

REQUIREMENT SPECIFICATION

Establishment of a new
Data Management System

NAUTILUS



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1 Introduction

1.1 NMA & NHS's Organization and setup

The Norwegian Mapping Authority (Kartverket) bears nationwide responsibility for geographical information, operates the national property registry and undertakes all property registration in Norway.

The Norwegian Mapping Authority collates, systemizes, manages and communicates public geographical information. In practice, this means that the Norwegian Mapping Authority is responsible for and provides the following:

- **National geodetic frame:** The Norwegian Mapping Authority is responsible for the ratified framework on which mapping and measuring work in Norway is based.
- **Positioning services:** Services for determining accurate, satellite-based positions.
- **Digital maps:** The Norwegian Mapping Authority produces and manages national digital map series (land maps and nautical charts).
- **Land registry:** Property rights registration for fixed property and flats in cooperative housing.
- **Property information:** The Norwegian Mapping Authority operates the national registry for public property information (the New Cadastre and the land registry).
- **Place names:** Administers the National Place Name Register.
- **Standards:** National standards for maps and geographical information.
- **PRIMAR ENC Service:** Has operational responsibility for Primar, the international electronic navigational chart service.

Geodata coordinator

The Norwegian Mapping Authority also plays an important role as the nationwide coordinator of geodata, which involves establishing and coordinating work with the national geographical infrastructure within Norway.

This means working closely with municipalities and other public sector suppliers and users of geographical information via Norway Digital.

Divisions within the Norwegian Mapping Authority

The Norwegian Mapping Authority has around 850 employees and is a public agency under the Norwegian Ministry of Local Government and Modernisation. The Norwegian Mapping Authority is organised in four divisions.

Johnny Welle is our director-general. The four divisions are:

- The Geodetic Institute
- The Land Mapping Division
- The Hydrographic Service
- The Cadastre and Land Registry

The Norwegian Mapping Authority Hydrographic Service is responsible for preparing and updating nautical charts and covers all marine and coastal waters in Norway and around Svalbard, as well as Norwegian areas in the Antarctic.

All tasks undertaken by the Norwegian Mapping Authority involve geographical or ratified information, whether in regard to data on which a map is based, the name of a town, property boundaries or property rights issues.

The Norwegian Hydrographic Service, NHS, was established in 1932 and has operated as a division of the Norwegian Mapping Authority since 1986. The division has appr. 115 employees and is based in Stavanger.

NHS organization from 01.04.2021 is shown in figure below:

