

REGIONAL AIRCRAFT NOISE MONITORING SYSTEM

Program of requirements

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Colophon

Requirements Regional Aircraft Noise Monitoring System

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1 Introduction

Since 2003 ten noise measurement units are located in the surrounding area of Airport Eindhoven to gain insight into noise levels associated with passing air traffic. These units continuously measure noise. Data is sent to a central system where they are linked to air traffic data and complaint data.

Measuring and monitoring aircraft noise at and around Airport Eindhoven is part of the job description of the Eindhoven Airport Consultation (LEO). According to the Workgroup Noise of LEO there is a need for a new aircraft noise monitoring system around Airport Eindhoven. LEO gave the Workgroup Noise the assignment to write a proposal.

To arrive at a new proposal, the Workgroup Noise has formed a committee which included representatives of stakeholders in the airport community such as residents, surrounding municipalities, ministry of Defense and Eindhoven Airport. For that committee, cooperation was sought with the Workgroup Health of LEO. This proposal is a product of this committee and a binding advice for the development of a program of requirements for the new Regional Noise Monitoring system. The proposal was submitted and approved by the members of LEO. A tender committee has been formed to execute the assignment and translate the proposal to a tender document to follow the necessary procedure. The new Regional Noise Monitoring system must be operational by January 1st 2025 at the latest.

This document describes the requirements (PoR) for a future system and the handling of reports in the field of aviation noise. The following documents were used as a starting point for the preparation of this document:

1. Proposal measurement system aircraft noise (LEO/workgroup Noise committee)
2. Note measurement system aircraft noise Eindhoven (TNO)
3. National Measurement Strategy (PAMV)

Chapter 2 includes some key concepts and assumptions relevant to the PVE. Chapter 3 and 4 formulate the functional and technical requirements for the new system. In Chapter 5, several commonly used terms and abbreviations are explained in more detail. In the last chapter, several points of interest are presented with regard to the tender. Finally, the appendices contain various background documents.

1.1 Background

1.1.1 General Information about Eindhoven Airport

Eindhoven Airport is the Netherlands' second largest airport, with over 6.7 million passengers in 2019. Airlines connect the south of the Netherlands with over 85 tourist and business destinations. The airport provides easy links between Brainport and Europe - and beyond - in balance with the surroundings. Together with its partner companies, the airport provides almost 2,000 jobs, making it one of the region's largest employers.

Eindhoven Airport operates the civilian section of the Eindhoven military airport. Runways, taxiways, fire brigade, bird watch and emergency management facilities of Eindhoven Air Base, of which Eindhoven Airport is a co-user.

It is essential for the airport to have a strong bond with the surrounding community. We want our regional community to reap the benefits of the airport and to experience as little inconvenience as possible. That's why we continuously work on sustainable airport operations as well as on a sustainable living environment.

As a good neighbour we are an approachable, open, inviting organisation that reaches out to our neighbours. We reach out and engage with our immediate stakeholders. Or invite them to join us. Getting to know each other is an important basis for respecting each other. In everything we do, the most important thing is what our activities mean for our 'neighbours' in the Brainport region of Eindhoven - for better and for worse. Safety comes first, both at and around the airport. We also want the Eindhoven region and surrounding area to benefit as much as possible from the airport and experience as little nuisance as possible.

1.1.2 General Information about LEO

The Eindhoven Airport Consultation (LEO) was established on 1 September 2020 as the new, permanent consultation structure proposed in the advisory report 'Reconnected'. Participants in this LEO, besides Eindhoven Airport (EA) and local residents, are the air base, surrounding municipalities, the province, ministries and various other agencies. Each participant delegated employees to participate actively in the different steering committees and workgroups. Central to the advice 'Reconnected' are five spearheads with which Eindhoven Airport, in cooperation with the region, can actively work out the proposed qualitative development direction for the airport in the period 2020-2030.

1. Actively aiming for less noise pollution
2. Structurally contributing to the climate goals
3. Actively steer toward improving air quality
4. Adding value to the region
5. Trust from the community

For the further development of the airport, which is focused on sustainability and quality, support from the community is very important. Together we can achieve an airport that suits (and offers added value to) Eindhoven and its surroundings. More information about LEO can be found via [this link](#) (only in Dutch). Samen op de hoogte [Staying informed together] is the [information platform](#) of LEO (only in Dutch), where you can also find news and background information about the various topics that are covered in LEO.

1.2 Current Aircraft Noise Monitoring System

Since 2003 ten noise measurement units are located in the surrounding area of Airport Eindhoven to gain insight into noise levels associated with passing air traffic. These units continuously measure noise and send the measurement data to a monitoring system where they are linked to air traffic and weather data and to the complaint handling system.

More about the current system via [this link](#) (text only in Dutch).

2 Process and definitions PoR

To arrive at this PoR, which is the basis for the tender documents to replace the current system, the following process was followed: first, a baseline measurement was performed based on the LEO proposal. This proposal was used to gain insight into the quality level and ease of use of the current system. Next, in consultation with all involved parties, an inventory of the functional and technical requirements was made by the tender committee. Finally, several plenary consultations took place to compile the final requirements package and its prioritization. The requirements were then presented to ICT, infrastructure, maintenance and procurement specialists, stakeholders, Workgroup Noise and LEO.

