affects to the quality of vehicle data

In the setting of requirements for geographical coverage, especially related to vehicle-based datasets, the quality of data might be affected by the decrease of traffic volumes (and subsequently number of probe vehicles) when moving from main roads in urban areas towards lower-level roads in the rural areas. Similarly, the data quality may differ between nighttime and daytime. So the key question becomes; **what is the road network most relevant for the use case and does the data quality reach the minimum requirements on that network?**

Acknowledge potential in-built "false negatives"

NRA's should be aware of potential "false negatives" that originate from the measurement solution used in 3rd party data. A good example of this is road slipperiness warnings, that can be produced from vehicle's control systems such as ABS-brakes and ESC (Electronic Stability Control). Several tests and pilots have shown, that such system produce warnings mostly in intersection areas, where vehicles brake or accelerate and the control systems are activated due to loss of grip of the tyres (Kotilainen 2024). However, when a vehicle is traveling with steady speed on a line section of a highway, the vehicle's control systems are not activated and possible slipperiness remains undetected.

How to measure "timeliness" of third party data?

NRA should acknowledge that in vehicle-based datasets such as FCD there are several phases in the data handling by the provider each of which cause some amount of 'delay' in representing a traffic phenomena;

- the location of the vehicle can be monitored in real-time (e.g. 20 times per second) or the monitoring interval may be much more sparse e.g. every 30 seconds
- in order to avoid unstable data behaviour (based on e.g. traffic lights phase green/red) service providers may use e.g. 5 minute sliding average. Because of this, it takes some minutes before the data reacts clearly to a sudden phenomenon.
- there is some amount of latency in the calculation of the aggregated information from multiple vehicles and updating this information to the content access point.

Because of such processing methods, it may be sometimes difficult for an NRA to get a grip of the real timeliness of the offered data. To overcome this, NRAs should focus on the outcome and make a test in the Proof-of-Concept phase for. e.g. how fast an incident blocking a lane on main road has a credible effect on the 3rd party dataset, and is this level of delay acceptable for their operative use cases.

Fitness for purpose analysis – direct use or data fusion?

Considering 3rd party data as complementary source

On the previous page certain shortcomings in the 3rd party datasets were presented in comparison to traditional roadside monitoring systems. However, such shortcomings should not necessarily lead an NRA to discard the use of 3rd party data. In many cases, **the best value from 3rd party data can be derived when it is used as a complementary data source rather than one that substitutes completely the existing monitoring systems**.

Examples of the use of 3rd party data as complementary source

- use a trustworthy data source in the validation for the 3rd party data
- use the 3rd party in the extrapolation of measurements made with a fully trustworthy data source
- use several data sources and their individual best features to create the most accurate situational awareness information.

Using slipperiness warnings as a use-case, an NRA may use meteorological data and models, road weather stations and vehicle data and fuse those data in a smart way to create cross-validated road weather information with a very high network coverage.

Case study of data fusion of stopped vehicle alert data

The CEDR funded project SHADAR (Cornwell, MacDonald 2023) prepared a case study of the application of data fusion to stopped vehicle alert data. In the study, two sensor-based systems, using different detection technologies, were employed on the same highway. Because no real ground truth of stopped vehicles was available, it was assumed that all stopped vehicles were detected by either system A or B. The system A had an individual inferred detection rate of 36% and a false alarm rate 4%, whereas system B provided individual figures of 82% and 31% respectively. The false alarm rates were validated by human operators.

The following table shows the detection rates and false alarm rates that could have been achieved by fusion regimes if they had been used operationally. OR regime refers to a situation where either system alerts, and AND regime where both systems alert.

Regime	Detection rate	False alarm rate
Source B alone	82%	31%
Sources fused (OR)	100%	27%
Sources fused (AND)	17%	1%

The simple study setup proved, that using these sources together in a data fusion system with an OR rule would have increased the detection rate and reduced the false alarm rate when compared with using a single source.

Fitness for purpose analysis – feasibility of the licensing terms

3rd party data providers may offer NRAs their off-the-shelf data products, that have standard licensing terms setting certain limits how their customers are allowed to use the data in their processes. The main purpose of such licensing terms is to ensure, that clients cannot utilize the data in such a way that weakens the provider's commercial position towards other potential clients on the market. For NRAs planning the purchase of 3rd party data **it is critical to make sure in the fitness for purpose analysis that the licensing terms regarding the solutions on the market allow the use of data in the intended use-cases**. If conflicting interests are found, they should be discussed early to make sure that a satisfactory outcome is possible in the procurement phase.

Before entering to the actual procurement phase, it is advisable for an NRA to make sure that the licensing terms in place on products on the market do not completely hinder the intended use-cases. This should be done by contacting several providers on the market with a list of the planned use-cases described on a concrete level. **It is also important to understand and accept the difference in using data that is owned by another party and using data produced entirely by the NRA itself.**

Choosing a constructive approach towards license restrictions

Many licensing restrictions arise from true concerns regarding underlying commercial aspects and may be dealbreakers for many or all potential providers. There are cases where service providers have dropped out of a procurement because of conflicting requirements from NRAs. Therefore, the best attitude towards this analysis is to **make sure the licensing terms fully enable the use of data in the core use-cases and accept some level of compromises** in the less significant topics.

It should also be understood that even though in many European countries the national laws oblige NRAs to share as open data the data they collect, **this does not account for the data bought as a service from a 3rd party**. If an NRA signs a contract with a company, it cannot act against that contract even though there may be open data regulations in place. In addition, the whole aim of the European open data policy is to foster the data market by opening public data, but if the market is already there, it does not make sense to use public funding to buy data from the market and make it open.

Fitness for purpose analysis – feasibility of the licensing terms

Typical requirements of NRAs and their estimated conflict potential on commercial license terms

Topic	Typical feature in 3rd party data licenses
Data IPR (Intellectual Property Rights)	Ownership and IPR to the data belong to the provider
Right to analyse and aggregate data and fuse it with data from other sources to be used in traffic management and planning	Typically not restricted in licensing terms
Right to publish on roadside information panels	Typically not strongly restricted in licensing terms as it is part of traffic management services
Right to publish on NRA's internet information service and mobile application	Potential conflict of interests if NRA's information services can be seen to compete with end-user services of the provider
Right to publish **as is** as open data	Very high risk for conflict of interests as this reduces the commercial potential of the data.
Right to publish as open data when aggregated and fused with NRA's other data sources	Potential conflict of interests as this can be seen to reduce the commercial potential of the data.
Right to re-distribute to regional road authorities, municipalities and other public bodies (police etc.)	Potential conflict of interests as this reduces the potential to sell the data to the other authorities in the area. May increase the pricing of the data or the interest to participate in the procurement.
Right to re-distribute to 3rd parties such as consultants	Low risk for conflict of interests as long as the 3rd party use is limited to work done for the NRA itself.
Right of use for the data after the contract period (historical database formed during the contract)	Low risk for conflict of interests.

The European Data for Road Safety ecosystem as an example of collaborative license agreement

The European Data for Road Safety ecosystem provides an example of collaborative agreement of data sharing of safety related traffic information (SRTI) between public and private partners. The DFRS ecosystem originates from the SRTI 886/2013 delegated act and its implementation of sharing the safety related traffic information (SRTI) free of charge to end users reciprocally between the partners in the ecosystem with limited license.

The DFRS ecosystem agreement can be considered as an exceptional achievement on how to agree on licencing terms in public-private multi-party ecosystem establish by European Member States, OEMs and service providers.

The Multi-Party Agreement article 7 provides States and/or Public Authorities with rights of use for Level 3 data (extracted, aggregate and processed road safety related traffic information data).

data for road safety

Right of use for L3 data in DfRS ecosystem:

- Disseminate this Data (L3) to End Users (e.g. broadcasting)
- Make metadata affiliated to this Data (L3) accessible via their NAP or other suitable repository
- Act upon the Data (L3) to conduct its public tasks to enhance or safeguard road safety
- Any other usage that is required to fulfil applicable laws, regulations and public tasks following from law or regulation.

The rights of State and Public Authorities data usage comes from applicable laws and regulations. These forementioned obligations **allow the re-use by third party of Data L3 that has been created by the State (or subcontractor) on the basis of the Content received through the ecosystem**. The use of third-party data (L3) usage is not monitored or limited. States are also allowed to provide raw data (L2) or its enriched version (L2') in addition to the L3 data to local authorities and local private and public road operators as well as private radio broadcasters for the mentioned purposes.

Use of Proof-of-concept to validate assumptions

It is highly recommended that an NRA, planning to engage in long-term and wide-scale use of 3rd party data, should carry out a Proof-of-Concept (PoC) or a pilot before proceeding into data procurement. The main arguments for engaging in a PoC phase, and simultaneously the goals for this phase are presented in the figure.

Validation of data quality and relevance	The quality tests should cover the most critical quality criteria and should be carried out in a few network locations that differ in terms of traffic volume and other conditions. At the PoC phase though, the goal should be the get a reliable enough indication of the quality so it is recommended to use any easily accessible existing “ground truth” data source or comparison of independent data from different providers.
Risk mitigation	By conducting a PoC, the NRA can identify potential risks or limitations early in the process, such as technical compatibility issues, data privacy concerns, or integration challenges with existing systems. For example, the geographical reference system in the 3rd party data may differ from the one(s) used in the NRA, hance the compatibility should be checked to identify the necessary actions.
Integration with internal systems of the NRA	Many NRAs may still run their processes in complex legacy systems. If this is the case, especially if the NRA isn’t experienced in integrating external data, it is advisable to run an integration test to identify necessary changes in internal systems and processes early enough to allow timely budgeting and reservation of relevant resources. It may be necessary to test that the existing systems can handle the data volume in question.
User acceptance and feedback	NRA could also test the new data in the actual use cases (e.g. FCD travel time data to improve the situation awareness in the TMC) and get feedback from the actual users. Engaging the planned key stakeholders and giving them the opportunity to provide feedback in the PoC phase improves their commitment to the wide-scale implementation and process development. The feedback can help guide further development and refine the data integration process.
Data security and privacy control	Especially in case where the 3rd party data deals with personal level data, it is essential to use the PoC phase to reveal potential vulnerabilities or areas where the third-party data provider might not meet required security standards. In such as case, changes in the data or background systems can be required before proceeding to the actual procurement phase

Evaluating economic feasibility

Targeting to optimum quality level

The road operators including the NRAs need to ensure that 3rd party data is an economically feasible solution to the data need in question before investing in it. Several factors need to be considered in determining the economic feasibility.

First, it is important to determine what is the optimum data quality level from the economical point of view. The EU EIP project (Laine, et al. 2021) attempted to determine the socio-economically optimum data quality levels for traffic information. As illustrated in Figure 3, the benefits of traffic information increase as the information quality increases. Unfortunately, so do also the costs of acquiring the information, and the cost are increasing especially fast at high quality levels. Thereby, there has to be a socio-economic optimum for data quality.

The EU EIP study concluded that the research data available did not permit the determination of the optimum quality. However, the study provided expert estimates of likely optimum quality levels of some key data quality attributes for some service types. These can be used as crude estimates for the socio-economically feasible quality requirements for 3rd party data.

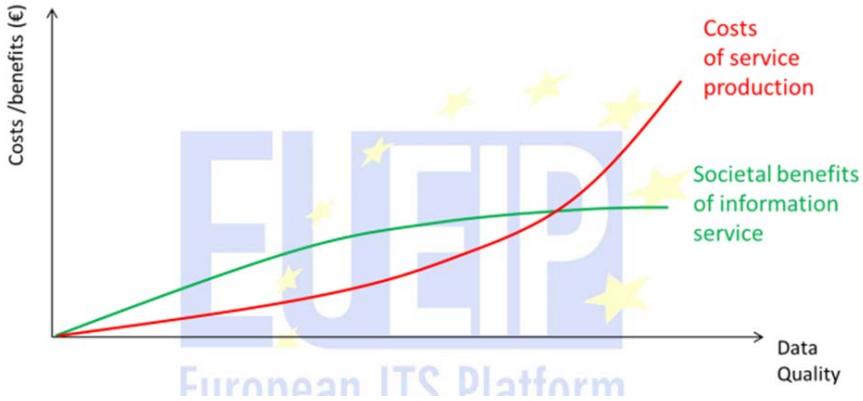


Illustration of the development of costs and societal benefits as a function of service data content quality (Laine, et al. 2021)

The road operator may also have financial challenges meaning that instead of the optimum quality, it is willing to acquire 3rd party data of the minimum quality as this will decrease the costs maintaining the economic feasibility from the viewpoint of the road operator/NRA. The minimum levels of data quality were also recommended for e.g. safety-related and real time traffic information by EU EIP (Kulmala, et al. 2019).

Evaluating economic feasibility

How to evaluate the cost-efficiency of 3rd party data?

it is often a challenge to evaluate all benefits of the data as the same data or parts of it can by used by different NRA processes and use cases. For instance, road weather data tends to be used today for winter maintenance, traffic control, traffic information, and asset management purposes, and in the future for C-ITS warnings and for determining the possibilities of automated driving systems to operate, etc. Therefore, a comprehensive benefits evaluation is (almost) a mission impossible.

Alternatively, an NRA could use simple comparison to existing "traditional" road-side solutions with regard to the costs as well as the benefits in terms of the monetary value of the changes in road crashes and delay times due to services utilising the data. Basically, the road crash and travel time benefits clearly dominate the benefit-cost calculations in the transport sector (e.g. FTIA 2020).

Due to the challenges of monetary evaluation of the benefits created by the use of third-party data it is often not possible to define the exact cost-benefit ratio for purchasing third-party data. **However, it is possible to provide certain monetary indications for decision-makers regarding the likely level of cost-efficiency.**

For example, if third-party data is intended to be used mainly in improving traffic safety, and the price level of the data acquisition is known, an NRA can calculate how many injury related accidents should be prevented to make the investment cost-beneficial. The accident unit costs established usually in each country should be used here. Such an indicator can be of great help in evaluating the economical feasibility of the planned investment.

Example calculation (simplified)

Data
Injury-accident unit cost: 440 000 eur/pc
Data service cost (3 year contract): 500 000 eur
Other costs: 150 000 eur
Network length: 2000 km
Injury-related accidents on network: 150 pc/a
Societal cost of accidents (3 years): 198 M€

Evaluation
Required accident saving to reach c/b=1: 1,48 pc
Required safety improvement: 0,33%

Conclusion
Investment is likely to be socio-economically feasible

Risk management

When an NRA that has traditionally trusted in their internally owned data sources enters to the world of third-party data utilisation, especially without previous experience, several issues can cause unpleasant surprises. However, many typical issues can be diminished when an NRA has followed the guidelines provided earlier in this report, i.e. an NRA has a clear understanding of the use-case specific needs, has a good market knowledge and has implemented a thorough fitness-for-purpose analysis and Proof of Concept testing or pilot. At this point, the NRA should have an understanding that the third-party data is the correct solution and no quality, compatibility or legislative problems should arise.

However, there are several risks related to the situation where NRA is not the owner of the data it is using and the value-chain behind the data production is constantly evolving in the market outside of NRA's control. The typical issues are discussed in the following table. In the end of the table, one risk related to the internal acceptance and preparedness, based on real-world experience, is also highlighted.

Risk management process

- ✓ **Identify**
- ✓ **Assess**
- ✓ **Control**
- ✓ **Monitor & Review**

Risk management

Risk	Possible effect to the NRA	Possible mitigation action
Data quality decreases during the contract period due to changes in the value chain (e.g. data exchange contracts between the service provider and data providers expire)	Data quality decreases below the agreed minimum quality level and this compromises the reliability of NRAs processes	• Periodic quality checks and related monetary sanctions/ rights to decommission the contract
Service provider goes bankrupt	Cease of the data flow from the service provider	• Use of credit ratings and other stability criteria as minimum requirements in the procurement • In case of highly critical use cases, use of several simultaneous service providers • High readiness to change the provider in the in-house ICT systems (e.g. use of standard data models and interfaces)
Creation of long-term vendor lock. This could be the case in novel third-party data use cases where the market is not mature or the solution utilises scarce resources such as mobile networks (usually few providers per country).	Decreasing functioning of the market as there are less incentives for newcomers to invest in data production → increase in future pricing and/or lack of interest to develop product.	• Use of several simultaneous service providers • Purchase of raw data (that requires less investment from the provider) and investing in in-house analytics to avoid dependency in only one certain solution
Underutilisation of the acquired data due to lack of commitment or resources to develop internal systems and processes	New data does not create the expected value and the investment becomes fruitless.	• Sufficient and timely communication with all internal stakeholders • Creation of trust and commitment through PoC • Early planning and budgeting for the data integration and process development works (acquisition of the needed expertise also)
Data privacy and security requirements are not fulfilled	Data containing personal information such as location or IP address may danger the individual privacy and compromise with the EU data protection legislation. Data that contains content that could be related to security threats, for example national security.	• Contractual sanctions can be established • Data validation ensuring for example data anonymisation and risk assessment. • Open and transparent communication and dissemination of the data content and usage to users.

Decision-making

Decision-making is the last phase in the use-case identification and validation process of an NRA. Ideally, before this stage the NRA experts have considered all the different aspects regarding the topic (discussed in this report) and have come to a conclusion to proceed towards third-party data procurement or either to continue to look for other alternatives. In addition to ensuring that the relevant "homework" is done properly and there is sufficient data to make an informed decision, there a certain topics of strategic nature that decision-makers may want to address in this process. These are discussed below.

1. **Is the data procurement a one-off exercise or a beginning of a new strategic path for data partnerships?** The market players such as OEMs and service providers would like to understand what is the long-term vision and strategy of the NRA regarding traffic and road weather monitoring in order to allow them to make their own investment decisions.
2. **What new capabilities may be required in the future from an NRA to be able to fully utilise third-party data?** A strategic decision needs to be made whether the NRA will be looking for turn-key data products ready to be integrated as-is to the existing processes, or are they looking for more raw-level data to be used in their internal data fusion and analytics.

Both strategies can be used, depending on the data maturity of the NRA in question. The upside of using turn-key data products is shorter lead time and less investments to internal ICT systems, but on the downside lies growing dependency on service providers and perhaps more superficial understanding of the data itself. On the other hand, investment to in-house data fusion and analytics may require large-scale investment to internal personnel and ICT-systems, but in the end may provide a platform for fuller utilisation of various new datasets also for the future use-cases.