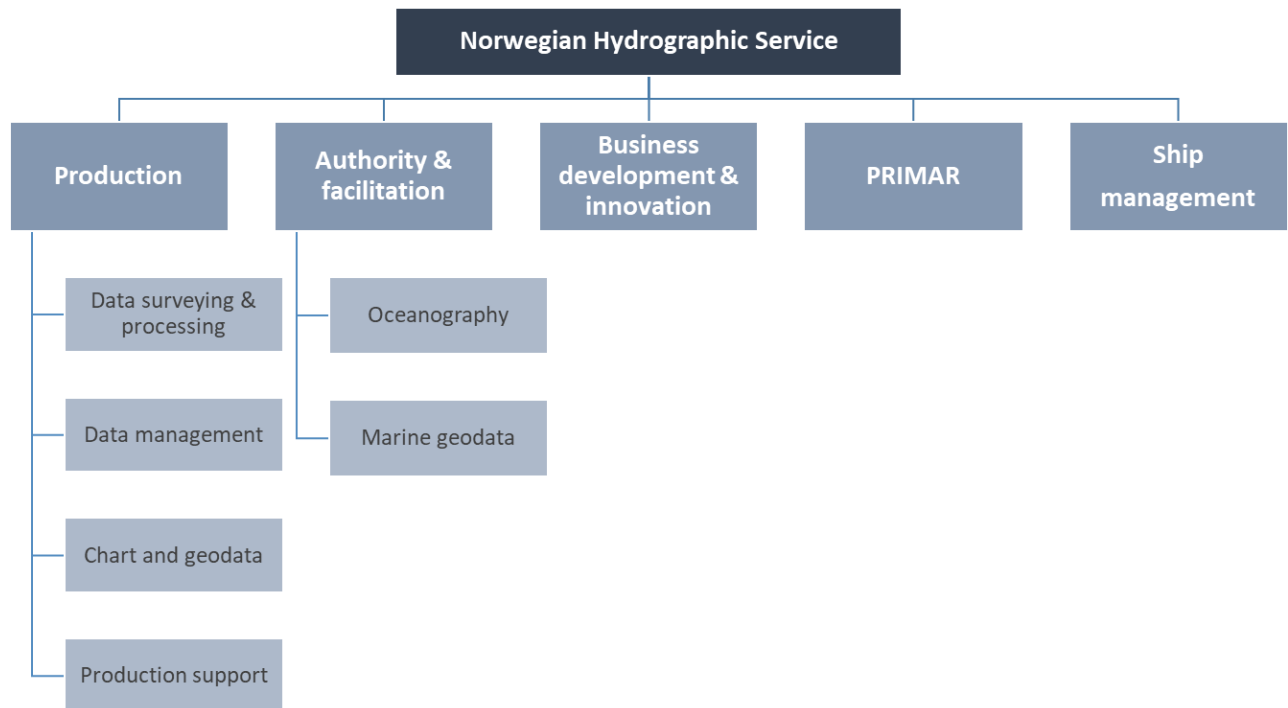


Figure 1 - NHS Organization

1.1.1 NHS Networks and users

The defined system is expected to be sizable and scalable to meet a high number of parallel/ simultaneous users. The system is a management system and as such NHS users are expected to be granted access to the system as needed and required.

The Nautilus solution are envisioned to be built up over several implementation and development steps, where deliverables for each step are expected to answer to its own set of requirements and functions. This step, current tender, of the Nautilus program are focusing on a data management system, for the classified network part only, covering bathymetric data with an integrated metadata handling.

The tenderer is also directed to **Appendix 1 Annex 1** and **Annex 2** indicating data formats and volumes expected to be supported by the system.

| Estimated number of system users, on Classified system | | |
|--|--|---|
| | Estimated number of users; during normal operations (not parallel users) | Price your solution supporting following number of system users (ref. <i>Appendix 7 - Total price and pricing provisions</i>) |
| SYS, DBA & other admin roles | 3 | 3 |
| System operators (Read/Write) | 10-25 | 10 |
| System users (Read only) | 20-35 | 15 |

Tabell 1 - Estimated and priced user licenses

The system is expected to be able to handle many more parallel users than given above without any degradation of system functions.

2 Project and tender details

2.1 How to fill in the requirement specification

The purpose with this document is to provide extended descriptions and explanations to the system, its usage and its expected functionalities.

The document **Appendix 2 - Customer requirements.xlsx** is providing a complete listing of all requirements, grouped and sorted by system modules, and a Compliance state must be given by the tenderer to each requirement. A separate document may be used if the requirement's Description cell is not sufficient or proper to use. Please ensure that correct reference is made in "Reference" cell.

2.1.1 Requirement categories

There are three categories of requirements used in this tender, **MUST**, **SHOULD** or **INFO**, and are listed in **Appendix 2 - Customer requirements.xlsx**.

MUST requirements indicate features and/or functions that NHS find to be minimal and mandatory for the proposed solution.

Compliance to the MUST requirements is required.

Failing to comply with a **MUST** requirement will disqualify the tenderer from the tendering process. The tenderer is therefore asked to carefully evaluate any **MUST** requirements where compliance is challenged to ensure correctness.

SHOULD requirements indicate where NHS consider the functionality important, wanted and/or expected within the proposed system, but the requirement is not considered mandatory. Compliance to a **should** requirement are solely up to the discretion of the tenderer, and must be categorized as **Fully**, **Partly** or **None** compliance.

INFO requirements indicates where NHS request further details to understand the systems or the solutions capabilities, its evolution or other relevant details. This requirement category and provided description will provide NHS with further details and information.

Further details to the different requirement types are explained below.

For further and/or more comprehensive descriptions, please use an external file and make a clear and unambiguous reference to the relevant requirement, using the “Req. ID”. Also make sure proper reference to the external file and chapter are made in “REFERENCE” cell for the relevant requirement.

2.1.2 MUST category

A **MUST** requirement is indicated in column “Req. Type” with value ‘**MUST**’.

All requirements must be given a compliance value.

Acceptable compliance values for a **MUST** requirement are:

| MUST | |
|-------------|---|
| YES | Indicate full compliance to the requirement. It is <u>required</u> that the tenderer provide explanatory description, in its own words, how the requirement is meet. |
| NO | Indicate that the requirement is not being meet. Failing to meet a ‘MUST’ requirement will disqualify the tenderer. |

Table 2- MUST compliance values

For the tenderer to be successful all MUST requirements shall be given the Compliance value ‘YES’.