2.1 Prioritization

The MoSCoW prioritization will be used to prioritize requirements and wishes. This prioritization is widely used in the automation world to prioritize options when developing computer systems and is close to the perception that a user has when making choices in software systems. This system uses the following priority classes:

- 'Must-haves' (fundamental requirements for the solution);
- 'Should-haves' (important requirements for the system).

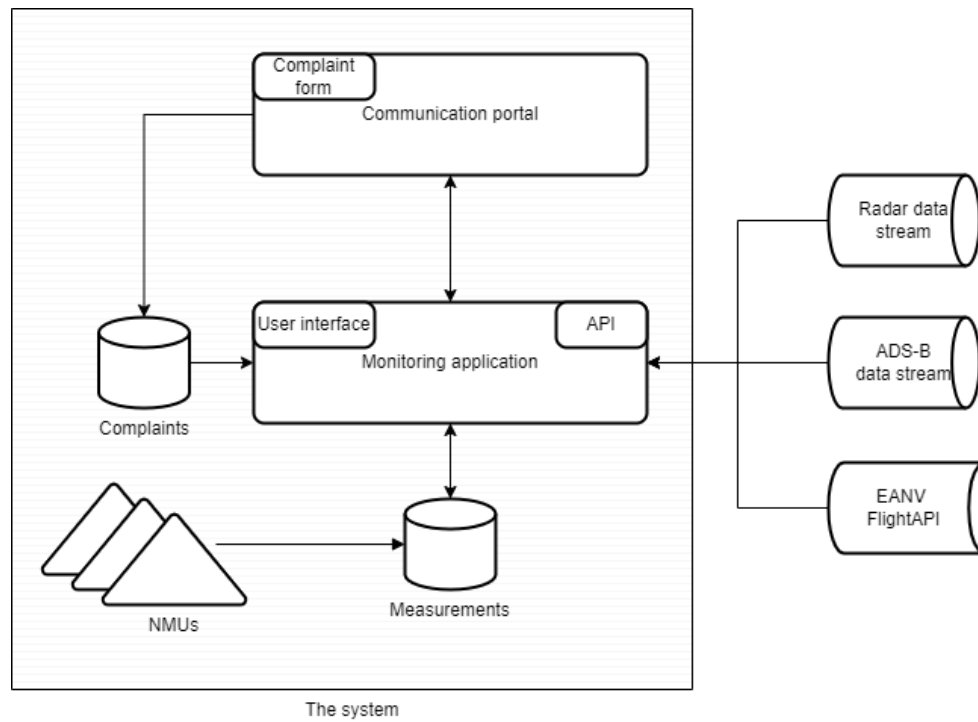
2.2 Detail level

The purpose of the Program of Requirements is to record functional and technical specifications so that a supplier is able to supply the requested system. The functional specifications determine WHAT the system must be able to do and the technical specifications determine HOW the system must function (its operation).

What the Program of Requirements does not describe is a detailed functional and technical design. This is a task for the supplier who must (develop and) deliver the system. These designs are seen as (part of) the supplier's product. We would also like to 'invite' a supplier to come up with (innovative) solutions themselves.

The Program of Requirements will mainly consist of lists with descriptions of formulated requirements. A requirement is generally recorded with a few lines of text. Each requirement is provided with a unique identification, consisting of a combination of the relevant system component and a serial number within it, so that it remains traceable during the project.

2.3 System overview



3 Functional requirements

This chapter describes the functional requirements of the new system. These specifications define WHAT the system must be able to do in order to be used as a tool for monitoring reports.

An initial classification of the functional requirements was made based on the identified system components and then a division was made into priority (MoSCoW).

This section will be included in its entirety in the documents prepared for the purpose of tendering to external suppliers.

3.1.1 Requirements implementation

Id	Priority	Specification
FIM01	Must-have	An instruction will be provided before commissioning the system. At least the following designs have to be included: • Use of the NMUs; • use of the monitoring application; • use of the reporting tool.
FIM02	Must-have	The supplier must indicate the expected lifetime of the new system. Based on this, the supplier has to make a calculation of the TCO (Total Cost of Ownership) of the application in case it is not offered as a service. In any other case, the costs of operation, maintenance, support, depreciation and line connections must be included in this TCO. The supplier has to aim for a TCO below 75,000 euros excl. VAT per year for a period of 10 years plus 5 years.
FIM03	Should-have	The supplier demonstrates which degree of quality is guaranteed when setting up the system. This involves developing, testing and validating results produced by the system.