3. **What are the impacts of third-party data usage to the traditional systems and processes of the NRA?** Can the NRA expect monetary savings from elsewhere through increasing third-party data usage? For example, if successful, third-party data could make some roadside-equipment based solutions (such as ANPR based travel time measurement systems) obsolete, allow a reduction in the amount of equipment or at least take out the pressure for new investments in certain roadside equipment. This is a significant question to consider and can provide more relevant arguments to the decision-making process.

Summary – 3rd party data as part of a toolkit

It is important to realise that there are many uses of third-party data by an NRA:

- To avoid installing roadside sensors where they don't yet exist, so avoiding capital and maintenance costs
- To augment roadside sensors especially where they have coverage or reliability issues, as no one sensor is perfect all the time.
- To replace some forms of roadside data and road surveys where third party data is better (cheaper, offers new or more complete coverage or new data types)

The balance of the above depends on the use cases you need data for to deliver outcomes. Typically, in an NRA there will already be some roadside data and safety critical sensors, but for newer construction and planned roads, these might not yet be there. A question is "can we use third party data instead?"

For an NRA considering the use of 3rd party data, the first question should be, what is the anticipated outcome, followed by the use cases for delivering these outcomes, and lastly the choice of the data. In many cases, the choice may not be a single dataset, but a fusion of several datasets of different origins.

A good example was explored in the previous CEDR project "SHADAR" that looked at fusion of many data sources, both NRA owned and third party, to deliver an outcome of improved road safety for an NRA based on the use case of stopped vehicle detection. It showed that by fusing traditional NRA sensors like cameras, loops and radar with third party data like Waze, Floating Vehicle Data and eCall activations, a better time to detect and reduced false positives could be gained than by using any one source alone.

But for non-safety critical use cases, third party data alone might be good enough (or is all that can be afforded). It might bring new insights to problems never before quantified.

Hence the question is not "do I use third party data" but "what data do I need to solve problems, and can third party data help as it has different coverage, quality, costs or types of data (eg direct from vehicle systems).

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Deliverable 5.2 Data Acquisition and Quality Assurance Guidelines

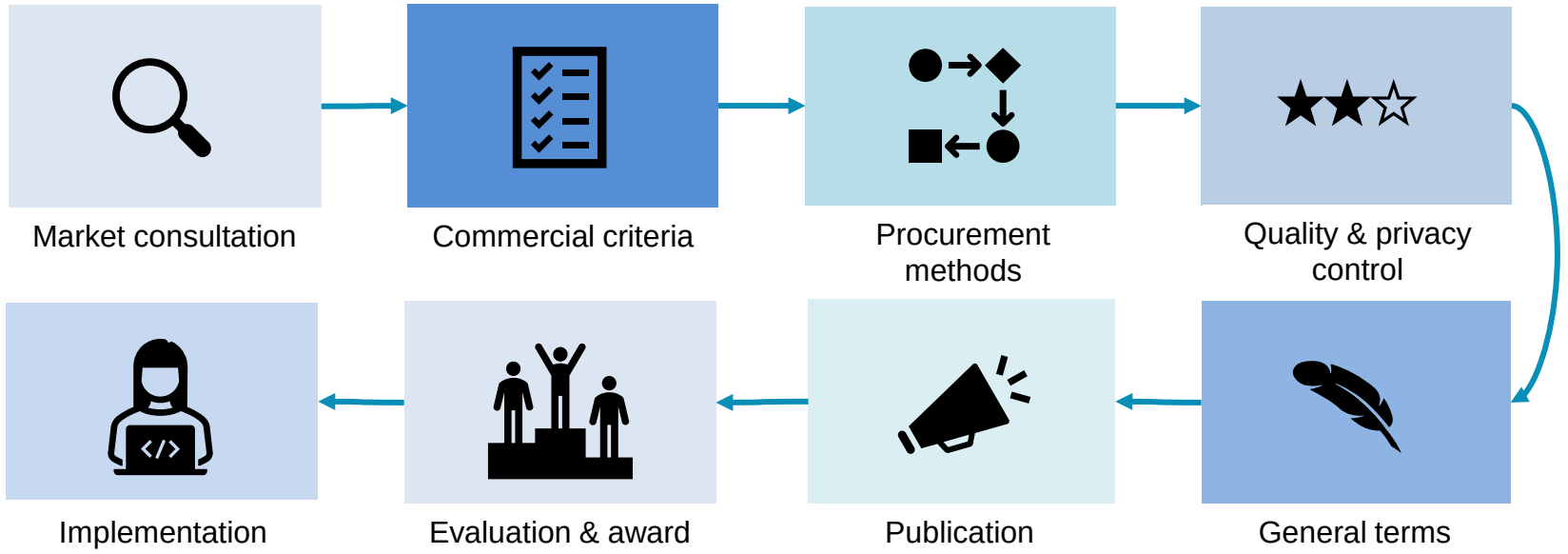
Introduction

Purpose of this deliverable

The objective of the deliverable is to provide NRAs guidelines and decision-support how to successfully perform a 3rd party data acquisition process. The guidelines are built on relevant legislation, guidelines, and recent experience from pioneering NRAs in Europe. Quality and technical requirements are addressed in detail, while different procurement models are also addressed. Furthermore, guidance on quality monitoring, privacy, and general contract terms is provided.

The guideline is prepared to solely serve the procurement of data services. However, as the general regulation guiding public procurement also applies to other types of purchases, the structure of the report follows the general process and includes general elements of public procurement.

Public procurement process:

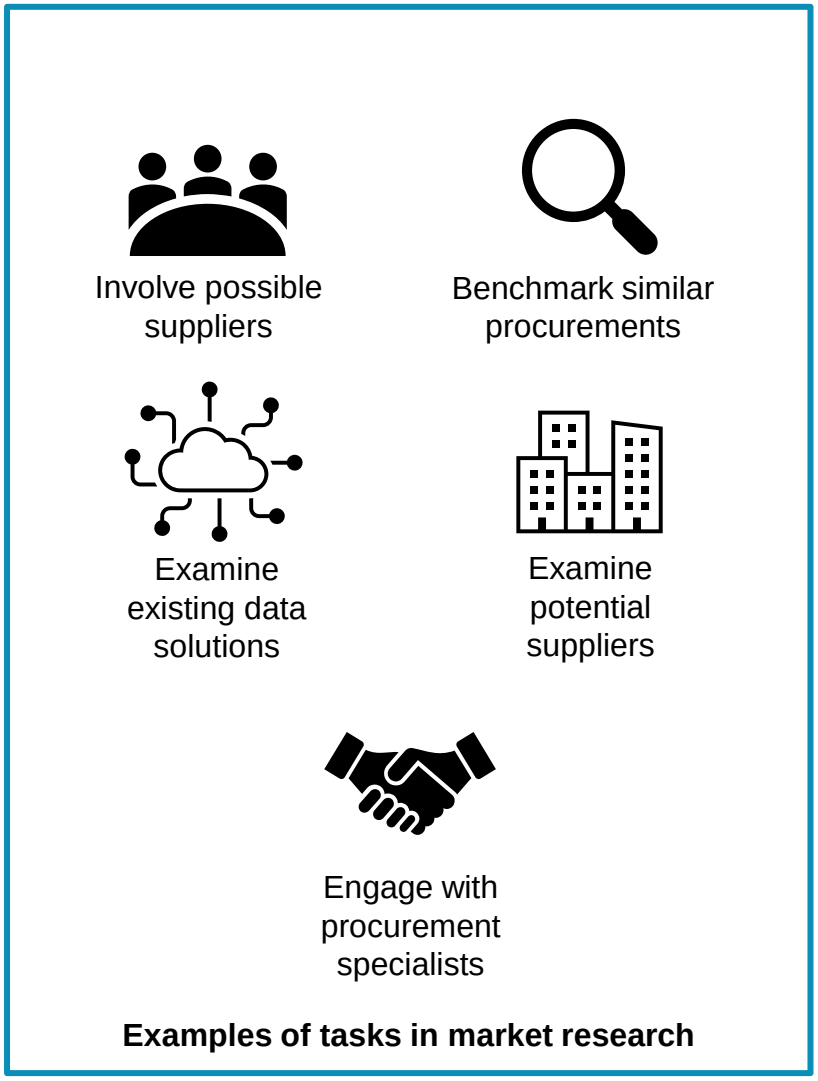


Market consultation

As a first step in any successful procurement process, the NRA should conduct market research. Through market research, the NRA can:

- strengthen its ability to **select correct criteria**
- **discard unnecessary criteria**, which could yield excessive costs.
- **approximate the price** of the data desired.
- determine the **current availability of data** on the market.
- estimate the **risk of collusions** during the process (SIGMA, 2016a).

Therefore, the NRA should carefully examine **availability of suppliers**, **and solutions**. Consequently, the NRA should gain the required insights from the market to evaluate prices and level of competition. Furthermore, the NRA should examine the prevalent **standards** on the market and whenever applicable utilize the standards on procurement documents. During the market consultation, the NRA should also benchmark **similar procurements** already carried out, whenever available. The market research is also part of the use case identification and validation and has been therefore discussed already in part 5.1 of this deliverable.



Examples of tasks in market research

Market consultation

The market research should contain **desk research**, and **stakeholder involvement through actual market consultation**. Through desk research the NRA can attain most of the previously discussed information, especially if the market is relatively mature. However, desk research should be complemented with **stakeholder involvement through market consultation**.

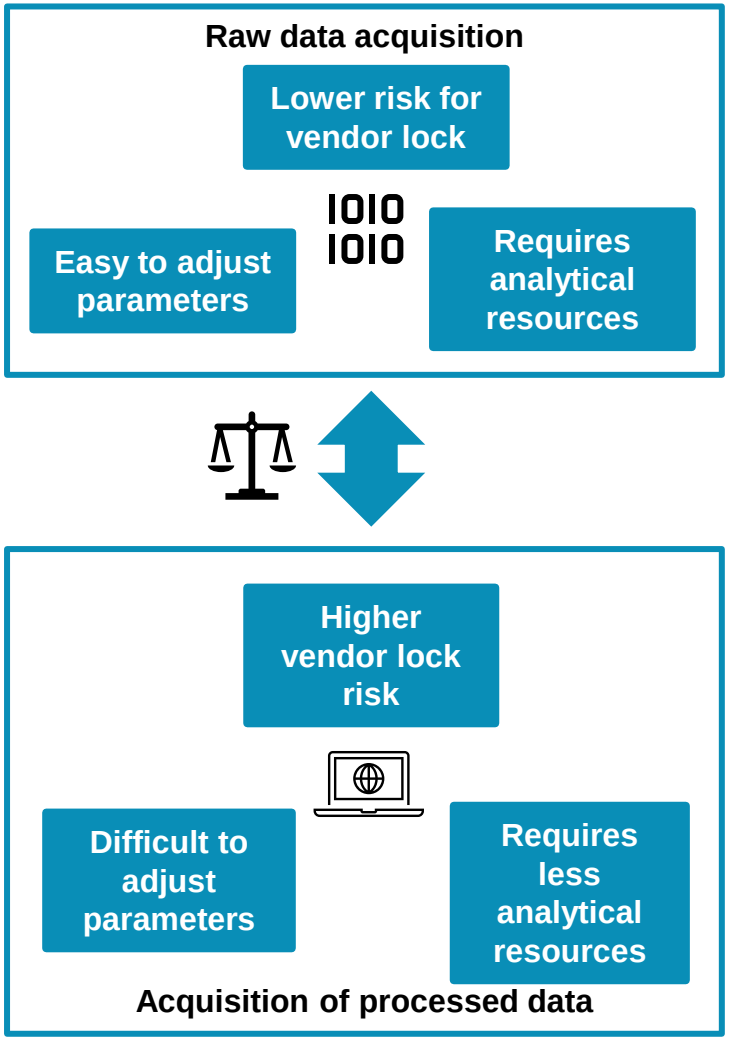
Through market consultation, the NRA can **inform economic operators** about the oncoming procurement and gather insight from relevant actors. Based on European Commission's (2018) guidance the market consultation can involve **discussions** with potential bidders. However, it is paramount that the NRA allows all actors to participate in the consultation, while relevant information from market consultation should be **openly shared** to all bidders during the actual procurement (SIGMA, 2016a). The NRA **should announce the market consultation openly for example through national procurement portals** to prevent distorting the successive tendering (European Commission 2018).

Do's in market consultation

- Announce market consultation openly
- Share information later with all candidates
- Foster transparency
- Avoid gathering confidential information

Never engage solely with few suppliers without proper, open consultation

Identifying the required level of data processing



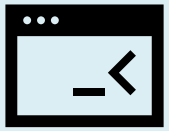
During market research, use case identification, and benchmarking of the best practices the NRA should determine the required level of **data processing**.

If the NRA lacks necessary **capabilities or knowledge** to process raw data, the NRA should pursue obtaining **processed information** in a form that is easy to utilize. However, obtaining processed information requires defining the appropriate level of processing in the procurement documents for example both through **technical criteria** and **use case descriptions.** If the NRA is pursuing a solution providing processed information, the NRA should try to align requirements with other similar acquisitions identified during market research as it could decrease costs compared to fully tailored solution and reduce risk of vendor lock.

Obtaining **raw data** allows in-house analytics and consequently facilitates easy adjusting of parameters within the software. However, acquiring raw data **requires the NRA to have sufficient capacity in processing the data**. Furthermore, the suppliers might be unwilling to offer raw data as sharing raw data could reduce the supplier's ability to utilize the data for other business cases.

Procurement documents

After market consultation the NRA should prepare the procurement documents. The preparation of **procurement documents** is the most important step in a successful procurement. Different procurement documents **contain information** about criteria, general contract terms, and explain the evaluation methods of submitted tenders (European Commission, 2018). The commercial criteria i.e., exclusion, selection, and award criteria are discussed next. Thereafter, the contract length, privacy, quality assurance, and different procurement methods are addressed.



Technical specifications

Detailed information about the requirements for the data.

Draft contract

Describes contractual arrangements such as termination clauses, quality monitoring, and payments. Refers to technical specifications.

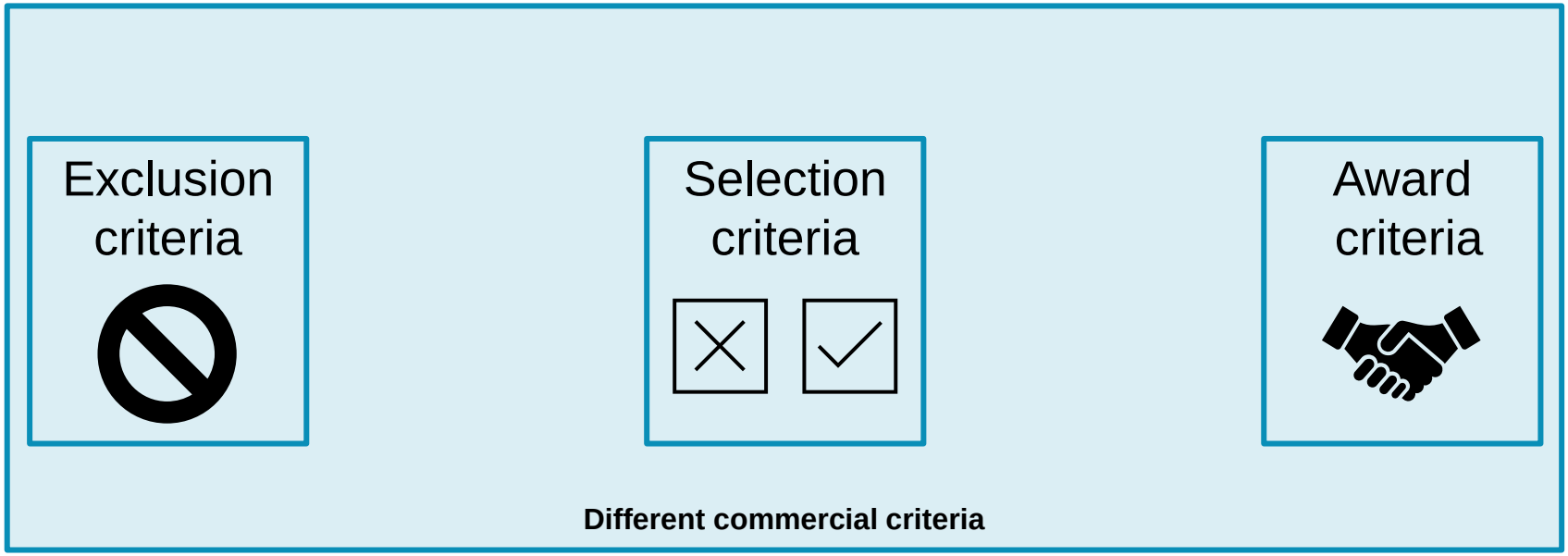
ESPD
(European Single Procurement Document)

Self declaration of financial status, abilities, and suitability for the procurement.

Examples of different procurement documents
(Amended from European Commission, 2018)

Designing the commercial criteria for procurement

After conducting successful market consultation and research, the NRA should have knowledge about available data, similar procurements, and expected costs of the data. Thereafter, the NRA should begin to formulate the **requirements** for the procurement as part of preparation of the procurement documents. All the requirements are included in the procurement documents and safeguard that the suppliers meet the requirements of the NRA. Next, **exclusion, selection, and award criteria** are discussed in detail.