The tenderer shall provide explanatory and detailed descriptions on how the requirement is meet using their own words/descriptions.

Please note that an affirmative reuse of the requirement will not be considered as a sufficient response.

2.1.3 SHOULD category

A **SHOULD** requirement is indicated in column “Req. Type” with value ‘**SHOULD**’.

All requirements must be given a compliance value.

Acceptable compliance values for a **SHOULD** requirement are:

| SHOULD | |
|---------------|---|
| Fully | This value indicate that the tenderer is, with the proposed solution, meeting the requirement in full. This means the requirement is meet without any limitations to functions and/or results and without further need for customization, development or any other bespoke engineering. It is <u>required</u> that the tenderer provide explanatory description, in its own words, how the requirement is meet. |
| Partly | “Partly” value indicate that the proposed solution are meeting parts of the required functionality/(-ies) or will meet the required functionality but further |

development, customization, engineering or other work is required.

It is required that the tenderer provide explanatory description, in its own words, of which part(s) of the requirement is (are) met and how (by which part of the solution etc.) and clearly identify any limitations or reservations where applicable.

None Tenderer confirm that no parts of the requirement are/will be meet.

Further description is not expected but may be given if the tenderer believe it will provide further clarity to the requirement.

Table 3 - SHOULD compliance values

Compliance and delivery to **SHOULD** requirements are solely up to the discretion of the tenderer. **None** compliance is an acceptable response.

2.1.4 INFO requirements

The INFO requirements are of informational character only, where NHS are requesting and allowing the tenderer to provide further details, information and/or insight to the requirement.

2.1.5 Evaluating and scoring requirements

NHS will evaluate the tender responses according to the **Tender notice, section 6.2**, and will use a standardized methodology template for the evaluation.

All requirement, except of INFO type, will be evaluated.

2.2 Pricing

For pricing this tender, the tenderer must use **Appendix 7 - Total price and pricing provisions.xlsx**.

Appendix 7 - Total price and pricing provisions is indicating the how NHS want to see a price breakdown.

The tenderer may add new rows to the price document, but must ensure that each sections total and page total are correctly transferred to the **"PRICE Totals - Summary"** sheet.

The document, **Appendix 7 - Total price and pricing provisions.xlsx**, must be returned duly filled in excel file format. The tenderer may, in addition to the excel document, also choose to return a static data format file e.g. PDF.

The Appendix 7 template is protected in Excel without any password.

NHS will be evaluating the tender based on a Total Cost of Life (TCoL) inclusive of "Delivery phase plus 5 years annual system maintenance."

A duration of 5 years maintenance are used as a basis for the price evaluation to make the tender offers comparable and realistic, however actual renewal of the agreement will depend on the contracting authority's annual budget.

3 Background and rationale

With the growing amount of data, higher volumes and better data being collected and the goal ‘to share more data to more users faster’ NHS have established a project named “Nautilus”. With Nautilus NHS aims at establishing a fast and generic data value stream from data collection to usage, improve data quality, lower time to users and ensure and support automation, machine learning (ML) and Artificial intelligence (AI) where possible.

The changing role for NHS today and in the future is a change from a traditional nautical data producer to an efficient data warehouse, still including provision of high quality and authorized nautical products. To ensure proper alignment, focus and capabilities, the Nautilus project is aimed at providing answers and solutions meeting the new requirements.