3.1.2 Requirements Management and Maintenance (SLA)

Id	Priority	Specification
FBE01	Must-have	The system has a minimal life cycle of 10 years from the moment of delivery. During this period, the system is used for its primary task and availability must be guaranteed. As part of sustainability after 10 years an yearly optional renewal of the system will be considered. The intention is to use the system for 15 years.
FBE02	Must-have	During the life cycle of the system, maintenance and support must be provided on the system components in case these components have been provided by suppliers.
FBE03	Must-have	Maintenance and support shall be provided as an all-in service for all parts of the system.
FBE04	Must-have	For support, a helpdesk portal is made available for asking questions, reporting problems and reporting wishes regarding the system including follow ups. The helpdesk is available by telephone during office hours between 08:30 and 17:00 Amsterdam time zone.
FBE05	Must-have	Malfunctions of the system must be solved within a specified period of time in the context of problem management. Supplier proposes realistic response deadlines for the different types of failures and associated fixed costs in the Service Level Agreement.
FBE06	Must-have	The trouble-free availability of the system (NMUs, Application and Database) is guaranteed for 99% of the time. This interference-free availability is defined as the time that users can normally use the system without being affected by any malfunction. Supplier describes how to achieve the trouble-free availability of the system for each part taking account of FBE12

FBE07	Must-have	In the context of maintenance, the supplier will provide updates to the software as a result of adaptive and corrective maintenance. In advance the supplier provides insight into licensing policy if standard software products are used as part of the total system. Possible updates of these standard software products can have an impact on the rest of the system (for example, a new version of the reporting tool or a GIS product). The supplier proactively and timely provides all necessary information regarding the updates so that timely insight is gained into the consequences of the updates for linked systems, external processing of data and the procedures and work instructions.
FBE08	Must-have	In the context of maintenance, the supplier will provide updates of data in response to developments in type of aircrafts, destinations, routes, tolerance areas of routes and airlines ASAP.
FBE09	Must-have	Support and maintenance including FMP10 are carried out by the supplier on a fixed price basis. For this item the supplier includes an annual cost.
FBE10	Must-have	The system components are clearly documented. As a minimum, this documentation includes a data model, data dictionary, architecture description, user instruction and management document. The documentation is updated with each update.
FBE11	Must-have	The data of the system is guaranteed by means of a backup capability. The supplier must describe how an integral "point in time recovery" can be achieved and which preconditions are set for the method of backing up the application, database and other (system) files.
FBE12	Must-have	The system is fully available between 04:00 – 23:59 Amsterdam time zone. Outside this time frame, processes may run which can have an impact on the performance of the system (such as backup or archiving).

3.1.3 Requirements general software

Id	Priority	Specification
FAS01	Must-have	The retention period of the following data is at least: • Measurements: 10 years, • Tracks: 10 years, • Reports: 5 years, • Reporters: 5 years, after 1 year anonymous. This data must be available and retrieved within the application. All data remains property of EA.
FAS02	Should-have	The supplier demonstrates how older measurement data is stored, e.g. in aggregated format.
FAS03	Should-have	The supplier demonstrates how the system provides recoverability of measurement data.
FAS04	Should-have	The supplier demonstrates how the system can be used by the system operator at any workplace.

3.1.4 Requirements Noise Measuring Units (NMU)

Id	Priority	Specification
FMP01	Must-have	Noise measurements are carried out at least 1 time per second and the results are sent directly via a communication link to a central unit/database.
FMP02	Must-have	The NMU is able to measure the following sound indicators: • $L_{eq(slow)}$ • $L_{Max,slow}$
FMP03	Must-have	Measured values are automatically A-weighted.
FMP04	Must-have	The NMU can calibrate itself electronically based on a user-adjustable interval. A calibration check does not lead to new events and does not start during an event.

FMP05	Must-have	Results of the calibration checks are stored over a period of at least 15 months.
FMP06	Must-have	The NMU can measure spectral noise in 27 1/3 octave band values from 25Hz to 10Khz.
FMP07	Must-have	The noise measurements are carried out in accordance with ISO 20906:2009.
FMP08	Must-have	Noise measurements outside the measurement range (TMP13) are marked.
FMP09	Must-have	All measurements are linked to UTC time, with a maximum deviation of 2 seconds. In situations where this maximum deviation cannot be guaranteed, measurements are marked.
FMP10	Must-have	A measuring station requires local maintenance and acoustical calibration once a year.
FMP11	Must-have	The supplier demonstrates how to contribute to the sustainability goals of Eindhoven Airport such as optimizing circularity and reuse of existing materials in order to minimize energy and the environmental footprint of the solutions (zero emission and zero waste).
FMP12	Should-have	The supplier demonstrates which additional indicators can be added.
FMP13	Should-have	The supplier demonstrates if other weightings are possible.
FMP14	Should-have	Users of the monitoring application should be able to make a sound recording on one of the NMUs at any time using the monitoring application.

3.1.5 Requirements infrastructure

Id	Priority	Specification
FIS01	Must-have	All data communication facilities between NMUs and the other components of the system are weatherproof, durable and require low transport costs for the data.
FIS02	Must-have	An online connection is present between the system and all external systems (with real-time data traffic).

3.1.6 Requirements monitoring application including report handling

Id	Priority	Specification
		GENERAL
FMA01	Must-have	The system is user friendly. An employee with knowledge of the operating system and applications on the operating system must be able to work independently with the FMA02 application within a short training period.
FMA02	Must-have	The system is one central system for processing, analysis and coupling reports to radar/flight data and coupling aircraft noise events to radar/flight data.
FMA03	Must-have	With regard to security, both the software and the data require the use of authentication..
FMA04	Must-have	The system has role-based access control (RBAC) implemented. The functionalities in the user application must be clearly presented and can be adjusted to the role of user. The following roles shall be identifiable at a minimum: • Basic: viewing real-time data flights, reports and measurements; • Expert: viewing and editing all data; • Administrator: application management, maintenance of the application and data, setting user rights;
FMA05	Must-have	The user application and management application are Multi-user. Both the applications and the database are concurrent. At least 5 users (excluding reporters) must be able to use the system simultaneously.
FMA06	Must-have	All units are based on the metric system. Coordinates are defined in EPSG:28992 - Amersfoort / RD New coordinate system. • speeds in km/h (excluding wind speeds in m/s); • height in meters; • temperature in degrees Celsius; • air pressure in hPa;