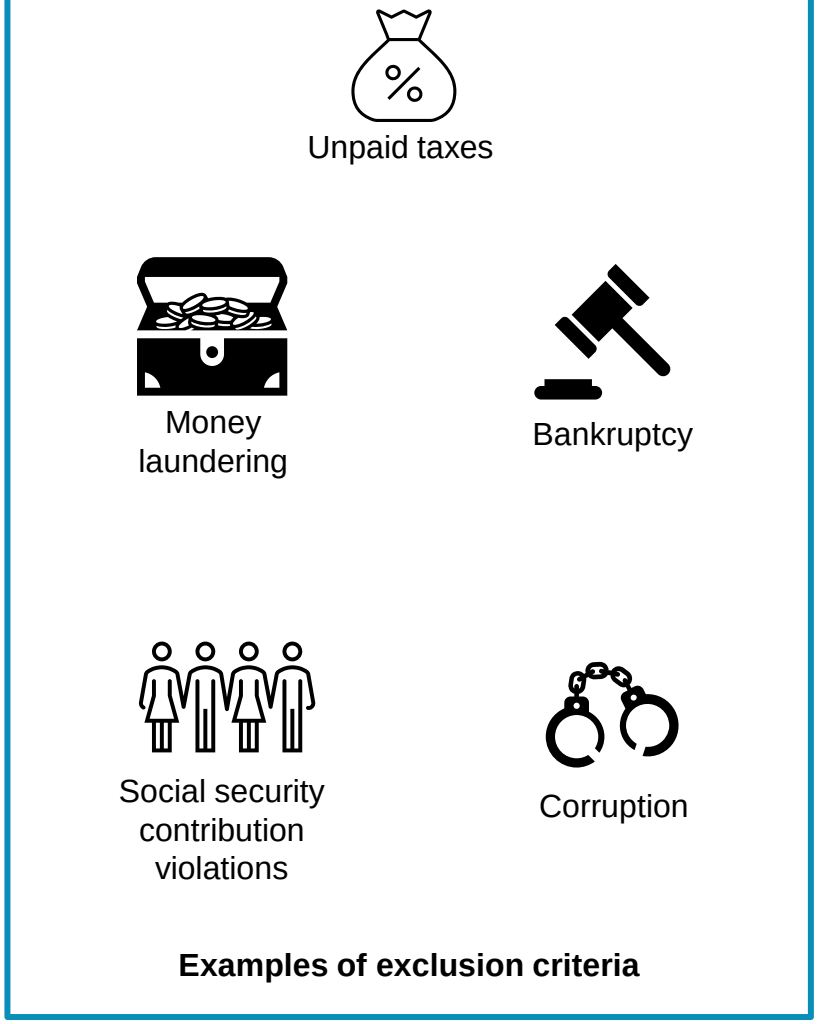
Different commercial criteria

Exclusion criteria

EU and national regulations set certain criteria when a a candidate **must be excluded** from a procurement process. The criteria for exclusion can be subdivided into **mandatory exclusion** criteria and o**ptional exclusion** criteria (Directive 2014/24).

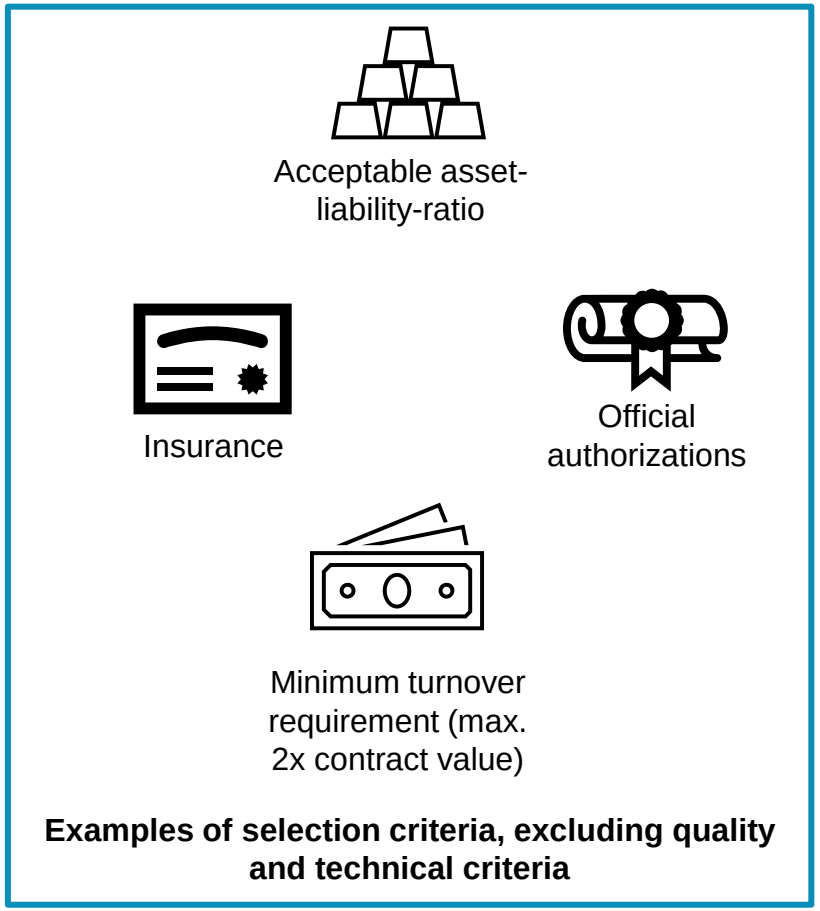
The mandatory exclusion criteria include convictions from the most serious offenses, while the optional exclusion criteria address less serious offenses (European Commission, 2018). Thus, **all procurements must include** the mandatory exclusion criteria, while the NRA should consider which optional exclusion criteria it should include on the procurement documents. Exclusion criteria are generally included in the ESPD-document (European Single Procurement Document), which allows the data supplier to declare its compatibility with the exclusion criteria (European Commission, 2018).

National variation in exclusion criteria is prevalent !



Examples of exclusion criteria

Selection criteria



Examples of selection criteria, excluding quality and technical criteria

In addition to exclusion criteria, selection criteria are required to define the **minimum requirements** for the supplier and data (Directive 2014/24). Thus, if a tender does not meet the selection criteria, it is excluded from the evaluation.

The NRA can add requirements not directly related to the data. For example, selection criteria related to sufficient turnover and financial stability can be used to safeguard that the supplier has **sufficient resources** (European Commission, 2018). The NRA should acknowledge that financial stability or turnover criteria can exclude SMEs. Therefore, the requirements should avoid excessively rigid criteria. Furthermore, the selection criteria also **include the minimum quality and technical criteria**, which are paramount for successful data acquisition, and are discussed on the following slides.

The selection criteria can be assed with a **passed-fail scale** (European Commission, 2018). However, **also other approaches** can be utilized. For example, in a point-based system each selection criterion yields a specific number of points (e.g. 10) and a tender is excluded only if the aggregated points fall under a certain threshold (an example is provided at section 5.3). The selection criteria can be included on the ESPD-document, technical specifications, or in the draft contract (European Commission, 2018).

Technical requirements for the service

To provide the NRA with a solution yielding in relevant data, the NRA needs to determine the required technical specifications for the data **as part of the selection criteria** (European Commission, 2018). Generally, some **minimum criteria** which the offered data need to satisfy are utilized.

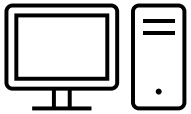
More rigid and comprehensive minimum criteria **decrease the risk** of unsuitable data offered for the NRA. Here the NRA should utilize knowledge from the use case identification, market research, and market consultation. The existing technology solutions adopted by the NRA may require the use specific technologies. In general, however, **technology agnostic technical requirements** are to be preferred. Furthermore, technical requirements **must be always non-discriminatory** (Directive 2014/24). Therefore, the NRA can not demand data to be collected using e.g., software or equipment from a certain manufacturer or brand. Equivalent solutions must always be allowed.

Furthermore, excessively **rigid criteria might reduce the number of tenderers possibly leading to increased costs**, while also limiting possibilities for innovation (European Commission, 2018). Therefore, the NRA must acknowledge the **trade-off** between rigid criteria yielding low risk, and flexible criteria with higher risk but more competition and innovation.

Examples of technical requirements for data services

Data attributes

The purchaser can require specific attributes to be included in the data.

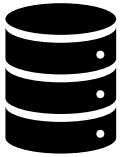


Data model, system architecture

Format of the data and specific system architecture can be required.

API

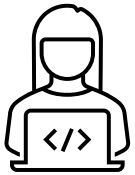
Requirements for the API should be stated. Requirements could include specifications facilitating integration into NRA's legacy systems.



Case examples on section 5.3

User interface

Minimum quality for UI should be outlined. Language, and required functionalities should be stated. NRA should state is a separate UI required or are the functionalities implemented in NRAs existing systems.



Documentation

Scope, language, and update responsibilities should be determined.

Quality & SLA requirements for the data

The NRA should also **set the minimum quality and SLA requirements, which are part of the selection criteria** (European Commission, 2018). Consequently, through setting robust quality and SLA criteria the NRA can safeguard that the data **is sufficient** for the intended purpose as insufficient quality could decrease the NRA's ability to utilize the acquired data. Excessive quality criteria can increase costs and decrease competition. Conversely, insufficient quality criteria could yield in low data quality. Therefore, increasing the data and thereby service quality yields higher user benefit, but also higher costs, while **at the highest quality levels costs increase more than quality**.

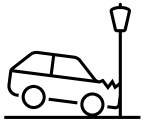
The NRA should differentiate between **status-oriented data and event-oriented data** due to the differences between the data types. Thereafter, the NRA should utilize the **knowledge from use-case identification, market research, and market consultation** in determining the optimum quality level. Furthermore, reports such as the EUEIP-report by Kulmala et al. 2019 have established minimum data quality guidelines mainly for other purposes than data procurement. However, these guidelines can be amended also for data acquisition. Therefore, the quality criteria/requirements developed by Kulmala et al. (2019) for minimum (where applicable enhanced) data quality-level are shown on next slides. In addition to the report by Kulmala et al. (2019) also the TISA-guidelines (2024) can be adopted as benchmark, even though their intention is to guide NRAs' own data quality development.

Status-oriented data

Provides a **continuous** overview of attributes such as speed, congestion, and travel time. The data can be either real-time or retrospective.

Event-oriented data

Event based data is related to **traffic incidents** such as roadworks, accidents, or other disturbances. The data consists of **event-related information**, instead of continuous monitoring.



EUEIP report by Kulmala et al. (2019) available through this link

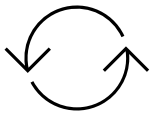
TISA (2024) report available through this link

Example quality requirements for status-based data

Timeliness

The time since the data was collected from the ground.

example criteria: 95% of data must be under 5-minute old (EUEIP "enhanced")



Refresh rate

The maximum time interval between consecutive updates of the data.

example criteria: max. 5 minute interval between data updates (EUEIP "enhanced")

Error rate

A pre-determined limit for allowed errors can be set. To define the proportion of errors in the data reference data or identification of outlier values can be utilized.

example criteria: max. 10% of data with deviation over 20 % (EUEIP "minimum")

Coverage

Percentage of relevant road network covered by the data at any time.

example criteria: at least 90% of relevant road network covered at any time (EUEIP "enhanced")

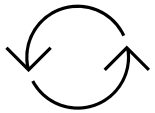
Amended from Kulmala et al. (2019)

Example quality requirements for event-based data

Timeliness (start)

The time between the traffic event and identification of the event in data.

example criteria:
for 95% of events under 10 min. (EUEIP “enhanced”)



Timeliness (update)

The time between dissipation of the traffic event and dissipation in the data.

example criteria:
best effort (not defined by Kulmala et al. 2019).

Location accuracy

Difference between actual event location and reported location.

example criteria:
for 95% of events: correct link between intersections (EUEIP ”minimum”)

Classification correctness

Number of events classified correctly (e.g., classified into crashes and congestion events correctly).

example criteria:
at least 85% correctly classified.
(EUEIP ”minimum”)

Coverage

Number of events detected in the data compared to the actual number.

example criteria:
best effort (not defined by Kulmala et al. 2019).

Amended from Kulmala et al. (2019)

Example SLA requirements for status- and event-based data

SLA

SLA defines the requirement for availability of the data through e.g. an interface. The NRA might want to allow maintenance breaks, which do not affect negatively the monitored service level as in the example. The procurement documents need also to determine whether reporting the realized service level is on the responsibility of the supplier, or whether the NRA monitors the service level independently.

example criteria: interface available 99,0% of time with two allowed max. 4-hour maintenance breaks each month. NRA monitors.

Requirements for support, management, and maintenance

The NRA should determine the necessary level of user support required for the data. Furthermore, the NRA should determine the timeframe of within possible issues in the data need to be resolved. Based on how critical the solution is for NRA's operations; the NRA might require for example 24/7 support and incident resolution.

example criteria: user support within 1 working day, incident resolution within 5 working days.

The SLA, quality, and technical requirements are **part of the selection criteria** of the procurement. Therefore, tenderers not satisfying the minimum criteria must be excluded.
All criteria should be **precise, sufficient in information, easily understandable, and have clearly defined and measurable outcomes as in the examples**.
Quality quantification is discussed later in this document.

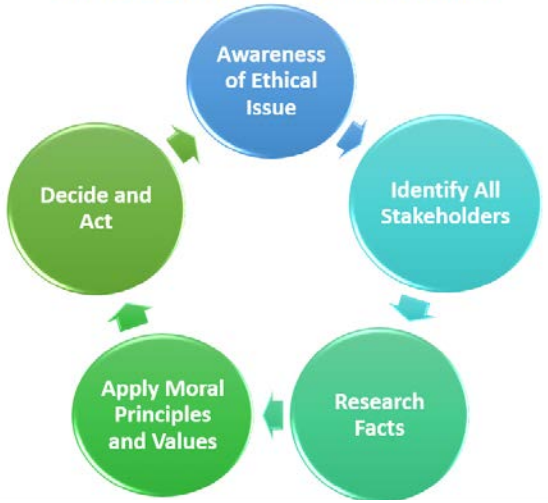
!

Ethical considerations

In addition to the previously discussed technical and quality requirements, the NRA should consider also **ethical aspects in the procurement**. The basic principles of data ethics for business professionals and organizations are the following based on Kotilainen & Kulmala (2025):

1. **Ownership**: Individuals own their personal information. Collecting data without consent is unethical and unlawful. Always obtain permission through clear agreements or policies.
2. **Transparency**: Be open about how data is collected, stored, and used. Clearly communicate your methods and intentions to data subjects, enabling informed decisions.
3. **Privacy**: Protect individuals' personally identifiable information (PII) by storing data securely and ensuring it remains confidential. Consider de-identifying datasets to maintain anonymity.
4. **Intention**: Collect data with a clear, ethical purpose. Avoid gathering unnecessary or sensitive information that doesn't directly serve your project's goals.
5. **Outcomes**: Assess the potential impact of data analysis. Be vigilant about unintended consequences, such as biases or disparate impacts, and strive to prevent harm to individuals or groups.

These principles should be complied to by NRAs as well as the third-party service providers providing data for the NRAs, and thereby **could be included as exclusion or selection criteria** in the procurement. The four first principles have mainly consequences to the **processes for acquiring the data**, but the fifth one is the most comprehensive one putting also pressure on aspects of data and information quality already addressed before.



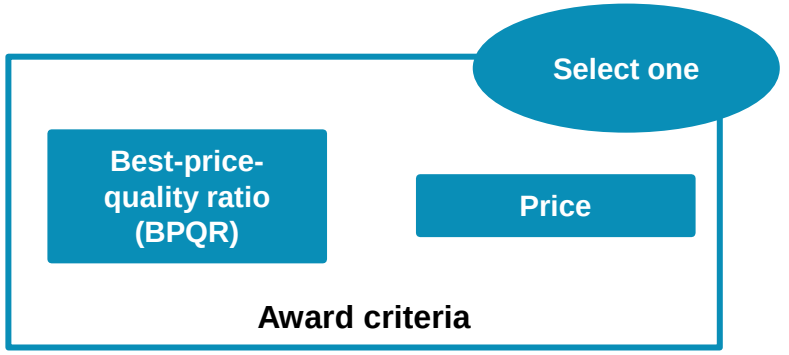
Ethical decision-making process
Kotilainen & Kulmala (2025)

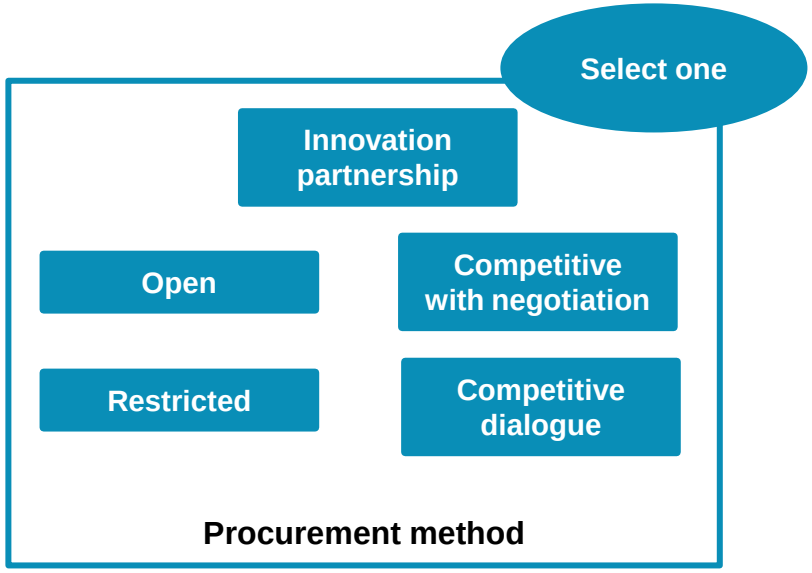
Award criteria

After defining selection and exclusion criteria the NRA must determine the **award criteria** utilized to select **the economically most advantageous tender, consequently selected as the winning tender** (European Commission, 2018). Award criteria must be clearly outlined in the procurement documents.

The award criteria for evaluating data quality can measure **similar attributes as the selection criteria**. Consequently, the selection criteria can be interpreted as depicting a minimum level of technical and quality-related criteria. Instead, the award criteria measures **quality exceeding the minimum criteria**. Section 5.3 presents examples of awarding criteria utilized in different data procurements.

The award criteria **shall not be subjective**. The award criteria can be defined as either **absolute** (the quality/price is compared to pre-defined maximum value) or **relative** (the quality/price is compared between the bidders) (SIGMA, 2016c). Award criteria were also discussed on a workshop organized in 24th of January 2025. Participants of the workshop include the CEDR Data Call PEB members as well as the experts from the three projects (Presort, DROIDS, TIARA). Results of the workshop are utilized in the analysis presented next.





Award criteria

Evaluation based on price

Evaluation based on price **is the simplest option** for determining the economically most advantageous tender (European Commission, 2018). The price can be for example the **lifecycle cost** of the data, **or a fixed cost** for acquiring the data with separate rates for possible user support (SIGMA, 2016b).

Evaluation solely based on price requires that the NRA has been able to determine **robust minimum criteria for data quality and technical attributes**. Price-based competition ensures lowest possible costs. However, the method does not promote innovation. More strengths and weaknesses are shown on the next slide.