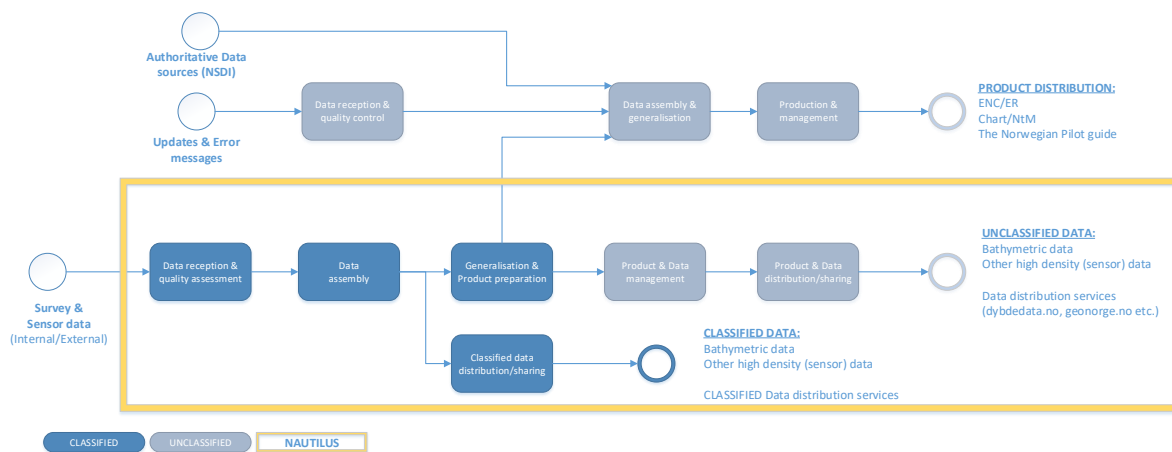


Figure 2 - Generic simplified process flow NHS – Nautilus

There are several distinct design goals. A common denominator is that it is designed with change in mind.

- 1) **Digital transformation**; the solution will be a central piece in NHS’ goal towards a fully digitized data-, information- and knowledge base.
- 2) **Data-centricity**; the data is our main asset, today and for years to come. In addition to all known use cases, the solution must also be able to support all future use cases. No restrictions other than regulatory is put on how data is accessed, all the way down to single features.
- 3) **Innovation**; NHS will emphasize Nautilus’ role as a platform for innovation and development. It is likely that the solution itself represents a leap in technological advances for hydrographic computing. To encourage research and development we will emphasize the ability to develop and execute new algorithms, scripts and workflows on high-resolution bathymetry to all parties interested to increase value and usability of the data.

Persistent storage of data and metadata is perhaps the most important building block of “Nautilus Open Core” (NOC). It must serve today’s needs as well as evolve over time. The functional requirements are still the same; in terms of data delivered safely, effectively, to the required standards and without further delay.

3.1 New Data Management System

This tender is established, as a first phase of the full Nautilus project, namely the “**new Data Management System**”, as a provision of effective data management phases.

NHS seek to acquire a new Data Management system that, as a minimum support receipt, storage, management and dissemination for bathymetric data, including a rich, standardized and generic metadata handling for data and products managed by NHS. Metadata management including but not limited to bathymetric data.

This tender is describing the new Data Management system (basic features) limited to the classified system part, storage and infrastructure requirements, displaying and organization of stored data, together with a standardized, integrated and structured solution for metadata handling and use. The specified system and its features are primarily asked supported based on COTS (Customized of the shelf) tools and/or components, where customization and bespoke work would be limited to NHS local/national requirements, specifications or other needs. NHS envision and accept that a certain amount of development/customization will be needed.

The system must be, as defined within the requirements, modular based, enhancements and new features must be possible to add to the system without the need to alter or change the system core or base. NHS envision a lifecycle duration for the core/basic system, which will be enhanced and grown over time with new features, new components, new data streams (in/out), learning features, algorithmic features, automation and more.

Additional development made on or on top of this core system are requested to support **Statens Kartverks infrastructure platform (SKIP)**, where applicable. **SKIP** is a kubernetes-based platform running on VMWare Tanzu, with tooling for modern development-practices.

4 Solution Requirements

The full NAUTILUS system is defined to, in a data and product generic manner, be a complete solution for NHS on managing and disseminating data and product, today and for the future.

The full NAUTILUS system is planned to handle planning activities, data receipt, quality control, centralized storage, management, manipulation and transformation of the data, catalogue and information services. The system is also believed to manage product specifications incl. metadata specifications. Data dissemination and data sharing, through tunable services are expected supported.

The full NAUTILUS system will not be limited to bathymetric data and must be sizable and tunable to grow with the needs of NHS, and NMA as a whole. The system is planned to support management and handling of, in due course of time, all current and future data streams not only limited to bathymetric data.

The full NAUTILUS system will cover the processes, for multiple data streams and types, within the yellow frame (illustrated below).