		- angles in degrees (360), north direction is 0 degrees; - date and time in local including Daylight Saving Time/Summertime (for flight and meteorological information).
FMA07	Must-have	The waiting time for various (batch) processes in the user program are acceptable. For simple actions (such as requesting the information of a track), this is a few seconds, while long-term actions (such as searching for all tracks within a period of a year) must be completed in a few minutes.
FMA08	Must-have	For (batch) Processes in the software, a clear progress must be shown and processes must be able to be paused and aborted by user.
FMA09	Must-have	The system includes a possibility to notify in case of any problems in one of the system components. Notifications shall be given in case of equipment failures, breakdowns, capacity or performance issues. Notifications are also logged in a logfile.
FMA10	Must-have	The system has the ability to manually or automatically archive data in a location outside the system (for example, a separate medium such as a hard drive). The period for archiving is adjustable. The format in which the archive is performed is described in such a way that the data can also be consulted without the application.
FMA11	Must-have	The status of a question or complaint is tracked and can be consulted at any time. At least the following statuses (including date and time) can be used: - incoming; - pending (in progress), - feedback, - closed; - and closed automatically (if complaint has been closed automatically by the system). The statuses can be adjusted (change, add, deactivate) by the application manager.
FMA12	Must-have	The system must be able to switch by user from metric to international aviation standards. - Coordinates in EPSG:3857 WGS84 - speeds in nautical miles (excluding wind speeds in knots); - height in feet; - temperature in degrees Celsius; - air pressure in hPa; - angles in degrees (360), north direction is 0 degrees; - date and time in UTC.
FMA13	Should-have	The monitoring application has an overview window with status and priorities handling of: (number of) questions/reports still to process; - status of NMUs; - status of all external systems; (number of)reports that are not coupled to a flight (which must be coupled manually); - other relevant indicators (proposed by the supplier).
FMA14	Should-have	The system should be able to notify application users about uncoupled reports-flights.
FMA15	Should-have	Within the application, users (not reporters) can send (chat) messages to each other.
		NOISE
FMA17	Must-have	The system must be able to discriminate (aircraft) sound sources from background levels ('noise events'). Supplier makes a proposal for an algorithm.

FMA18	Must-have	The system must be able to detect a passage of a flight ('aircraft noise event'). Supplier makes a proposal for an algorithm and demonstrates compliance with criteria referred in ISO 20906.
FMA19	Must-have	The sound of each noise event shall be recorded as an high-quality audio file and stored for a period of 15 months.
FMA20	Must-have	A detected aircraft noise event is automatically coupled to a track. Supplier makes a proposal for an algorithm and demonstrates compliance with criteria referred in ISO 20906.
FMA21	Must-have	In case of aircraft noise event is coupled to a track, the elevation angle is also determined and stored.
FMA22	Must-have	Failures that have affected the measured values may be marked as unreliable at the discretion of the administrator.
FMA23	Must-have	The system is able to distinguish foreground, background and total noise levels. If the noise levels can be filtered for other types of sources, a confidence interval of 95% shall be used.
FMA24	Should-have	The system should be equipped with smart features to prevent incorrect couplings to other noise sources, e.g. trains and cars. Any possible remaining errors can be corrected manually afterwards.
FMA25	Should-have	The sound of each noise event should be recorded in raw format, i.e. wav-format.
		DATA
FMA26	Must-have	The system is filled with information and detailed maps for the following area: within a circle with a radius of 75 km from Airport Eindhoven. Outside this area, this map material may be less detailed.
FMA27	Must-have	Flight data within the system shall be compliant to common data definitions, as defined by ICAO and IATA.
FMA28	Must-have	The system is designed to register, process and display data on all types of aviation, such as commercial (major, national, regional), general (emergency, medical transport, police, business) and military aviation.
FMA29	Must-have	Information about reports is coming from the communication portal. These reports are stored in the system.
FMA30	Must-have	The system will be able to distinguish raw tracks/tracks-points and average tracks/track-points (based on a SPLINE method). Both are saved. The supplier indicates what volume increase is involved with double storage of the track-points and tracks.
FMA31	Must-have	Within the system, at least the following data is stored: • noise measurements ○ Identification ○ 27 1/3 octave values from 25Hz to 10kHz ○ Leq, SEL, Lmax, Lmin, L95 and L50 ○ A, C and F weighting ○ Total value ○ Date/time ○ (optional local meteorological data) ○ over- and underload • NMUs: ○ identification ○ name ○ address ○ Zip code ○ residence ○ description ○ geometry ○ last calibration results (deviation/drift in dB) ○ date/time last calibration ○ date/time last maintenance