The price-based competition is suitable for acquiring standardized and widely available datasets. However, innovative or novel datasets should not be acquired though price-based evaluation.

Examples when price-based evaluation is suitable

- Non-essential data
- Raw data for NRAs fusion activities
- Widely available, highly standardized datasets
- Low dimensional datasets (e.g. static road works data)
- Simple data used regularly
- Journey time data

From workshop discussion

Evaluation based on price

From workshop discussion

	PROS	CONS
INTERNAL	**STRENGTHS** • Clear and easy • Objective and fair • Pushes towards cheap price	**WEAKNESSES** • Doesn't allow adjustments or changes of plans • Difficulty to set minimum requirements for complex needs • Quality might not meet expectations • Less new or innovative ideas, less support
EXTERNAL	**OPPORTUNITIES** • For mature and standardised data markets • Precise requirements can offer a change to "squeeze" requirements and providers • Innovativeness towards efficiency • Possibility to buy a lot of (raw) data - role of development and innovation mainly for the NRA • Potential for new players on market	**THREATS** • Not enough flexibility when plan for data usage changes or minimum requirements were not sufficient • Quality issues may arise in case technical minimum requirements weren't accurate • Changes in the market/technology may lower usefulness • Providers of "fake" data

Award criteria

Best price-quality ratio (BPQR)

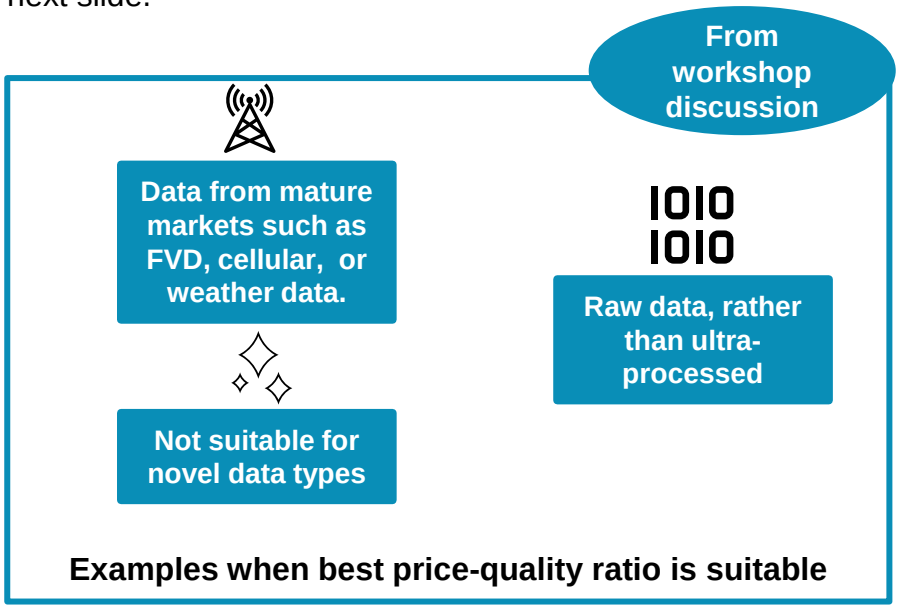
In addition to the evaluation based on price, the NRA can use **both price and quality attributes to determine the economically most advantageous tender**. Through inclusion of quality criteria NRA can promote bidders to offer **additional quality elements** to the data (SIGMA, 2016b). The best price-quality ratio approach is suitable for acquiring data categories depicting large quality variations between suppliers based on the workshop.

The inclusion of quality criteria requires **robust approaches for quantification** of the quality. Consequently, the NRA should determine quality criteria that clearly **depict attributes and properties of data** which the NRA considers relevant (European Commission, 2018).

The BPQR can contain several different attributes to be evaluated such as latency, error rate, or coverage of the data. Examples of the evaluated criteria are shown in section 5.3. The different criteria can have different weights, while also the weighting between the quality and price can vary based on the needs of NRA.

The evaluation of quality can be based on analysis **of actual data** which the bidders are required to provide while submitting the tender. Alternatively, the quality evaluation can be based on the bidders self-reporting the quality, which is then confirmed in **pre-implementation acceptance test**.

Best price-quality ratio-based awarding criteria can promote innovation. However, the method is more complex as the quality needs to be quantified. The quality quantification methods are discussed later. More strengths and weaknesses are presented on the next slide.



Best Price-Quality Ratio (BPQR)

From workshop discussion

	PROS	CONS
INTERNAL	**STRENGTHS** • An agile approach to fulfil needs – possibility to adjust price-quality ratio • Provides optimum quality for the procurement	**WEAKNESSES** • It requires experience to fully take advantage of this model • Difficulties in defining, measuring and comparing data quality
EXTERNAL	**OPPORTUNITIES** • Facilitates greater opportunity for innovation • Recommendation to first arrange a pilot to demonstrate quality (and its measurement)	**THREATS** • Requires thorough knowledge of supply chain & offering in the market • Over-defined requirements leads to inability to supply

Knowledge becomes a strength, when it is extensive!

Award Criteria

Evaluation based on quality

The NRA can also select the economically most advantageous tender **solely based on quality** (Baek & Ashuri, 2023). Consequently, the NRA sets a fixed price for the data. Thereafter, the selection is conducted solely based on comparing **the quality of the different tenders** (Baek & Ashuri, 2023). The NRA should carefully determine the fixed price, as an insufficient price could lead to lack of tenders in the process (Baek & Ashuri, 2023). Conversely, excessively high fixed price could lead in diminished price-quality ratio of the data. Thus, evaluating the data solely based on quality requires the NRA to have a high degree of market understanding to select a suitable fixed price. Based on the risks related to diminished price-quality ratio, the method **is not recommended** to be used in acquisitions of third-party data and is not further discussed in this document.

Comparison of award criteria

The price-based awarding is the simplest approach in determining the economically most advantageous tender. However, the BPQR allows the NRA to evaluate also quality attributes, consequently promoting innovation. The BPQR is currently the most utilized awarding framework in data acquisitions based on the workshop. However, price-based evaluation is suitable especially for NRAs with limited experience in data acquisitions. Furthermore, complex quality criteria in BPQR could increase workload related to evaluation of the tenders.

Risk for lack of tenders or poor quality-price-ratio

Requires careful analysis of market to set correct price

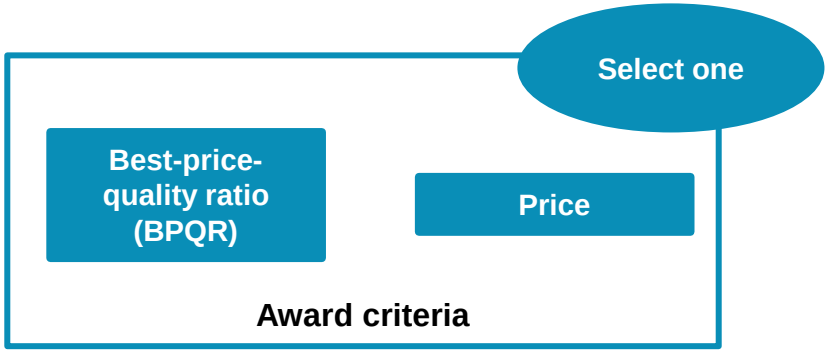
Can enhance innovation

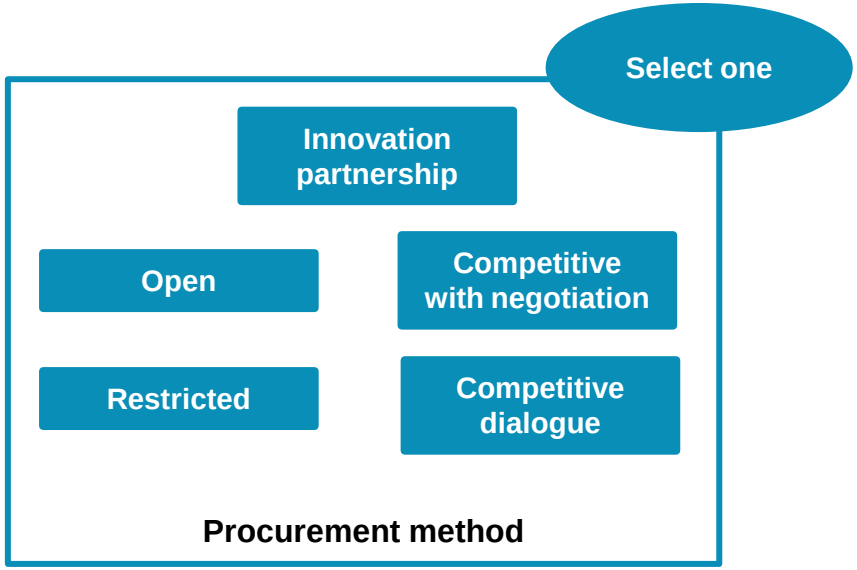
Evaluation based solely on quality

Procurement methods

After selecting the award criteria utilized to determine the economically most advantageous tender, a suitable procurement method should be chosen**.** Different approaches to procurement can be utilized based on **expertise, resources, and needs of the NRA**. Furthermore, the NRA should always comply with the relevant legislation to prevent any legal challenges. In case of possible European Commission's funding support, the NRA should also stick to the procurement methods allowed by the European Commission funding instrument. To determine suitable procurement method, the NRA should have **market knowledge**, obtained from previous experience or from the market consultation discussed earlier.

Most procurement methods can be combined with both the BPQR- and price-based awarding criteria. Therefore, the NRA should consider selection of the award criteria and procurement method holistically. The NRA should especially consider its **resources, knowledge, and the maturity of the data market** when selecting the procurement method. Different methods are presented on the next slides.





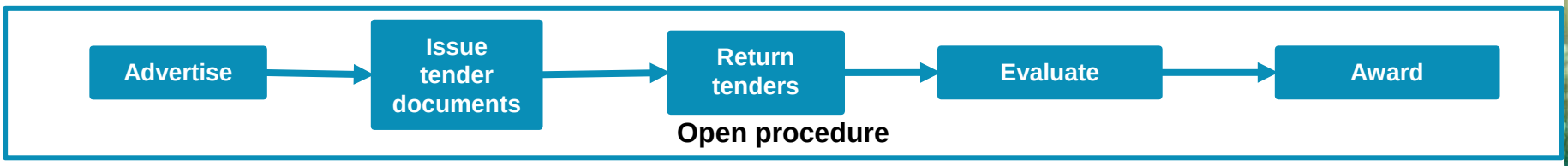
Procurement methods

Open procedure

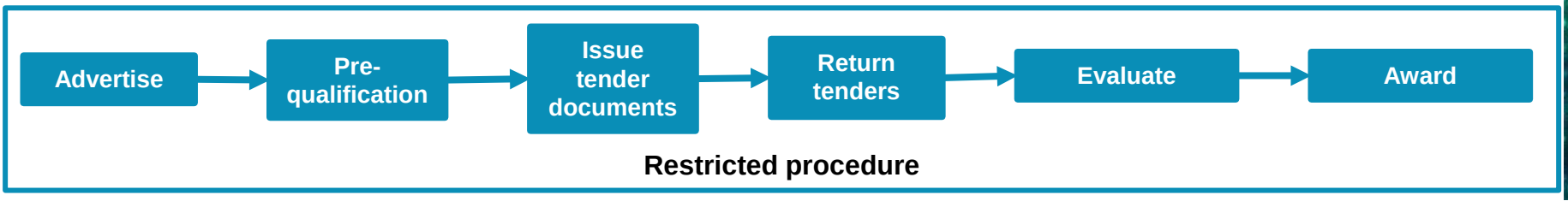
Open procedure is a single-stage method, in which all suppliers can bid for the contract (SIGMA, 2016c). Consequently, the method allows the NRA to receive the **maximum number of tenders**. The maximal competition can promote quality, while decreasing costs. The economically most advantageous tender is selected as supplier based on the award criteria discussed previously (SIGMA, 2016c).

Restricted procedure:

In addition to the open procedure process, it is possible to use a tendering process with a pre-selection. In the **two-stage** restricted procedure, a subgroup of original tenderers is selected based on some **objective criteria** (SIGMA, 2016c). Thereafter, final tenders are submitted. NRA should note that between the pre-selection, and actual bidding, **no negotiations are allowed**. The economically most advantageous tenderer is selected to offer the service (SIGMA 2016c). The restricted procedure allows the NRA to limit the number of tenderers, which can reduce workload if the evaluation of the actual tenders requires significant amounts of work for example due to a data sample. However, the pre-selection decreases competition.



Open procedure



Restricted procedure

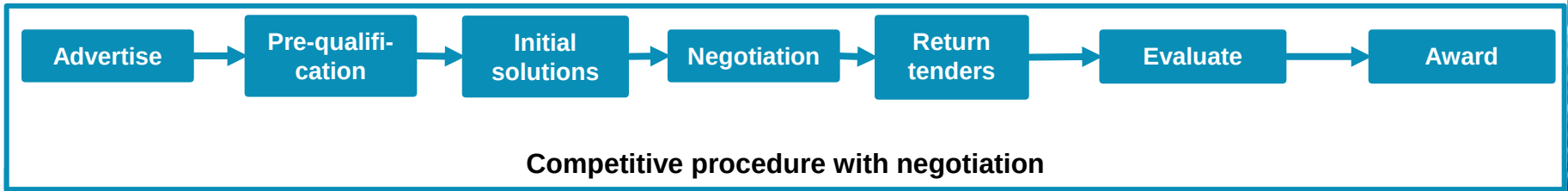
Procurement methods

Competitive procedure with negotiation (CPN)

The CPN **is a two-stage procurement strategy**, similarly as the restricted procedure. The NRA advertises the contract, and the data providers are pre-selected similarly as in the restricted procedure. After pre-selection, the initial procurement documents are published, and the data providers return initial solutions. Thereafter, the NRA **negotiates** with the candidates to safeguard that the proposals meet NRA's requirements (European commission, 2018). The **award or selection criteria can not be discussed** (SIGMA, 2016c). After negotiation, the final tendering occurs. No optimisations can be requested during or after the tendering (SIGMA, 2016c). The economically most advantageous offer is selected (SIGMA, 2016c).

Competitive Dialogue (CD)

The **CD** is a similar procedure as CPN (SIGMA, 2016c). However, **key differences exist resulting in increased flexibility** compared to CPN. After pre-selection, the data suppliers and NRA find the solution through negotiating on **all aspects** of the data. **No initial solutions** from data suppliers are required as in CPN (Slípková, 2022). The NRA ends the negotiation phase after it is certain that it can receive offers providing acceptable data. Final tenders must be evaluated based on **best price quality ratio** (Kuuttiniemi & Lehtomäki, 2017). After selecting one winning tender, **the NRA can ask the winning tenderer to clarify, specify, and optimise offers up to certain limits (European Commission, 2018).** In some countries only CP or CPN is utilized, not both (Burnett & Arribas 2024).



Competitive procedure with negotiation

Competitive dialogue

Procurement methods

Innovation partnership procedure

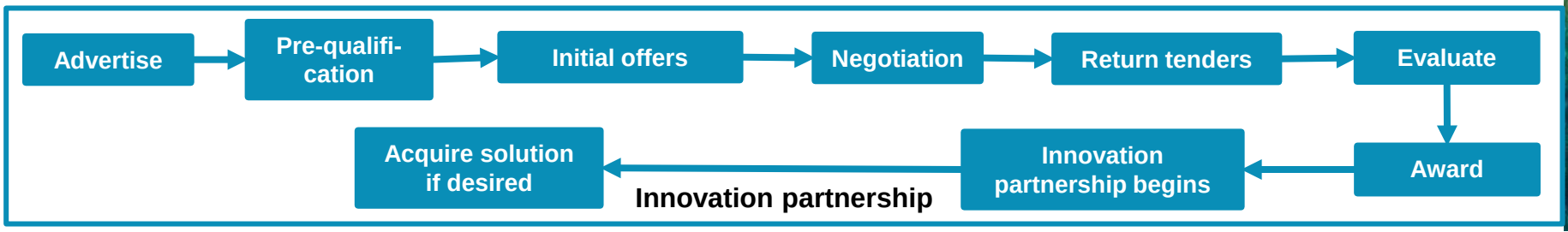
Innovation partnership is based on the competitive procedure with negotiation (CPN), while offering greater flexibility (SIGMA, 2016c). The procedure starts by advertising the contract opportunity (European Union, 2021). Thereafter, **a pre-selection** occurs similarly as in the CPN. The pre-selection is followed by tenderers **submitting initial solutions/offers** and by negotiation about the initial offers similarly as in CPN (Tekes, 2017). Thereafter, the data suppliers for the innovation partnership are selected based on the best-price-quality-ratio (European Commission, 2021). After the pre-selection, the actual **innovation partnership begins**. The innovation partnership is subdivided into steps that should reflect the innovation process, while the suppliers are **renumerated for participation** (Aho, 2017). During partnership, the parties can discuss all aspects of the data and the NRA can acquire data during the partnership without a separate procurement. (European Union, 2021). Benefits and risks are shown on next slide.

Through a direct award contract

Under certain circumstances the NRA can **directly** award the contract to a specific data supplier. However, a direct award contract **does not foster competition**, **nor incentivize innovation** (European Commission, 2018). Thus, direct award contract can yield to higher costs compared to the competitive procedures. Furthermore, EU and national regulation have stringent limits for the utilization of direct award contracts. Consequently, utilization of direct award contracts **is not recommended**.

Framework agreements

Framework agreements generally shortlist a specific number of suppliers, from which the NRA can later procure data (European Commission, 2018). Thus, after open procedure, restricted procedure, CPN or CD, the NRA has obtained suppliers from which it can acquire data without further procurement (European Commission, 2018). The framework agreement does not require the NRA to make any purchases from the agreement.



Innovation partnership

From workshop discussion

	PROS	CONS
INTERNAL	**STRENGTHS** • When successful, offers best value (best providers, best prices) • Clear communication allows for innovation • More participants, redundant data supply • No surprises in the outcome • Fail fast!	**WEAKNESSES** • Requires plenty of resources and time from an NRA • Many NRA's may lack such sophisticated procurement skills • Requires time & money from companies – smaller actors may not be able to afford • Procurement management is costly
EXTERNAL	**OPPORTUNITIES** • Welcomes new players and new ideas • Built-in flexibility for innovation • Outcomes that could not be foreseen by an NRA only • Possibility to adopt open data standards	**THREATS** • Vendor lock-in by agreeing to proprietary solutions • Risk of "snake oil" salesmen making it to the end of the process • Can lock out new suppliers with novel ideas (--> consider pre-qualification criteria carefully) • Continuity at risk if data provision is not financially feasible in the end

Which procurement method to choose?