NAUTILUS

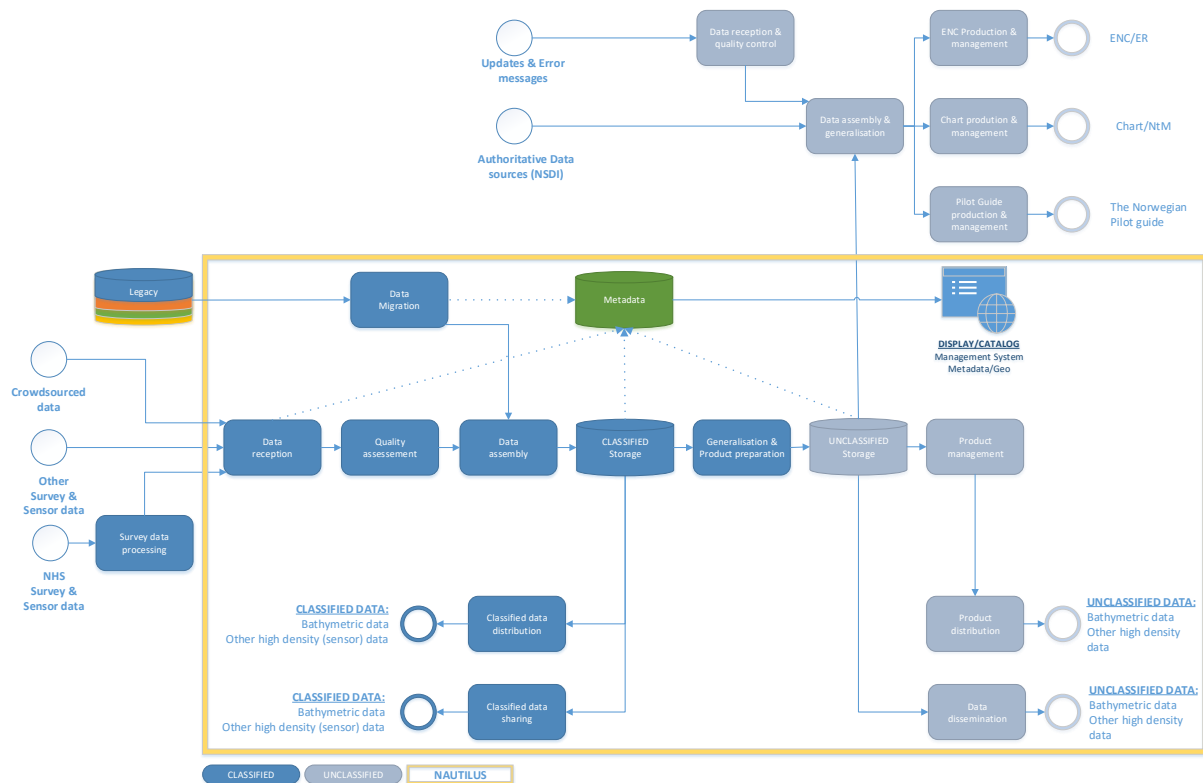


Figure 3 - NAUTILUS System overview – Processes

The full system configuration will have to support a classified and an unclassified setup, where data can be securely synchronized between the systems, preferable in a semi-automatic manner. Bathymetry and other reflective/sensor data are by law and by definition classified data. Due to this NHS operate a separate and closed network for all classified data. The classified system is understood to contain the complete content of all data and (classified) data products & products managed by and defined by NHS.

The unclassified (open) system will contain all unclassified open data.

Unclassification of data follows defined processes and/or approval steps, allowing data that are unclassified to be moved over to the open system, on an open network.

The full NAUTILUS system setup must support the two network infrastructures and allow a smooth and integral synchronization of data on both systems.

Only the classified system part is described within this phase of the Nautilus program and within this tender.

A simplified full system overview is:

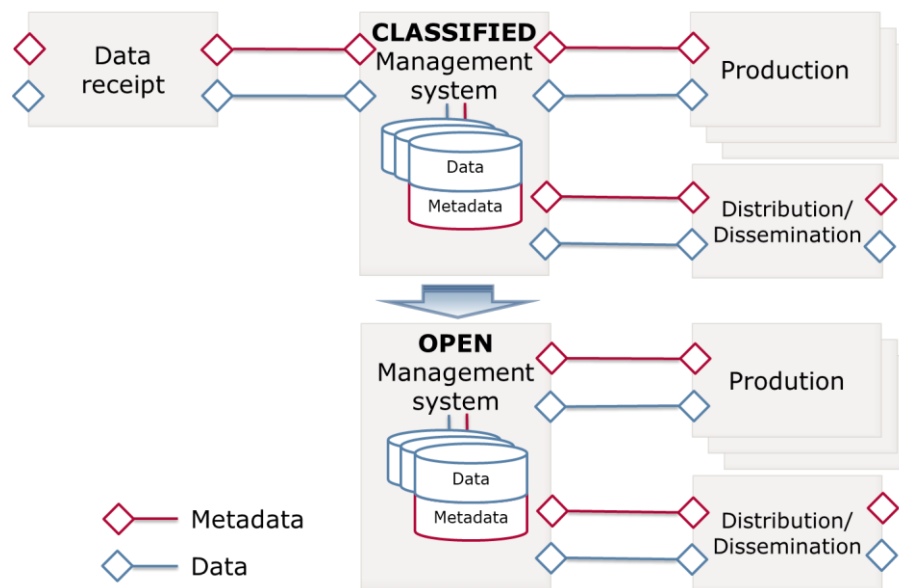


Figure 4 - Simplified system overview - Classified/Open

4.1 The new Data Management system – Tender scope

This setup and its illustrations are used to categorize the different requirements, based on modules and submodules, and provide **further explanations of our expectations and needs.**

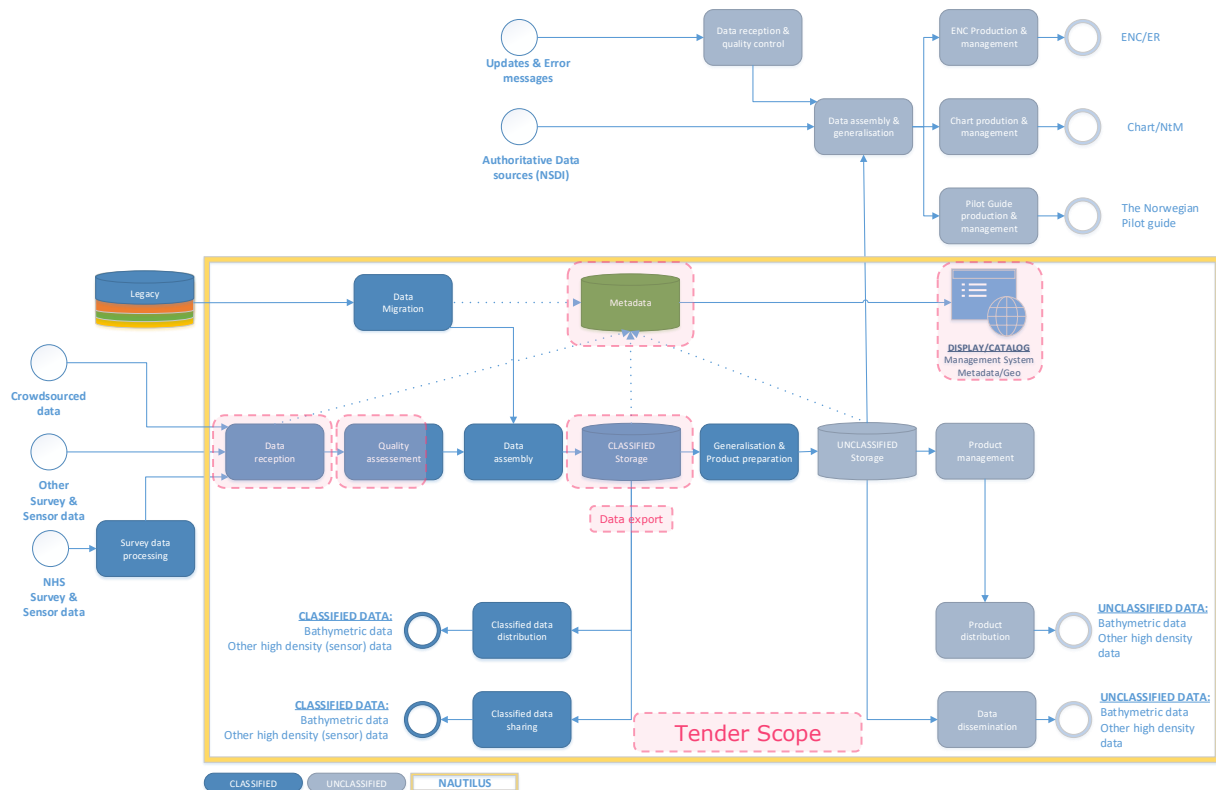


Figure 5 - Scope of this tender

4.1.1 Requirements to network setup – Classified and Open

As mentioned above, the full NAUTILUS system will have to support two separate network infrastructures and allow for a smooth and integral synchronization of data on and to both systems.