		○ work carried out last maintenance ○ maintenance person last maintenance • noise events ○ Identification ○ start date/time ○ end date/time ○ ID NMU ○ Lmax(slow), Leq, ○ SEL • aircraft noise events ○ All features of noise events ○ ID coupled flight ○ Distance, projected distance and AMSL/ AGL height (QNH corrected) ○ Elevation angle • reporters ○ Identification ○ name ○ address ○ Zip code ○ residence ○ email ○ telephone number ○ Additional fields to be determined • reports ○ Identification ○ description (plus aircraft type) ○ status (incoming, pending, feedback, closed, and closed automatically) ○ date/time entry complaint into system ○ date/time complaint relate to the nuisance itself ○ priority ○ Additional fields to be determined • (raw)track: ○ Identification ○ all associated (raw)track-points ○ date/time ○ callsign ○ SSR ○ aircraft type ○ registration number ○ propulsion ○ operating type ○ flight rules ○ SID (incl. SID area)? ○ peer airfield ○ runway ○ direction (landing, take-off, circuit and transit) • raw track-point: ○ Identification ○ geometry ○ AMSL/ AGL height (QNH corrected) ○ speed ○ date/time • track-point: ○ Identification ○ geometry
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		○ AMSL/AGL height (QNH corrected) ○ speed ○ date/time • KNMI meteorological records (per 5 minutes) ○ date/time ○ wind direction ○ Wind speed ○ humidity ○ temperature ○ air pressure ○ precipitation
FMA32	Must-have	The attributes of reporters and reports can be changed.
FMA33	Must-have	External data sources are used to collect all data. This concerns the following systems: • Eindhoven Airport FlightAPI • radar data stream • ADS-B data stream • KNMI meteorology
FMA34	Must-have	When determining the height of track-point, necessary meteorological information (air pressure) is used. A marker is placed at a track-point if no meteorological data is present.
FMA35	Must-have	The system will be able to couple aircraft noise to a track. A pairing capability is based on time and distance. The quality of the coupling is indicated. Supplier makes a proposal for an algorithm.
FMA36	Must-have	Reports based on an address and time are coupled to a track. A coupling capability is based on time, distance and aircraft type. The quality of the coupling is indicated. Supplier makes a proposal for an algorithm.
FMA37	Must-have	Uncoupled reports can still be coupled manually at a later stage. A coupling status can be changed by user.
FMA38	Must-have	Accuracy of the address details for registration of reports are at the level of 6 position zip code, house number and suffix including X/Y coordinates. This is connected to the available geographical reference system in the Netherlands (BAG).
FMA39	Must-have	All collected data can be exchanged by use of a APIs. Both a batch-based API, e.g. a RESTful HTTP API similar to the existing API "Samen Meten" ¹ , and a real-time, event-driven API, e.g. ActiveMQ message queue, shall be available. Unlimited access and use to/of these APIs shall be included as part of the solution.
FMA40	Must-have	Based on the noise measurements (FMA31) and detection of aircraft noise events (FMA18) the application can calculate noise indicators Day, Evening, Night, Lden and Ke based on user defined time periods
FMA41	Must-have	All steps that are taken to handle a complaint are logged. At the end of a complaint handling, it must be clear whether all steps have been completed, whether feedback has taken place with the complainant and whether the complaint procedure is completed. Supplier makes a proposal for the handling of reports
FMA42	Must-have	The application must be able to set which information regarding a complaint is automatically sent back to a complainant by use of templates (if reports are handled automatically in accordance with FCP06).
FMA43	Should-have	Changes of Reports (and coupled tracks) by users are logged for username and date/time.

¹ <https://samenmeten.nl/dataportaal/api-application-programming-interface>

FMA44	Should-have	The supplier demonstrates how the new system incorporates the data from the current database. The supplier provides a separate offer for this. The documentation of the database is included in the annex.
FMA45	Should-have	The supplier demonstrates how the system registers, processes and displays data on the different types of aviation (requirement FMA28).
FMA46	Should-have	The supplier demonstrates which information is needed from EA to have a fully operational monitoring application.
FMA47	Should-have	The supplier demonstrates how the information (encodings) relating to airlines, aircraft types, operation type and aircraft codings, destinations, can be edited and added (e.g., new aircraft type) by the application manager.
FMA48	Should-have	If data is missing after an incident, fault or failure, data (track data, flight plan data, noise data, meteorology and reports) can be easily added afterwards to the system by the application manager without manual actions. The supplier describes a solution for this.
FMA49	Should-have	There are at least 3 thresholds for trigger noise events values whose value and color are adjustable by application manager. These thresholds can be defined separately for the day, evening and night period.
FMA50	Should-have	Track-points must be added to the system database with the same frequency in which they are supplied (from transponder/radar data).
FMA51	Should-have	The system is able to monitor the completeness of the datasets and where there are 'gaps'. This applies to all data from external systems.
		VIEWER
FMA52	Must-have	The information regarding flights and reports is displayed in real-time. The minimum refresh time is 1 second. Immediately after starting this functionality, all current flights are shown on the screen in its entirety (full track), including the flight plan.
FMA53	Must-have	Coupling an uncoupling reports to tracks can be done on the map
FMA54	Must-have	On a map view, the following information can be consulted (on selected items): • NMU: ○ Name ○ Noise level ○ threshold indication • Complaint ○ geometry ○ name complainant ○ address complainant ○ ZIP code complainant ○ Municipal complainant ○ date/time complaint relate to the nuisance itself; • (raw)track: ○ all related track-points ○ date/time ○ direction (landing, take-off, circuit or transit) ○ callsign ○ SSR ○ aircraft type ○ registration ○ propulsion ○ operator ○ noise category ○ peer airfield (incl. city) ○ runway ○ SID incl. SID area ○ noise event Lmax • (raw)track-points: ○ geometry