If the expected number of tenderers is small, and the NRA has resources to evaluate all the tenders it is recommended to use the open procedure as it yields maximum competition. The restricted procedure allows only to limit the number of tenderers, which reduces the workload related to evaluating the tenders. However, it does not allow negotiations or interaction to provide e.g., innovative data for needs incompletely defined by the NRA. **Both open and restricted procedure are relatively easy to implement and should be utilized if data exists on the market.**

The competitive dialogue procedure, competitive procedure with negotiation, and innovation partnership are suitable for situation where the NRA needs to elaborate on the data-solution with the candidates. The procedures are **more complex** but allow the NRA to discuss the data-solutions especially if based on the market research no suitable data currently exists. Furthermore, if the NRA is not capable to formulate sufficient criteria the procedures allow NRA to discuss the data-solutions to safeguard suitable offers**. The dialogue procedure and innovation partnership offer more flexibility than the competitive procedure with negotiation as discussed earlier**.

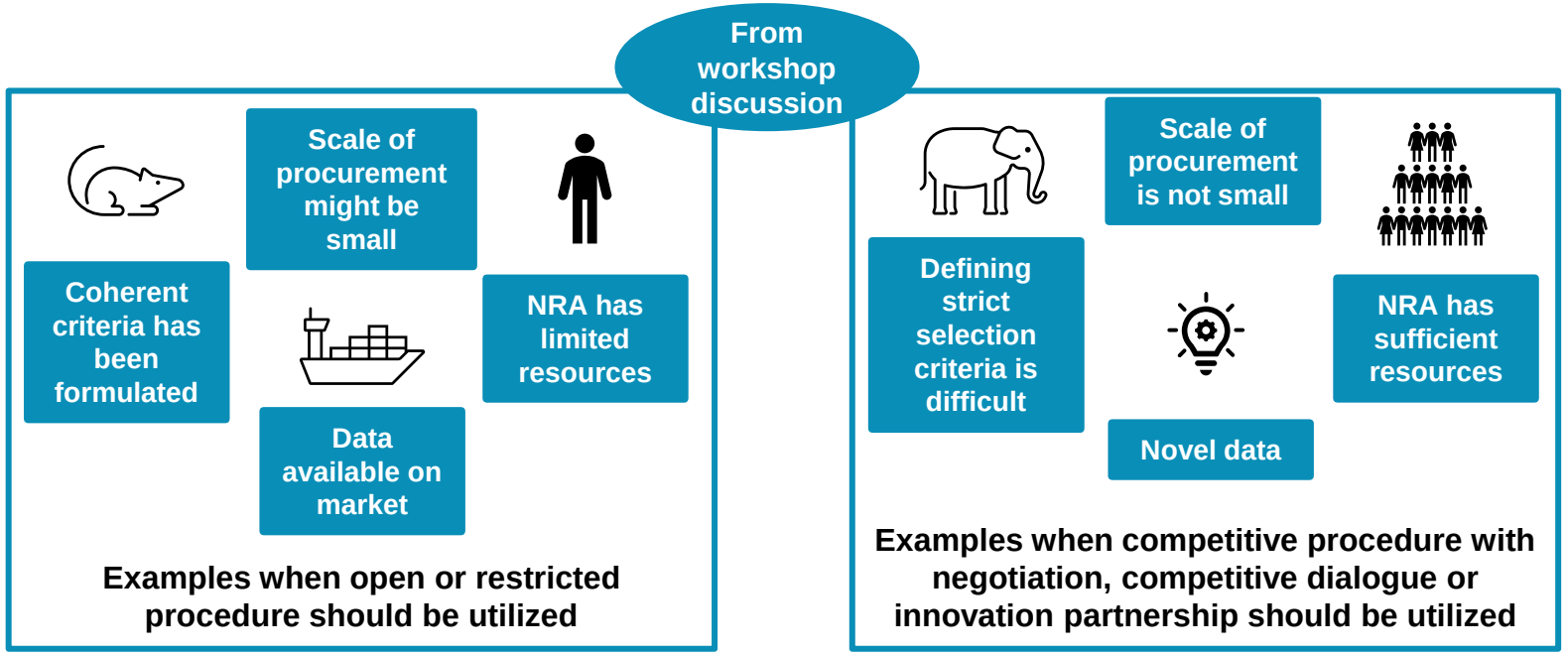
Table: summary of different procurement methods (Amended from European Commission, 2018)

Procedure	Open	Restricted	Competitive with negotiation	Competitive dialogue	Innovation partnership	Direct award
Level of competition	High	Medium	Medium	Medium	Medium	Low
Workload for NRA	Medium	Medium-Low	High	High	High	Low
Risk of complaints	Low	Medium	Medium	High	High	High
Incentive for innovation	Low	Low	Medium	High	High	Low

Which procurement method to choose?

Before utilizing competitive procedure with negotiation, competitive dialogue or innovation partnerships, the **NRA should carefully consider whether sufficient resources and expertise for the time-consuming procurement process are available**. The NRA must have sufficient market understanding and procurement expertise as these methods are complex compared to the simple open and restricted procedure.

Consequently, these complex procedures should be **utilized only if novel data and innovations are required, and the NRA has the sufficient procurement experience**. Conversely, for small acquisitions of available data either open or restricted procedure should be utilized due to their lower workload.



Quantification of quality

The NRA needs to be able **to quantify data quality**. Quantification of quality is required **for the award criteria** utilized in the procurement processes discussed previously. Furthermore, **acceptance testing and quality controls** during the service's operation require the NRA to quantify quality.

Different methods for **quantifying** data quality can be utilized as shown below. The draft contract or technical specifications **should clearly state the methodology utilized in evaluation of quality**.

Continuous monitoring of equipment

Quality defects can be observed through continuous monitoring of the data produced (Kulmala et al., 2019). The methods such as algorithms for deficiency detection are generally dependent on the technology applied in data collection.

Reference testing

Reference testing is carried out by comparing the obtained data to a reference data, which is known to be sufficiently accurate (Kulmala et al., 2019). Different mathematical methods can be utilized to compare the datasets, while selection of the correct method is dependent on the datasets and their mathematical characteristics. Time-space oriented reference test methods include e.g. the QKZ-method based on two quality indicators; the detection rate and false alarm rate (Kulmala et al., 2019). An example of QKZ is provided on chapter 5.3.

Manual verification

Different events or conditions can be also identified manually and compared to the data provided by the solution (Kulmala et al., 2019). For example, CCTV cameras can be utilized in detecting events, vehicle classes, or weather.

Case examples on section 5.3

Quantification of quality

User satisfaction surveys

For example, quality of user support can be measured through user surveys (Kulmala et al., 2019).

Latency monitoring

Data latency monitoring methods are utilized to determine the latency of data deliveries and can be based on comparing the timestamps related to system operation (Kulmala et al., 2019).

The NRA should consider the **availability of resources** when determining suitable quality quantification methods (Kulmala et al., 2019). For example, if relevant reference data is not available, utilization of reference testing methods would require extra measurements, which incur costs for the NRA. However, if reliable reference data is available reference testing methods are generally efficient.

After determining the suitable methods for quality quantification, the NRA should clearly outline the methods in the **procurement documents such as draft contract or technical specifications**. Thereafter, the NRA should design the actual procedures for both acceptance testing and quality monitoring during the contract's implementation, which are discussed next.

Quality validation before service implementation

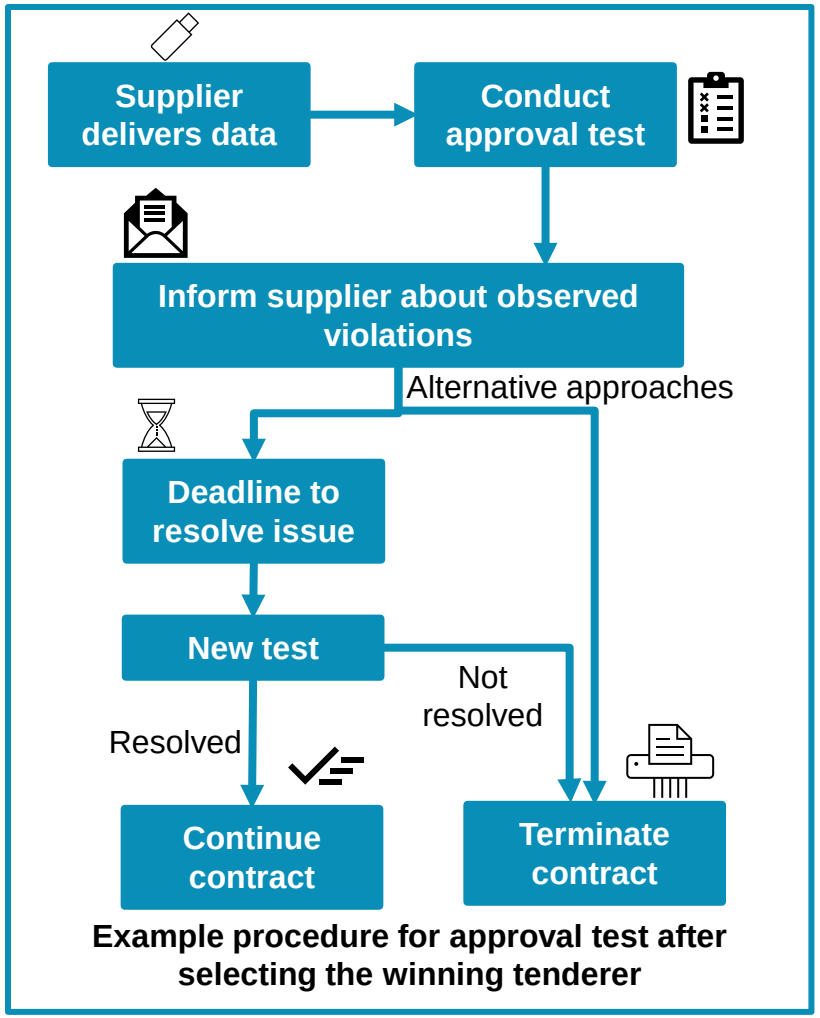
After awarding the contract for a supplier, the NRA can conduct **approval tests** for the data **before accepting** the data. If the NRA determines that quality validation before approving the solution is necessary, the requirement for approval testing should be clearly **stated in the procurement documents such as draft contract** (European Commission, 2018). Therefore, design of quality validation procedures **is part of the design of the procurement documents**.

Furthermore, the method(s) utilized in acceptance testing should be clearly stated in the procurement documents (European Commission, 2018). The NRA should define an approximate **timetable** for quality validation, and determine the **input required** from the supplier. Quality validation can occur after the economically most advantageous tender has been selected and/or during evaluation of the tenders (examples for both cases are provided in section 5.3). Furthermore, the procurement documents should determine the **distribution of costs** due to quality validation. Determining the cost distribution is especially important if the quality validation involves actual on-the-ground measurements to validate the data.

Consider when designing approval tests

- Distribution of costs
- Timeframe for testing
- Required input from supplier
- Procedure for addressing deficiencies

Quality validation before service implementation



Example procedure for approval test after selecting the winning tenderer

The approval tests should allow the NRA to determine whether the data by the supplier **satisfies the selection and award criteria** set out in the procurement documents. Furthermore, if the supplier has offered additional quality elements compared to the minimum criteria, the NRA should also examine that the additional elements have been implemented.

The procurement documents should also determine a procedure for **addressing possible deficiencies** observed during the quality validation. The NRA can determine for example that if the quality validation is failed, the supplier has **a specific timeframe to fix** the issue. Thereafter, the review is repeated. If the quality validation is failed the NRA should reserve the right to **terminate the contract**. The NRA can also determine that if approval test is failed the contract is immediately terminated. However, immediate termination might be an excessive procedure especially if only minor defaults are observed and could cause additional costs as the NRA must choose the second-best supplier. However, the NRA must always outline the procedure of quality validation as well as the procedure for dealing with possible deficiencies, such as termination of the contract, in the procurement documents.

Quality control during service operation

Quality control of the provided data is necessary during the contract period **to safeguard stable data quality**. The realized quality of operations should meet the selection and award criteria discussed earlier. Therefore, the NRA should **oversee the supplier** over the whole duration of the contract. The procedure for quality control should be **outlined in the procurement documents such as draft contract or technical specifications** (European Commission, 2018).

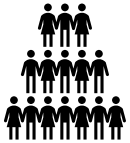
Quality control during operation of the service can be organized through **pre-defined** (e.g. monthly) quality controls or **random, unannounced** checks. Furthermore, the NRA can also decide to conduct quality monitoring **only if deficiencies are observed.** The selected procedure for quality reviews during data delivery should be always clearly depicted in the procurement documents.

Checks at pre-defined intervals

Random checks

Checks based on observed deficiencies

Different models for quality control



NRA's resources

Criticality of the data

Costs related to validation

Consider while choosing quality control model

The NRA should aim to monitor both technical quality (i.e. data) and service quality (e.g. response times to service requests).

Quality control during service operation

Cost sharing

Method utilized in validation

Responsibilities of different parties

Possible fines or bonuses

Consider when designing the procedure for quality control

When designing the quality control scheme, the NRA should consider the **availability of resources**. Through pre-defined quality controls such as monthly controls, the NRA can safeguard the continuous robustness and accuracy of data. Conversely, more frequent quality controls require more resources from the NRA. Therefore, if the NRA acknowledges that the resources for quality controls are scarce either less frequent random or detected-deficiency based controls could be more applicable.

The quality review process can cause additional costs both for the supplier and for the NRA. Therefore, the contract needs to explicitly state **who is responsible for the costs**, especially if quality validation includes measurements on the ground causing additional costs. While designing the quality monitoring the NRA should avoid excessively complex quality validation schemes as such schemes increase costs for both the supplier and NRA. Furthermore, the procurement documents should clearly state the responsibilities of each actor in the process.

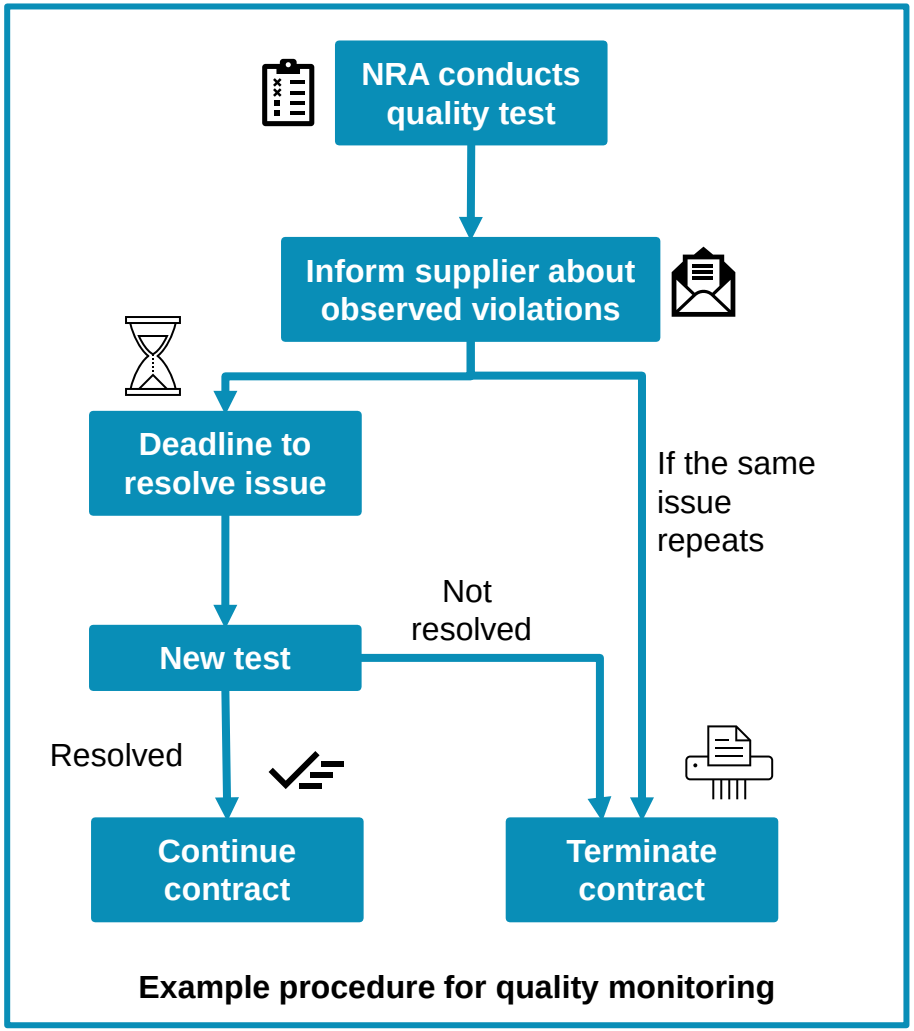
The NRA should consider when designing the contract whether **fines or bonuses** should be applied to quality deviations. It is possible to set a fine for the service provider if the quality requirements are not met. Conversely, the supplier can be incentivized to reach or exceed the quality requirements for example through bonuses.

Quality monitoring during service operation

In addition to possible bonuses and sanctions, the procurement documents should reserve the NRA a right to **terminate the contract** if quality deficiencies occur. Generally, after detecting quality deficiencies, the supplier should be given a timeframe for fixing the issues. Thereafter, a new quality review is carried out and if the issue persists the NRA can use the right to terminate the contract.

The NRA should also carefully consider how to approach situations where **the same problem repeats** sporadically (e.g., once in January, and later in October). If the contract period is long, a repetition of problems is more likely, and the contract should allow some degree of problem repetition. However, on shorter contracts repetition of problems should be dealt with appropriate determination.

The procurement documents should **reflect** the chosen **approach for quality control accurately**. If the NRA states in procurement documents e.g., that it conducts a monthly data quality check, but never implements the checks the NRA could face legal issues, when the quality deficiencies are found as the NRA has neglected its duties in providing feedback for the supplier.



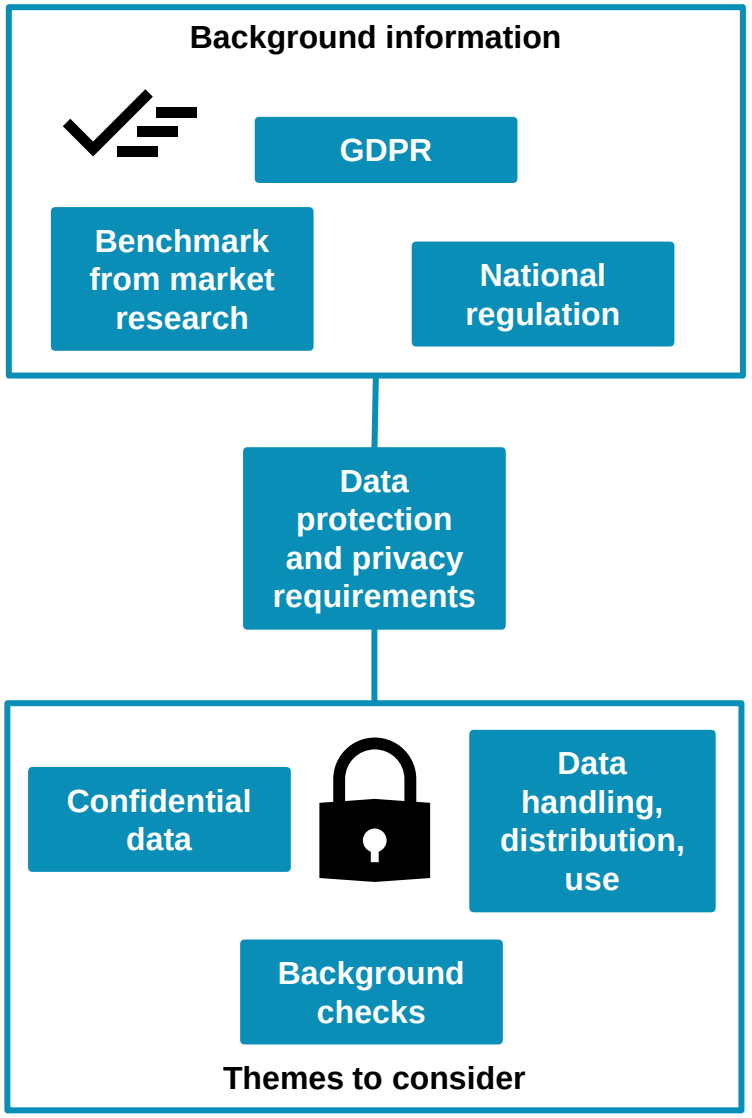
Example procedure for quality monitoring

Data protection and privacy

The NRA should carefully determine the required data **protection and privacy terms**. The data protection requirements **should be stated in the procurement documents**. The NRA should consider relevant EU-regulation such as the **General Data Protection Regulation (GDPR)**, and any relevant national regulation in detailing the requirements. The data protection and privacy requirements are usually specified on the technical requirements and draft contract (European Commission, 2018).

Generally, the NRA should impose requirements for **handling of confidential data**. The procedures regarding the storing, managing, and distribution of confidential materials should be robust. Furthermore, the NRA must determine whether **background checks** for the data supplier's employees are required.

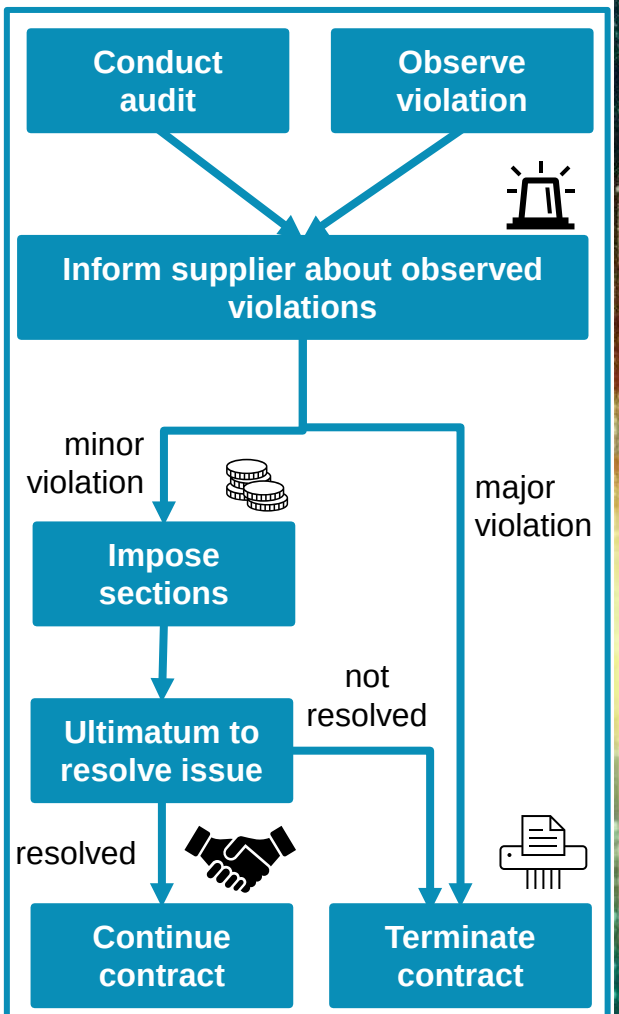
The NRA should also set sufficient requirements for **safe handling, distribution, and use** of the data. The requirements should depend on the sensitivity of data utilized. The contract should also require correct handling of any personal information.



Data protection and privacy

The NRA can retain **right to conduct checks** on the supplier regarding the data protection and privacy. The checks can be either **regular audits, or random checks**, which have not been disclosed to the supplier in advance. However, the NRA is encouraged to state clearly on the procurement documents the methods (such as the example on right) utilized in data protection control.

Furthermore, if violations occur the NRA should retain the right to either impose **sanctions** on the supplier or **terminate** the contract based on the scope of observed violations. For example, serious violations can be determined to lead to immediate termination of contract. Conversely, minor violations could lead to a monetary sanction and to an ultimatum to **fix the issues within pre-defined time-window**. The NRA should retain the right to terminate the contract if the issues are not fixed during the defined time-window. The sanctions and conditions for termination need to be outlined in the procurement documents.



Example procedure for addressing data protection violations

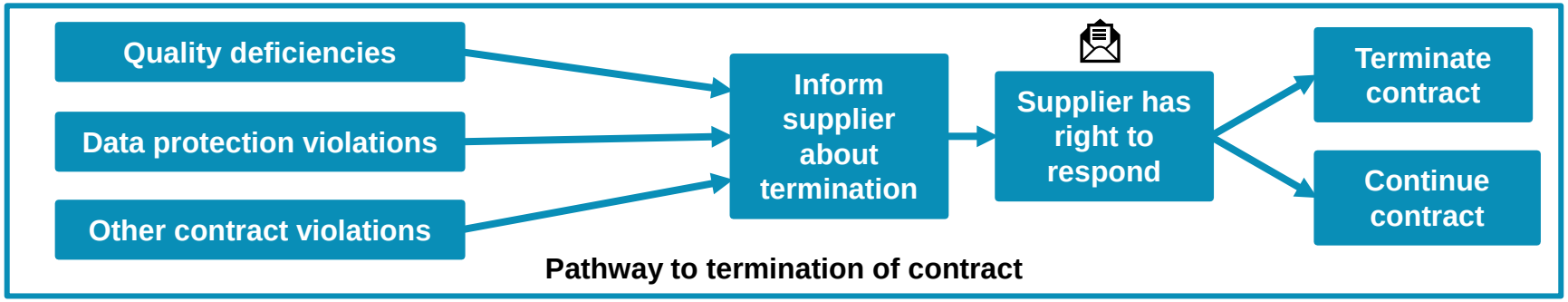
Termination of the contract

The NRA should carefully design terms for possible termination of the contract, to allow termination after possible quality, data safety or other issues as discussed earlier. The conditions for terminating the contract must always be **clearly stated** in the procurement documents, usually in draft contract (European Commission, 2018). Generally, **at least the NRA** should have right to terminate the contract.

The NRA should carefully consider whether giving the **supplier right to terminate** the contract is necessary. However, in long contracts with high risk for the supplier, a lack of termination option for the supplier might increase the cost of the contract as supplier includes the expected risk in the price of their offer. If the NRA determines to allow some termination mechanism for the supplier, the termination period should be sufficiently long to allow the NRA to re-procure the service, without need for temporary contracts.

Possible termination of contract always incurs costs not only for the supplier, but also for the NRA. Especially, if the data provided by the supplier is critical for the NRA, the NRA might be forced to sign **temporary** direct award **contract** with another supplier to provide data or postpone contract termination until new procurement has been completed, which might cause **cost increases**. Furthermore, a new procurement process always entails costs for the NRA. Concise, precise, and clear contract terms are necessary to prevent any legal action by the supplier after termination of the contract.

In addition to the prerequisites for termination, the NRA should also state the **right to obtain reparations from the supplier** if the supplier **violates** the contract terms or causes **damage** through neglecting privacy or quality requirements.



Pathway to termination of contract

General considerations for contracting

The NRA should also consider more **general terms of the contract**, such as length of the contract, generally stated on the draft contract. Based on the market consultation, the NRA should have established an understanding about the usual **length** of the contract. In data acquisitions requiring significant investments from suppliers longer contracts should be preferred to reduce annual costs (European Commission, 2018). However, if rapid development of data is expected excessive contract length should be avoided.

The contract can also include an **option** (e.g. + 2 years), which can be used after the actual contract period has ended. Generally, the option can be used only if both the data supplier and NRA agree on using the option. The NRA can also use the possibility of option to **incentivize** the supplier. Thus, the NRA can define in the procurement documents for example that the option can be realized only if no quality violations have occurred (European Commission, 2018).

Considerations

- Review clauses
- Sub-contractors
- Contract length
- Options

In addition to options, the NRA should consider the need of **review clauses in the contract**. Review clauses can allow the NRA to decrease or increase the volume of the contract (European Commission, 2018). Furthermore, the contract can include a price review clause or mechanism, allowing price adjustments during the contract e.g. based on price index (European Commission, 2018).

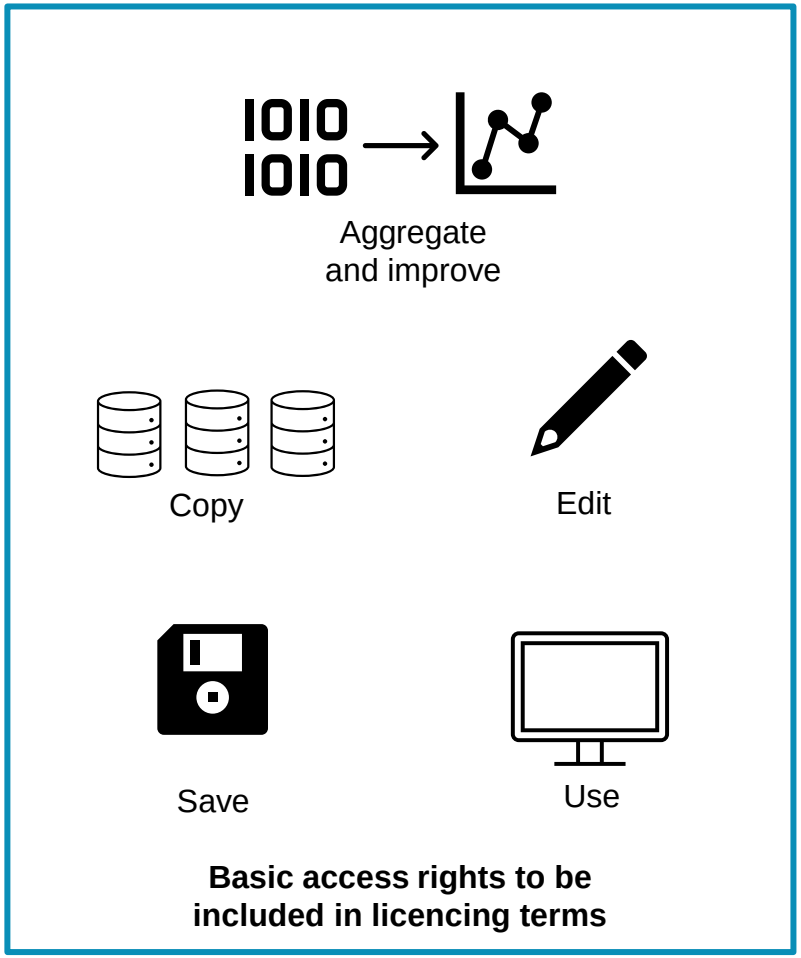
The contract should also determine whether the NRA allows the supplier to utilize **subcontractors** or form **consortiums**. Both prohibiting the use of subcontractors and prohibiting consortiums could decrease the ability of small and medium sized enterprises to participate in the procurement (European Commission, 2018). In complex tasks consortiums or subcontractors might be necessary even for well-established actors with large resources, while consortiums could even enhance data quality if different data supplies are combined for higher data coverage. However, allowing consortiums and subcontractors could decrease competition, successively resulting in excessively high costs (European Commission, 2018). Therefore, based on the market research the NRA should be able to determine whether allowing subcontracting or consortiums could lead to excessively decreased competition.

Licensing

The NRA should always consider the licensing terms and immaterial rights when determining general terms of the contract. As discussed on section 5.1, the NRA should acknowledge that data suppliers might have **concerns related to the commercial value of the data**. In addition to the fitness-for-purpose analysis related to licence terms discussed on section 5.1, the NRA **should also formulate the actual licencing terms** on the draft contract, which is discussed next.

The NRA should design the licencing terms based on the use case identification described on section 5.1 and require license only for actions required for fulfilling the identified use cases. Thus, the NRA should require that the licence terms grant NRA **sufficient usage rights** to utilize the data. The requirements for licence terms should state that the NRA must have basic access rights such as right to **edit, save, or aggregate the data**. All access rights must be clearly stated on the contract documents, otherwise the NRA can not safeguard its access to the acquired data.

Furthermore, the NRA should clearly state whether the supplier should grant the NRA access to the **data during the contract period or indefinitely**. Consequently, without requiring indefinite access, the NRA does not have the right to access the data after the contract has ended.



Licensing, immaterial rights

The NRA should carefully consider terms for sharing the acquired data. Generally, it is **not advised to reserve right to share the acquired raw data as open data, or excessively with other public authorities**. Distributing raw data as open data or with many public authorities would undermine the data supplier's ability to sell the data to other customers. Hence, the price for acquisition could increase significantly or the suppliers could decide not to participate in the tendering. Furthermore, excessive data sharing by NRA could prevent the existence of data markets as the number of customers would decrease. Thus, the NRA should only retain rights to share and distribute data in such a manner that does not undermine the supplier's ability to sell the data to other customers. Generally, the NRA can retain rights to publish aggregated data, publish the data in roadside VMS and other displays, or share the data with selected relevant authorities and NRA's consultants.

Immaterial rights state the ownership of the data acquired. Generally, the NRA should only require the access rights and allow the supplier to hold the immaterial rights to the data as transferring the immaterial rights to NRA generally yields no significant benefits.

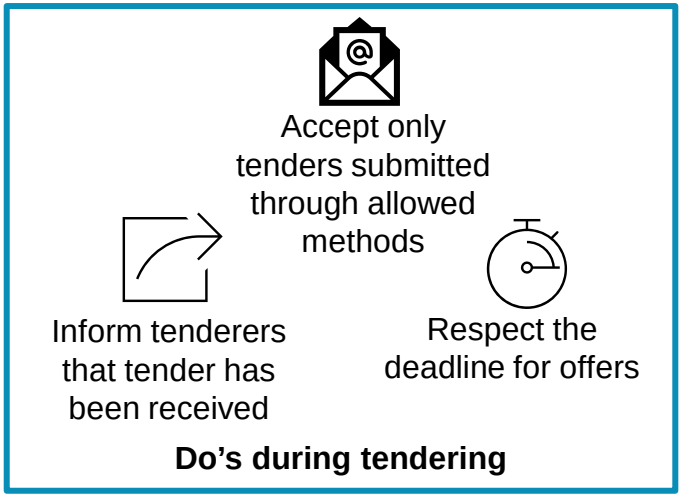
Licencing terms the NRA could require:

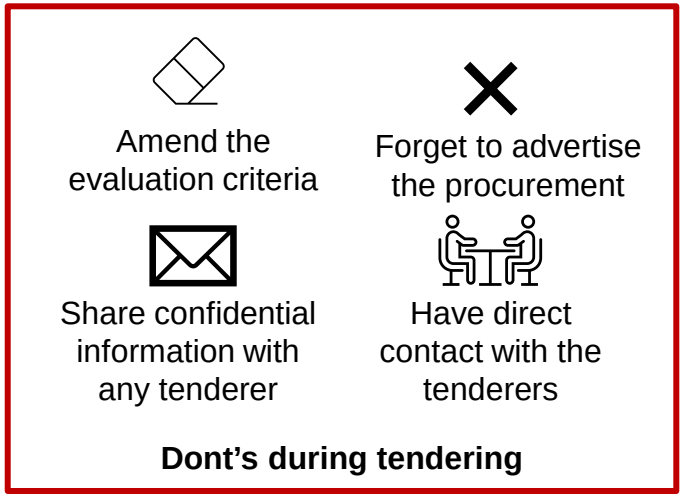
- Right to present data in roadside VMS and other displays
- Right to publish aggregated data as open data
- Right to share raw data with selected authorities/NRA's consultants

Consider carefully before requiring in licencing terms:

- Right to share raw data as open data
- Right to share raw data with several public authorities

Publication





After finalising the contract documents, the NRA can publish the tender. The tender should be **advertised in a contract notice on a public procurement platform** (European Commission, 2018). Furthermore, a prior-information notice preceding the publication of contract notice can be used to alert data suppliers about a coming tender in 35 days – 12 months in advance (SIGMA, 2016d).

After the tendering has been initiated it is recommended **not to have direct contact with the tenderers** (European Commission, 2018). Generally, a written Q&A is utilized during the tendering. After pre-selection in the competitive dialogue, innovation partnership, and competitive procedure with negation discussion is allowed during the negotiation phase.

The tenderers can submit their tenders only using the methods (e.g. online portal) described in the procurement documents, while other methods should not be allowed (European Commission 2018). Furthermore, the deadline for tenders should be precise and enforced (European Commission, 2018).