		○ AMSL/ AGL height (QNH corrected) ○ speed ○ date/time
FMA55	Must-have	On a map view, the following information is visually displayed: • selection made by the application manager from the fields (per role) as mentioned in requirement FMA54 for the complainant, NMUs, tracks and track-points per chosen time period • the tracks as being a line with distinction between landing, take-off, circuit and transit flights • the track-points as points • measured value at measuring location NMU including threshold indication colour for the relevant period of time (f.i. day-evening-night) • at least the following overlays ○ municipal boundaries ○ Agglomeration boundaries ○ Scalable maps (e.g., Open Street maps or raster maps EA)
FMA56	Must-have	The map has the following display features: • displaying information as 'layers' on a map. Reporters, NMUs, tracks, track-points, nominal route and tolerance areas, exclusion areas (increasing traffic) are a minimum set of available layers; • layers can be read based on GIS Shape files or through WMS/WFS; • layers can be turned on and off; • be able to create thematic settings (color and display type) per layer based on attributes (as mentioned in requirement FMA54). Settings must be stored per user; • Add layers by the user in the map view; • Zoom in/out and pan map view.
FMA57	Must-have	Playback of a time window (between and start date/time and end date/time) and display of selected flights, noise levels and reports within the time window. During playback there are options such as fast/slow/normal reverse/forward and pause.
FMA58	Must-have	Playback of a track and showing coupled noise levels and reports within the time frame of the track.
FMA59	Should-have	For all traffic, it should be possible to define (horizontal/vertical) areas of interest (e.g. SID tolerance areas, heights) for the routes. These must be able to be drawn and included as a layer in the system.
FMA60	Should-have	The map view has the following analysis capabilities: • make selections of reporters, NMUs, tracks and track-points based on selection on the map (1 or more objects) and from the database; • make additional selections of reporters, NMUs, tracks and track-points based on attributes (1 or more objects); • Selections can be made by a mouse click, drawing a rectangle or line segment; • measure distances with a ruler (icon) on the screen; • measure distances based on combination of type of objects: ○ Complaint - track-point ○ Complaint - track (nearest) ○ Complaint - route (nearest) ○ Complaint - NMU (nearest) • show the flight route versus SID nominal and tolerance areas
FMA61	Should-have	The information (coding's) relating to airlines, aircraft types and aircraft codes, destinations, are always shown to the user/complainant including a detailed description (see also FMA35)

		SEARCH/EXAMINE/ANALYSES
FMA62	Must-have	When searching by date/time, the user can choose between UTC and local (Amsterdam) time.
FMA63	Must-have	For users a feature is available for easily query data from the database (Query tool). The user can make a selection from tables, attributes, relationships and filters in a user-friendly way. Relationships can also be defined by the user and a range can be specified for each domain. Selections can be saved (views). The Query tool can also create graphs and perform statistical analysis. Vendor shall provide all information about the data model and relevant data of the application.
FMA64	Must-have	Surveyed information can be displayed in tabular form and in graphical form
FMA65	Must-have	For users a feature is available for making reports using the data that becomes available through the Query tool of requirement FMA53. The layout and layout of the reports can be freely arranged. The document is saved in a common and modifiable format (e.g., MS Word).
FMA66	Must-have	It must be possible to export (large amounts of) data to a common format such as XLSX, CSV, ESRI GIS Shape formats, JSON, XML and GML using the functionality of requirement FMA53.
FMA67	Must-have	It shall be possible to determine which flights have a deviation from the tolerance area (track offender). The height shall be included as a criterion, as well as the defined SID areas. The result of this analysis is a set of tracks (which can also be shown on the screen or exported).
FMA68	Should-have	Display of a (aircraft) noise event in a graph (time versus noise level) and real-time.
FMA69	Should-have	Overview of take-off and landing profiles for a selected track.
FMA70	Should-have	Feature to search addresses of reporters.

3.1.7 Requirements communication portal

Id	Priority	Specification
FCP01	Must-have	An online communication portal (hereafter referred to as the 'portal') is used to inform citizens.
FCP02	Must-have	The portal can be accessed independently, is 24/7 available and shall be integrated into the website samenopdehoogte.nl .
FCP03	Must-have	The portal is suitable for all common internet browsers from any device (Desktop, Tablet, Mobile).
FCP04	Must-have	The ease of use and language of the portal is tailored to the level of citizens. Sufficient (context-sensitive) help information must therefore be provided. The portal is flexible, consistent and intuitive to use.
FCP05	Must-have	The portal must give substance to the concept of "first informing and, if necessary, then submitting reports and asking questions".
FCP06	Must-have	The portal gives citizens an impression of how "real-time" flying is done. This is displayed online with a "live" traffic viewer with "live" noise levels measured by all NMUs. For safety reasons, this "live" data is displayed with a delay of 1 minute (or adjustable number of seconds). After receiving the complaint, a complainant automatically receives information about the flight with track information which causes the complaint (based on automatic (FMA36) or manual coupling (FMA37)).
FCP07	Must-have	The portal uses the same internal and external data sources/systems as the monitoring application.
FCP08	Must-have	The portal provides citizens with information about specific aircraft movements/flights, which can be selected based on a time frame to be specified.
FCP09	Must-have	The following information is displayed for a selected flight: All flight paths including the SID and tolerance areas (of the corresponding route);