Amending criteria or contract terms during tendering should be avoided. If amendments are required, the tendering is halted, and a correction is published (European Commission 2018). Furthermore, the deadline for tenders can be extended after issuing a correction (European Commission, 2018).

Evaluation and awarding

After the deadline for submitting tenders has passed, the NRA should **open and evaluate** the tenders. First, the NRA should exclude any tenders that do not satisfy exclusion criteria or selection criteria. Thereafter, the awarding criteria is utilized to determine the economically most advantageous tender. **An evaluation committee** can be used in evaluating the tenders (European Commission 2018).

Consequently, the NRA has determined the best data supplier. Thereafter, the NRA should inform all tenderers about the results for example through providing a summary table containing scoring of the tenders (European Commission, 2018). After awarding the contract an award notice should be published naming the winning tenderer (SIGMA, 2016c).

The NRA can sign the contract after a standstill period based on legislation has passed (European Commission, 2018). During the standstill period the tenderers can file complaints to the relevant authorities (European Commission, 2018).

Never amend criteria or scope of the procurement during evaluation (European Commission, 2018). The NRA can **request clarification for inconstancies or minor mistakes** in the tenders during the evaluation. However, the tenders can never be changed during evaluation (SIGMA, 2016c) The NRA can also decide not to award the contract under certain circumstances such as exceeded budget or when irregularities during the evaluation process have occurred.

Chair
Leads, coordinates, ensures compliance

Evaluators
Assess the tenders independently or jointly based on the criteria

Secretary
Minute preparation, supports chair

Example evaluation committee
(European Commission, 2018)

Inconsistencies in evaluation

Circumstances of the contract have changed

No tenders received

All tenders exceed budget

Reasons not to award the contract
(European Commission, 2018)

Contract implementation

The final step in public procurement process is implementation of the contract. After awarding the contract, the data supplier should implement the data-solution. During implementation, the NRA and supplier should pursue an open relationship, through sufficient communication and regular meetings. Furthermore, a kick-off meeting to facilitate formation of common objectives and understanding regarding the contract is recommended (European Commission, 2018).

Management of the contract is **steered by the procurement documents** created by the NRA before the tendering. If deficiencies are detected the NRA should **immediately contact the supplier** using procedures outlined in the procurement documents. Sanctions, quality controls, and termination clauses outlined on the procurement documents are important for successful contract implementation, since otherwise the NRA can not efficiently react to deficiencies in the data provided by the supplier. During the implementation phase, the NRA **can not add new requirements or terms.**

The NRA should **avoid contract modifications** during the implementation of the contract. EU regulation prohibits changing the scope or value of the contract significantly (European Commission, 2018). However, under certain circumstances modifications are allowed. Furthermore, the procurement documents, such as the contract, can have clauses allowing reductions, or increases in the volume of the service as discussed earlier in the general terms-section.

Have frequent contact with supplier

Have a kick-off meeting

Inform supplier immediately about deficiencies

Good practices in contract implementation

10

Modification's value under 10% of the contract's value

Modification is not substantial

Changes included in contracts review clauses.

Example prerequisites for contract modification (European Commission, 2018).

Conclusions

Through sufficient market research the NRA should design clear, concise, and accurate technical and quality criteria to facilitate successful data acquisition. Expertise is required to find the correct balance between flexibility of innovation and securing the desired output when designing the criteria for the procurement. Through market understanding the NRA should select most suitable procurement method. After successful procurement, collaboration and trust promote partnerships, which can foster innovation and exceptional outcomes. By utilizing robust quality criteria, the NRA can maintain sufficient data quality through the whole lifespan of the contract. However, inclusion of termination clauses and quality control mechanisms allows the NRA to react if the contract is violated.

It is important to remember that **close co-operation between the NRA and data supplier** can alleviate risk of quality issues and data protection violations. Therefore, the NRA should always have sufficient communication with the supplier, and possible deficiencies should be rapidly reported to the supplier.

If the NRA wishes to obtain similar data after the contract period has ended, the NRA needs to organize **a new procurement**. However, the NRA can not require the bidders to submit an identical data-solution compared to the realized solution as it would disproportionately favour the incumbent supplier and could incur higher costs to the NRA due to lack of competition and yield in vendor-lock if other suppliers exit the market.

Finally, it should be highlighted that the successful **design of contract terms as well as selection, exclusion and award criteria is the most important tool to safeguard successful implementation**. If the contract design has failed and for example technical requirements do not accurately reflect the desired solution, the NRA can not require the supplier to produce the desired solution if the contract did not accurately reflect the desired state. Furthermore, lack of sanctions, quality control mechanisms, or termination clauses prevents NRA from reacting to deficiencies during the implementation.

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Deliverable 5.3. Best Practises

Best practices

As discussed on section 5.2, data acquisition processes are complex. Next, best practices to support data acquisition from real-life examples are provided to complement the recommendations provided on section 5.2. Furthermore, the section elaborates on best experiences gathered from NRAs in work package 4.The case examples studied are briefly summarised on this slide.

Case examples studied

Dutch FCD acquisition

The Dutch National Road Traffic Data Portal conducted an open procedure-procurement. Selection of the economically most advantageous bid was based on the best price-quality ratio. The data was to be used for travel time, traffic flow, and speed monitoring. Furthermore, aggregated FCD data was to be utilized for traffic management in traffic control centres.

Data purchaser: Nationaal Dataportaal Wegverkeer (National Road Traffic Data Portal), The Netherlands
Procurement year: 2024

Finnish FCD acquisition

In the Finnish FCD data acquisition, data was acquired for the most congested part of the highway network. The NRA aimed to utilize the data in traffic management, incident detection, and travel time estimation. The NRA organized an open procurement to acquire the data. The economically most advantageous bid was selected based on the best price-quality ratio.

Data purchaser: Liikennevirasto (Finnish Transport Agency), Finland
Procurement year: 2018

Swedish friction data acquisition

The Swedish NRA identified a need to acquire friction data utilizing a vehicle probe solution. The NRA pursued improved efficiency, quality, and sustainability of winter maintenance. The data could be utilized to enhance analytical capabilities and to steer the deployment of winter maintenance fleet. The procurement was organized as competitive procedure with negotiation, while the awarding criteria were based on the lowest price.

Data purchaser: Trafikverket (Swedish Transport Administration), Sweden
Procurement year: 2021

Market research and identification of needs

The Swedish NRA identified a need for improving monitoring of winter maintenance. Based on the **need and benefit** identification market research was conducted.

During market research the NRA identified possible suppliers and existing solutions. Based on the market research, the Swedish NRA determined that **several suppliers were able to provide the friction data**. Therefore, the NRA could conclude that the procurement is feasible, and tenders can be expected during the process allowing to proceed with the data acquisition.

Best practice:
Always screen the market, identify benefits, and determine whether data is available before procurement.

Swedish friction data

Identified needs

- *Tool for road surface forecasts required.*
- *Better planning of winter maintenance needed.*
- *Quality monitoring of winter maintenance performance.*

Identified benefits

- *Enhanced capability to conduct the right maintenance actions at the right time and location.*
- *Enhanced monitoring of road conditions.*
- *Better maintained roads, resulting in improved user experience and safety.*

Exclusion criteria

As discussed earlier in section 5.2, **exclusion criteria are required in all procurements**. The criteria related to turnover and credit rating can exclude some SMEs. Therefore, the NRA must balance between safeguarding that all tenderers have sufficient resources, and that SMEs have reasonable access to tender. Example exclusion criteria from Sweden is presented.

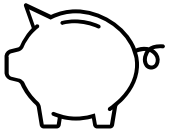
Best practice:
Avoid excessive exclusion criteria as it could exclude e.g. SMEs from the tender.

Swedish friction data

Financial stability

At least certain credit rating (A) required. Verified through submitting a reference from bank or credit reference authority.

For newly founded companies e.g. cash flow analysis suffices.



Technical & professional competence

General written outline of the solution required. Reference assignments related to delivery of data during last 5 years required.

Certain offenses

Unpaid taxes, social security contribution violations, and certain crimes under Swedish law will cause exclusion.

Selection criteria

As earlier stated on section 5.2 of this deliverable, defining **selection criteria** such as minimum quality and technical requirements is required to safeguard sufficient data quality. Example selection criteria from the Dutch FCD and Finnish FCD acquisitions are shown next.

Dutch FCD

Statement of approval

The bidders were required to approve the specifications of the assignment by completing a signed letter, which should be attached to the tenders.

Minimum completeness

The length of network from which data was obtained during a specific time-window was compared to the network length. At least 70% completeness was required.

Minimum coverage

The bidders were required to submit a map showing the number of probes in different segments of the road network. The number of probes within a segment must be at minimum 8 % of the total traffic volume within the segment. The traffic volume is compared to data from other sources not specified in the procurement documents.

SLA

Service available annually 99.9% of time.

Selection criteria

Best practice:
Define clear and measurable selection criteria for the procurement

Finnish FCD

Measurement accuracy:

at maximum ± 20% deviation in travel time estimate compared to reference data.

API

designed based on REST-principle.

Proportion of errors:

at maximum 10% of travel time estimates were allowed to deviate from the reference data.

Minimum data attributes

1. *Real –time travel times and/or travel speed*
2. *Travel time and/or travel speed under free flow conditions*
3. *Traffic congestion classification (e.g., congested, slightly congested, not congested)*
4. *Attributes required to geographically position the traffic data*
5. *Unique ID for each incident*
6. *Attributes required to geographically position the detected incident*
7. *Direction(s) of traffic physically affected by the incident*

SLA

The API needed to be available for 99.5% of time in each month
A pre-defined number (1-2 depending on length and time) of maintenance breaks allowed.

Service & support

Language Finnish or English. Supplier must handle requests within three working days. Documentation in Finnish covering description of the measurement system, attributes, algorithm, network, and API.

Award criteria

Award criteria allow the NRA to select the winning tender as discussed on section 5.2. In the Dutch case best price-quality ratio was selected as award criteria. Furthermore, the quality was quantified through **methods such as QKZ- and MAPE-scores**.

In the Dutch case a **real-time data feed was required from tenderers**, based on which the evaluation was conducted. **Requesting a data sample is best practice** if the NRA has sufficient resources to quantify the quality of all tenders. However, if resources are scarce an alternative approach based on quality self-reporting is presented later.

Best practice:
If using best price-quality ratio as award criteria utilize effective quality quantification methods.

Dutch FCD

Based on WP4

Price

The data purchaser had decided on a maximum budget, which it had not disclosed with the bidders. If the price of a specific offer exceeded the maximum budget the bid was not evaluated.

Max 1000 points

Data availability

The evaluation of data availability was based on evaluating the attributes described below. The bidders were given score of either 0, 200, 400, 600, 800, or 1000 points. Score 0 led to the exclusion of the supplier.

Stability
More stable fleet increased score.

Coverage
Higher coverage of both network and traffic flow increased score.

Segments
Size, start, and end points of the road segments utilized were evaluated.

Data delivery
Data delivery method was evaluated.

Representativeness
More representative fleet increased score.

Award criteria

Dutch FCD continues

Max 1000 points

Evaluation of implementation, management, and maintenance

The bidders had to describe how the service availability of 99.9% was to be achieved and sustained. Furthermore, handling of malfunctions, management, and maintenance was evaluated. Suppliers were required to provide 24/7 handling of malfunctions and data deliveries. After evaluating these criteria, the bidders were given a score of 0, 200, 400, 600, 800, or 1000. If the score was 0 the bidder was excluded due to insufficient assurances.

Max 1000 points

Timeliness

Difference between actual traffic phenomena occurring and identification in data was computed. The data was first processed (outliers removed and smoothened by a Savgol-filter). Thereafter, a correlation between the supplier's data and reference data was calculated for delays of 0 to 10 minutes, which allowed to determine at which delay the datasets had the highest correlation. Reference data was obtained from induction loops and ANPR-cameras.

Exact calculation shown in WP 4

Max 500 points /score

RMSE- and MAPE-score

The Root Mean Square Error-method (RMSE) was used to compare the difference in speed between the supplier's data and reference traffic data. Data from 5-minute aggregated intervals was utilized.

The Mean-Absolute-Percentage-Error (MAPE) was used to compare difference in travel times between the supplier's data and ANPR-travel time data.

The supplier with best result from RMSE was give 500 points, while others were given proportional scores. A similar scoring was carried out for the MAPE-score.

Award criteria

★☆☆

Filtering and quality assurance of data

Max 1000 points

The suppliers were required to describe the use of data older than 30 minutes, and how the timeliness and number of observations could be analysed using simple indicators. Furthermore, handling of parallel lanes, outlier values, and extreme delays was evaluated. After evaluating these criteria, the bidders were given a score of 0, 200, 400, 600, 800, or 1000. If the score was 0, the bidder was excluded due to insufficient data quality assurances.

★★★

Dutch FCD continues

QKZ-method

Max 1000 points

The QKZ-method was utilized to determine the solution's capability to detect congestions and delays. The data was aggregated into 5-minute intervals, from which the arithmetic average of speed was calculated. The number of delay periods was calculated both in the supplier's data and in the reference data from ANPR-cameras and induction loops. A delay was interpreted as speed under 60% of the free-flow speed in the reference data and as under 70% of the free flow speed in the supplier's data.

The number of false alarms was also calculated. A false alarm was defined as speed in supplier's data being lower than 60% of the free-flow speed (for at least 15 minutes) if the reference data's speed was higher than 70% of the free-flow speed during the same period

Thereafter, the score for justified and false alarms was calculated by dividing the number of correct and false alarms by the total number of events in the reference data.

Higher rate of correct detections, and lower rates of false detections implied higher quality. The results were calculated as averages from different road segments. The supplier with the best score was given 1000 points while the other suppliers were given a proportional score.

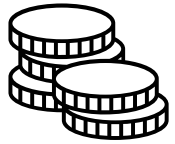
QKZ's exact calculation in WP 4

Award criteria

Based on the award criteria presented on previous slides, the Dutch data purchasers computed final score for each tenderer. Consequently, the tenderer with highest points was determined to have the best price-quality-ratio (BPQR) and was awarded the contract.

Furthermore, as presented on previous slides it is possible to set minimum levels for some award criteria. Consequently, if some award criteria were not rated as sufficient, the tenderer could be excluded from the tender. Thereby the Dutch approach partially merged the selection and award criteria.

Best practice:
Define clearly how the award criteria is utilized to determine the winning tender.



Dutch FCD continues

$$\frac{(\sum \text{award citeria points of supplier A})^3}{\text{price of supplier A}}$$

Supplier B score | **Supplier A score** | **Supplier C score**

Select supplier with highest score

Economically most advantageous offer

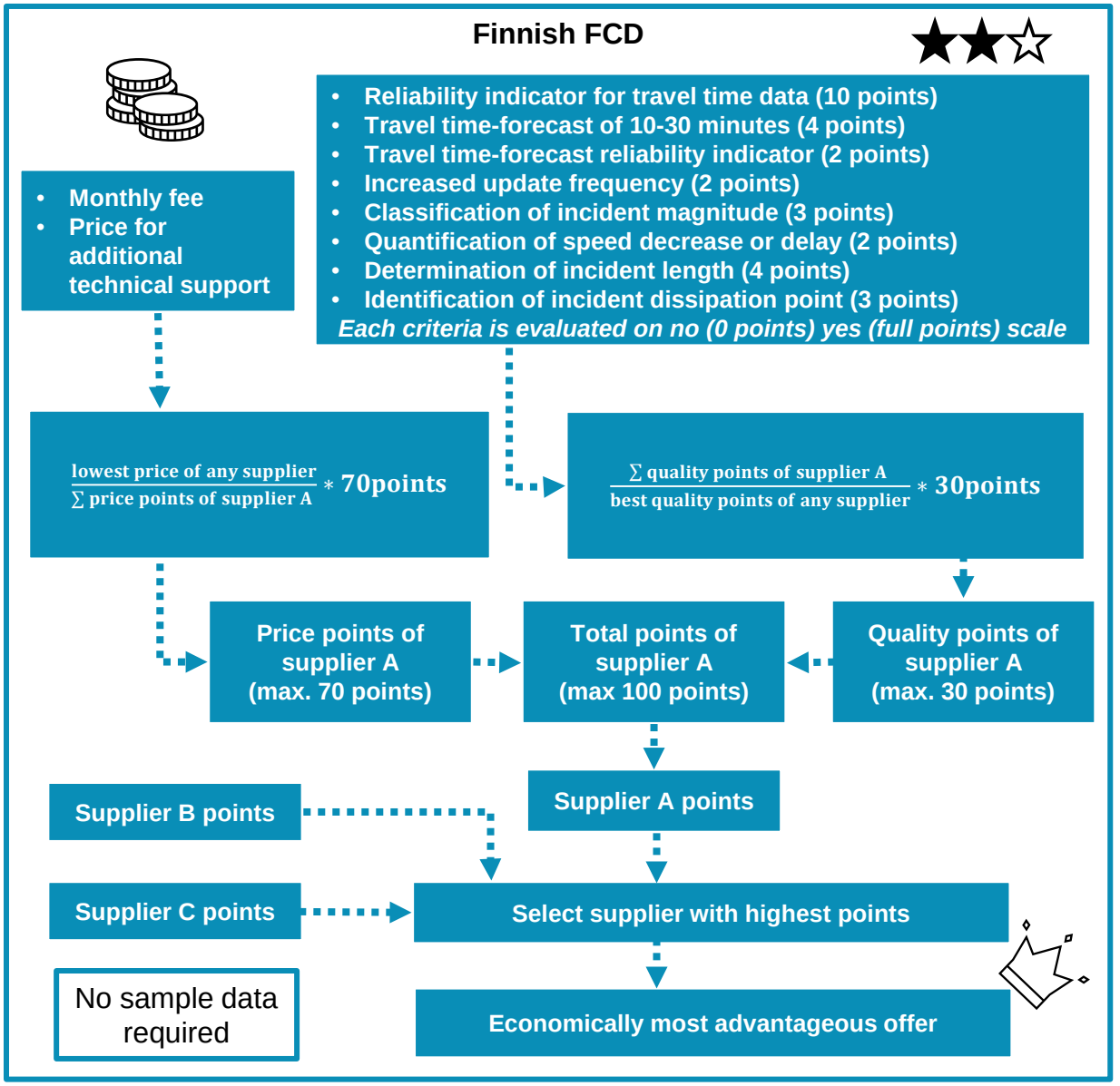
Determining the economically most advantageous offer

Award criteria

The Finnish NRA also utilized best price-quality ratio as award criteria. The implementation was based on calculating price and quality points for each supplier. Maximum of 30 points yielded from quality, while 70 points from price.

The Finnish NRA did not require a sample data as in the Dutch case discussed previously. Instead, the tenderers **self-reported** the quality attributes. Each quality attribute yielded either 0 or full points. Consequently, decision to rely on self-reporting of quality attributes on pass-fail-type scale reduced the NRA's workload compared to scoring based on actual data, which requires NRA to conduct significant amount of work, especially if number of tenderers is large.

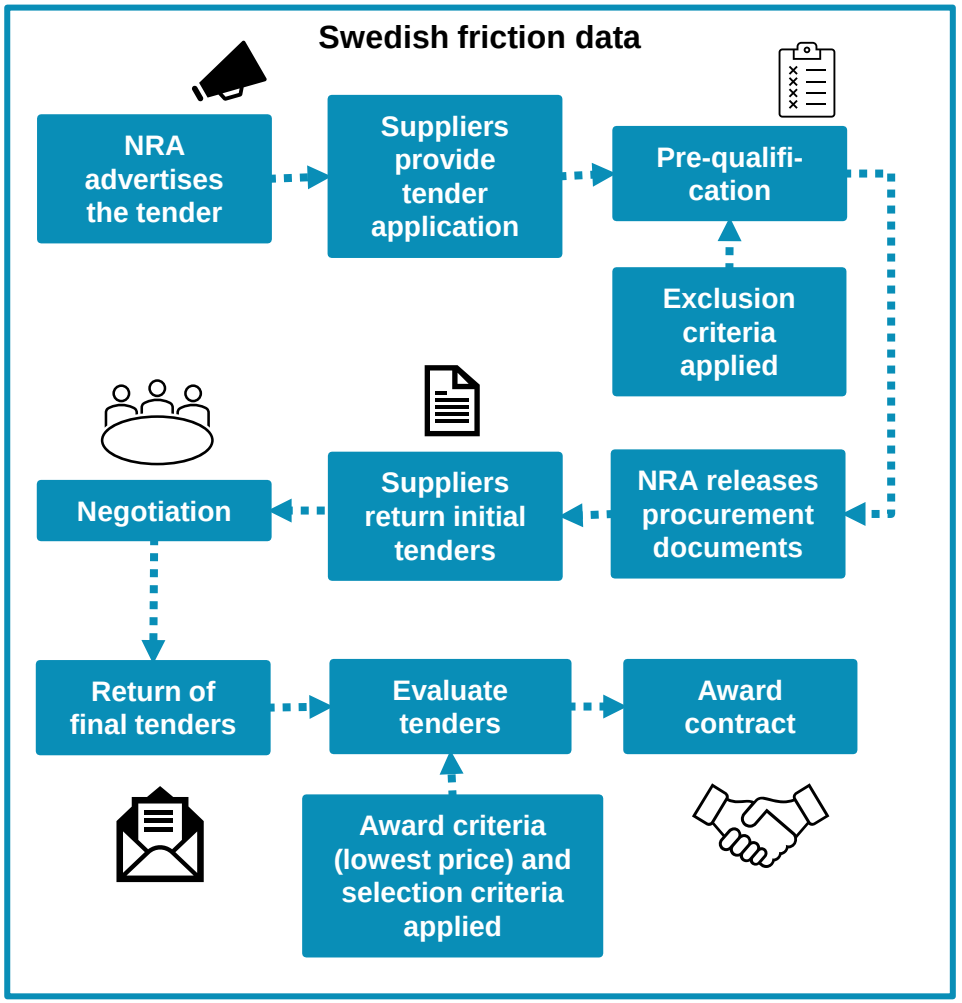
Best practice:
Self-reporting of quality can reduce workload during procurement.



Procurement method

During market research the Swedish NRA identified that defining exact and comprehensive criteria was difficult, while fully compatible solutions were not readily available on the market. Therefore, the Swedish NRA decided to select **competitive procedure with negotiation** as the procurement method. Consequently, the selected method allowed the NRA to obtain initial tenders and negotiate before selecting the winning tenderer. For detailed guidance about selecting the correct procurement method, refer to section 5.2 of this document.

Best practice:
Select the procurement method based on availability of suitable solutions on the market and ability to define robust criteria.

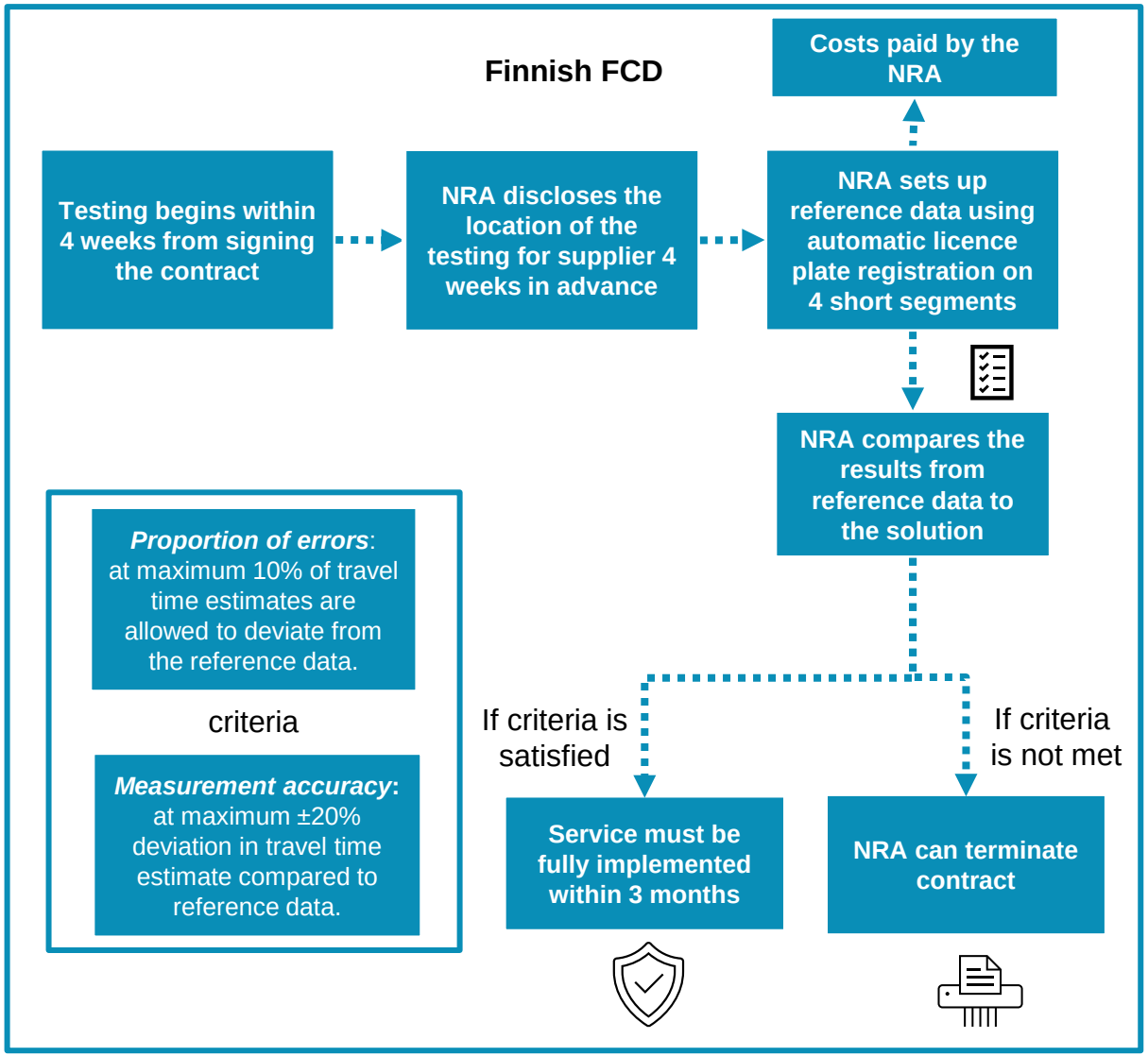


Acceptance testing

If the NRA decides to utilize self-reporting as discussed earlier, the NRA should always conduct **acceptance testing**. However, acceptance testing is strongly **recommended even if a data sample has been required during tendering**.

The Finnish NRA did not have adequate **reference data** available. Therefore, reference data was collected through license plate registration set up specifically for this scheme. However, the reference data was collected only from four road segments to reduce the cost of data collection. Thus, the NRA can reduce costs by limiting the scope of reference data collection as done in the Finnish example. However, limited coverage of reference data (as in the example only 4 segments) could decrease reliability of acceptance testing.

Best practice:
Utilize acceptance testing.



Quality control

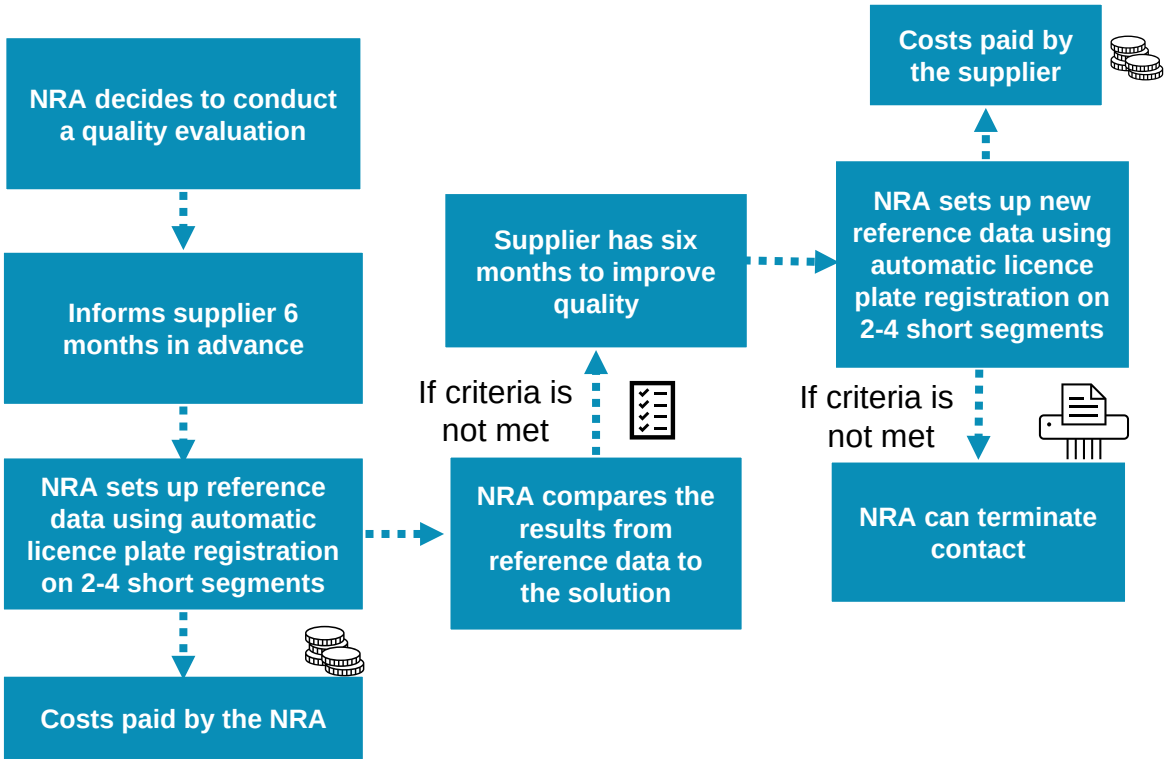
Quality control during the implementation-phase should be robust. The Finnish NRA utilized quality control **based on random measurements**, instead of regular controls. Less frequent controls allowed to reduce the costs related to quality monitoring, as the Finnish NRA did not have existing reference data. If reference data had been available, the controls could have been more frequent.

Therefore, the NRA should always **consider its resources and availability of reference data** while planning quality control, as in the Finnish best practise. Furthermore, utilizing similar methodology in both quality control and acceptance testing can simplify the quality verification procedures.

If quality issues emerge, the NRA should have adequate resources to address the issues according to the quality procedures depicted on the contract.

Best practice:
Define quality control protocol in the draft contract

Finnish FCD



Proportion of errors: at maximum 10% of travel time estimates are allowed to deviate from the reference data

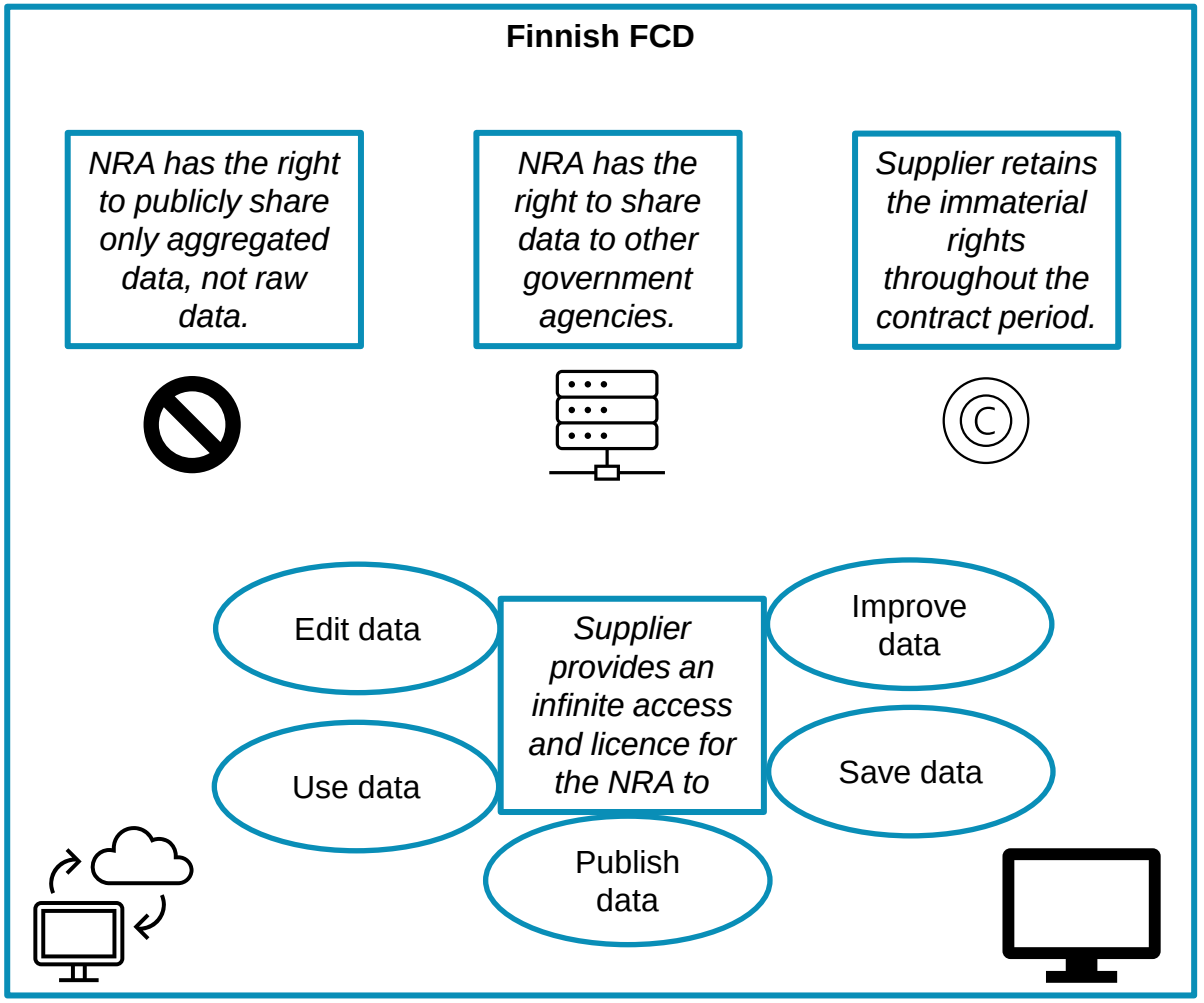
criteria

Measurement accuracy: at maximum +- 20% deviation in travel time estimate compared to reference data

Licensing and immaterial rights

As discussed on section 5.2, **licensing** is required to ensure that the NRA can utilize the data to the purposes desired. The NRA should identify the required use cases to determine licencing terms that **cover the identified use cases, while avoiding excessive requirements**. Therefore, avoiding excessive licensing terms is best practice as irrelevant or excessively broad licensing items and terms could increase the price of the acquisition. The NRA generally does not have to require the immaterial rights to the solution.

Best practice:
Avoid excessive licensing terms



Options

Options allow the NRA to expand the scope of the service after signing the contract. The Finnish NRA reserved an option to **increase the geographical coverage** of the service at a separate cost. In the Dutch example an option to **distribute aggregated data as open data at separate cost** was included. Thus, options can be used to reduce the value of the actual contract, while less relevant "nice-to-have" extensions can be included as options. This can prevent NRA from exceeding the budget especially if evaluation of market price has been difficult.

Options are also commonly used to **extend** the contract after the actual contract period has ended. In the Finnish and Dutch examples, an **option of 2 years** was included to the 2-3-year long contracts.

Best practice:
Use options to extend the duration or scope of the contract.

Finnish FCD

Length of contract 3 years

Possible option to extend contract for 2 years

Option to increase the network coverage to a larger area at separate cost

Dutch FCD

Length of contract 2 years

Possible option to extend contract with 2 one-year options

Option to distribute aggregated data as open data at separate cost

Conclusions

The Dutch, Finnish, and Swedish case examples highlighted some best practises related to data acquisitions. All the presented data procurements had robust and comprehensive criteria. Furthermore, the procurement method selection was successful, while quality control protocols were well defined justifying the selection of these examples as best practise.

However, the procurement of data is **highly dependent on the properties of the data to be acquired**. Therefore, the contract terms and procurement process should **always be founded on the actual properties of the data to be acquired**. Consequently, the presented best practices are not generally transferrable as such to all data acquisitions. However, the best practices can provide the NRAs with **inspiration and benchmarks** to facilitate successful data procurement. Furthermore, the recommendations provided in section 5.2 of this deliverable provide more general decision-support, which can be amended based on the actual properties of the data desired.