		• position of the citizen (determined on the basis of pre-entered ZIP code and house number); • Track information: device type, speed, altitude (for selected track-point), X and Y coordinates, destination/origin airport, arrival/departure and runway; • indication of any deviation for departing traffic based on altitude, deviation from the route, within noise limit value, legitimacy start at time; • indication of any deviation for incoming traffic based on altitude, approach route, within noise limit value, legitimacy landing at time; • flight based on commercial, general or military aviation; • relationship between flight movement, complaint and measured noise level.
FCP10	Must-have	The portal gives the possibility with the “live” traffic viewer to select real-time and historical flights and report a complaint about this flight.
FCP11	Must-have	The portal shall have the functionality to make general reports (not necessarily linked to a flight).
FCP12	Must-have	The portal should be protected against to automatically generated reports (e.g., via scripts or bots), e.g., by CAPTCHA functionality. Supplier provides a solution for this.
FCP13	Must-have	The portal gives the possibility to ask general questions.
FCP14	Must-have	To use the portal, where aircraft and flight data can be consulted, citizens must have registered (at first contact). So-called 'accounts' and 'authorization' are used for this.
FCP15	Must-have	To submit reports, reporters must authorize themselves in the application.
FCP16	Must-have	The accounts on the portal can be managed by the application manager (e.g., via the administrator application).
FCP17	Should-have	The use of the portal should preferably be periodically evaluated with tools like Google Analytics or VWO, in order to detect optimization opportunities.
FCP18	Should-have	The portal contains a catalogue of aircrafts that can be searched by users based on registration/flight number. This catalogue contains both textual information and photographs.
FCP19	Should-have	The layout and content of this portal is flexible in design and can be changed with minimal effort.
FCP20	Should-have	All steps that are taken to handle a complaint should be transparent (based on a checklist). At the end of a complaint handling, it must be clear whether all steps have been completed, whether feedback has taken place with the complainant and whether the complaint procedure is completed.
FCP21	Should-have	The information on the portal should be focused on explanations, reports, publications, submitting reports/questions and contact
FCP22	Should-have	The portal should have a native app for Apple iOS and Google Android, available in the Apple app store and Google play store) for submitting reports/questions.

4 Technical requirements

This chapter describes the technical specifications of the future system. These specifications mainly define the HOW of the system. The technical specifications are laid down in outline form. The supplier is expected to fill in the specifications in detail.

An initial classification of the technical requirements was made based on the identified system components and then a division was made into priority (MoSCoW).

This chapter will be included in its entirety in the documents drawn up for the purpose of tendering with external suppliers.

4.1.1 Requirements infrastructure

Id	Priority	Specification
TIS01	Must-have	The transport of data between the system components and external data suppliers shall be done via connections based on GSM/UMTS/LTE.
TIS02	Must-have	The monitoring application is designed to be used with a maximum available bandwidth of 20 Mbit/s (up- and download). The supplier takes this into account when designing the system and the required data streams.
TIS03	Must-have	Supplier proposes algorithms to aggregate and archive historical data. This as a measure to keep the database size manageable. Supplier provides the expected data volume growth per year of the following two scenarios: • storage of all noise events including all noise measurements (samples); • noise event storage only.
TIS04	Must-have	The supplier provides a specification of the required memory and number of CPU cores for the workplace.
TIS06	Must-have	The system uses standard software and hardware components wherever possible and is built according to the latest state of the art.
TIS07	Must-have	The system shall use standard data exchange methods wherever possible, e.g., Apache AVRO, JSON, XML.
TIS08	Must-have	The system uses standard, upper layer ² , protocols for data communication where possible.
TIS09	Must-have	The system shall only use hardware and software components and libraries that are actively developed and/or supported by its respective manufacturers/developers. In case of end-of-support components, the supplier shall substitute/upgrade this component at no additional cost.
TIS10	Must-have	Any internet-facing system shall be equipped with a professional DDoS protection service, e.g. Cloudflare or Akamai.
TIS11	Must-have	Any data communication within the system shall be encrypted according to modern protocols, algorithms and ciphers.
TIS12	Must-have	The system shall be compliant to the Eindhoven Airport Security Annex.

4.1.2 Requirements monitoring application

Id	Priority	Specification
TMA01	Must-have	The monitoring application shall be built and run using modern, up-to-date technology.
TMA02	Must-have	If the monitoring application is a web application, it shall be fully compatible with the most recent versions of at least: Microsoft Edge, Google Chrome and Mozilla Firefox.

² Layer 5 and up, as described in the OSI reference model

		The application shall not require the installation of any plugins or other additional software for its core functionality.
TMA03	Must-have	If the monitoring application is a desktop application, it shall be fully compatible with the most recent version of Microsoft Windows.
TMA04	Must-have	A multi-tier setup is applied in the overall system. At least the data layer and the application layer must be logically separated from each other to guarantee reliability and continuity.
TMA05	Must-have	The data in the system must be protected and only accessible after authentication and suitable authorization.
TMA06	Must-have	The software does not use hardware tokens for any type of security, e.g. license security.
TMA07	Should-have	It is strongly preferred that the monitoring application is a web application.
TMA08	Should-have	If the monitoring application is a desktop application, it should be fully compatible with macOS and/or Ubuntu Desktop.
TMA09	Should-have	The license policy of the software is based on concurrent use. The number of possible users of the system is not limited.
TMA10	Should-have	On a computer display map material can be displayed in a window or full screen.
TMA11	Should-have	The database and data entry forms are easily expandable by an administrator.

4.1.3 Requirements Noise Monitoring Units

Id	Priority	Specification
TMP01	Must-have	The operating temperature range (outside) of the NMU must be between -20 and 45 degrees Celsius.
TMP02	Must-have	The NMUs are using latest state of the art transfer protocols to send data to a central unit.
TMP03	Must-have	A minimum of 10 NMUs will be put into operation. The sound measuring equipment and microphone are conform to the electro-acoustical performance specifications of NEN-EN-IEC 61672-1:2014 for a class 1 sound level meter.
TMP04	Must-have	The system can be extended with NMUs with sound measuring equipment and microphone which are conform to the electro-acoustical performance specifications of NEN-EN-IEC 61672-1:2014 for both class 1 and class 2 sound level meters.
TMP05	Must-have	The standard microphone height of the NMU must be at least 6 m above ground.
TMP06	Must-have	The diaphragm of the microphone must directed upwards, parallel to the local surface
TMP07	Must-have	the microphone of the NMU that shall be free of obstacles 70 degrees left and right and between 10 and 90 degrees elevation between the nearest point of the nominal aircraft route and the microphone location.
TMP08	Must-have	All acoustically relevant reflecting surfaces other than the ground shall be at least 10 m away from the microphone
TMP09	Must-have	The LAmax, slow of the quietest aircraft to be detected is at least 10 dB greater than the residual long-term-average sound pressure level (L95).
TMP10	Must-have	The NMU station is weatherproof according IP65. A lightning conductor is located at least 0.5 meters from the microphone.
TMP11	Must-have	The NMU is able to measure at least 1 calendar year with a minimum availability of 98%.
TMP12	Must-have	The NMU is only accessible to authorized persons and is physically protected from access by unauthorized persons. This to prevent damage to the NMU by vandalism. This is not only about accessibility by humans, but also animals that can cause damage to the NMU.
TMP13	Must-have	The noise measurement range is at least 30 to 120 dB SPL.
TMP14	Must-have	A wind shield is used on the microphone. The manufacturer of the microphone and/or wind shield shall demonstrate that the installed wind shield results in an LAeq of less than 65 dB(A) with a continuous wind of 10 m/s.
TMP15	Must-have	A NMU shall be protected by multi-factor authentication, e.g. username-password combined with IP address whitelisting.

TMP16	Should-have	The position of the microphone should be above grass or other soft soil. If not possible, influence of ground reflections is minimized
TMP17	Should-have	The system can be extended with low-cost citizen science sensors (e.g., noise sensors like https://sensor.community/nl/sensors/)
TMP18	Should-have	A NMU can be extended with a meteo station measuring local windspeed and direction, temperature, humidity, pressure and rainfall
TMP19	Should-have	Supplier should have procedures in place to ensure that former/unauthorized staff cannot access an NMU, e.g. modification of login credentials
TMP20	Should-have	A NMU should be equipped with an firewall.

5 Terms and definitions

This document uses many terms in acronyms in the field of IT, software systems and aviation. The table below explains the most common terms.

"The system"	In this document, the successor to the existing ANOMS is often referred to as "The System." The future system is often referred to as "the new system" or NAME MONITORING SYSTEM.
24/7	During every hour of the day, all week including weekends.
6ppc	Six Position Zip Code format '1234AB'
ADS-B	ADS-B stands for "Automatic Dependent Surveillance-Broadcast." This refers to surveillance technology for tracking aircraft middle transmissions ("Over the air").
ADSL	ADSL stands for "asymmetric digital subscriber line" and refers to broadband technology for data connections.
AGL	Above Ground Level
AMSL	Above Mean Sea Level
API	Application Programming Interface. Interface layer to develop own programs that connect with this system.
HTTP	HyperText Transfer Protocol
REST	Representational state transfer
JSON	JavaScript Object Notation
XML	Extended Markup Language. Exchange format for data between different systems.
NMU	Noise Measurement Unit: Metal case with noise measuring equipment, control unit, modem and battery (24H), including: • 6 meter Tilt Down Pole • Microphone with windshield and bird spikes • Foundation with lightning conductor • power cables • Fencing with lockable access door (3x3m.) • Weatherstation (optional)
Leq(slow)	Lp,eq,1s
Lmax(slow)	Lp,S,max or Lp,eq,1s,max
Lmin(slow)	Lp,S,min or Lp,eq,1s,min
L95	Lp,S,95,1 h
L50	Lp,S,50,1 h
QNL	Query Nil Height
SEL	LE,time of (aircraft) noise event in s
Leq	Leq,time of (aircraft) noise event in s