Requirements and scope of this tender is covering storage and data management on classified network infrastructure.

Below descriptions are given to establish a better understanding of the direction Nautilus and NHS are moving, as well as providing further information to the technical requirements.

Data and classification levels are defined like following:

CLASSIFICATION LEVELS (States)

| CLASSIFICATION TERM | CLASSIFIED NETWORK | UNCLASSIFIED NETWORK | DESCRIPTION | REQUIREMENTS |
|---------------------|--------------------|----------------------|--|--|
| KUN GRADERT | X | | Data, products and (possibly) metadata are only allowed to be used for CLASSIFIED purposes | No distribution and/or sharing allowed by system. Manual system extracts allowed. |
| GRADERT | X | | Data, products and (possibly) metadata are permitted to be used for CLASSIFIED purposes and may be processed/derived to UNCLASSIFIED data/products | Distribution for Classified production allow, data/products are allowed derived to Unclassified data/products. |
| | | X | UNCLASSIFIED data are allowed shared to Unclassified system | Distribution/sharing to Unclassified system is allowed |
| FELLES | X | | Data and products are unclassified. (defined as e.g. high resolution data that are unclassified based on laws and content) | Data/products may be shared in a 1:1 ratio between classified and unclassified system |
| ÅPENT | X | | Data and products are UNCLASSIFIED and can be shared freely between the systems. | No limitation on sharing, access or use of the data. |

Figure 6 - Classification levels

Above “Classification terms” are defined to properly identify and categorize data managed within the system, properly assign classification details within the metadata and to allow processing procedures (QC routines) on the data. There are a number of requirements defined to ensure correct and proper handling of the data and to ensure full compliance on data storage and data synchronization. These classification terms must be covered within the metadata adjoining the data, and the highest classification of the data is the ruling category, e.g. if only one of multiple data objects within a source is classified the entire source is and must be handle as classified.

4.1.1.1 Classified network.

The classified network at NHS is a separated and fully isolated network setup. This means there are no connection to any open services, such as e.g. NHS LAN/WAN, internet, etc.

The requested system must support this type of network setup.

There is also an approval process for all equipment that will be installed on and operate on the classified network. A successful tender **must** meet these requirements for the proposed system and its individual components.

The data registration process defined for the system, any classification, is done on the classified system. This to ensure completeness of data and coverage and to ensure correct and proper handling of data with mixed classification grade (within the same dataset).

Registration of data must be fully supported, metadata established must favor both classified and unclassified requirements, allowing full and comprehensive data attribution.

4.2 Storage requirements

4.2.1 IT platform

NHS is investing in new infrastructure on which to run its systems. The new Data Management system is required to be aligned with this strategy. The most important parts of this are the following:

- Architecture

The system components must be integrated in such a way that there are few dependencies between the components. This is a *service-oriented architecture* and guarantees the various units of functionality, independent of vendors, programming language and technologies.

- Hardware/System

- Virtualization. NHS uses VMware for its virtualized environment. It allows for greater flexibility when allocating resources to systems and applications more suited to the usage pattern etc.
- Development activity will make use of our internal development platform – *Statens Kartverks Infrastructure Platform (SKIP)*.
 - Kubernetes-based platform (VMWare Tanzu)
 - Integrated tooling through Gitlab (or equivalent) for source code control, delivery pipelines and other features.
 - Good practices for continuous integration and continuous delivery will be preferred.
- Machine learning, data analysis and other hydrographic data exploration calls for dedicated hardware-enabled High Performance Computing systems. NHS will make available hardware accelerated computing, based on the VMware Bitfusion system (Linux only)

- Software

To keep license cost at a minimum, NHS encourages use of open source software where available. Also, NHS wants to reduce the variety of database systems and development platforms. This document specifies a few of the preferred systems, although alternative solutions is also considered possible.

4.2.2 Data size, data complexity, performance

The combination of data volume and complex computing tasks like machine learning and data analytics will require a storage design to store safely and read quickly to feed the various processes. To make sure the system is scalable and flexible enough for growing alongside new user requirements, a few points about data handling at storage level must be detailed out. These are the *technical* storage requirements outlined in the **Appendix 2 – Customer requirements.xlsx**.

5 Data Management system - modules

The new data management system is expected to have a modular architecture, allowing it to be scaled dynamically, to enrich system capabilities, to fully support data management, storage and retrieval and provide a comprehensive metadata management.

NAUTILUS

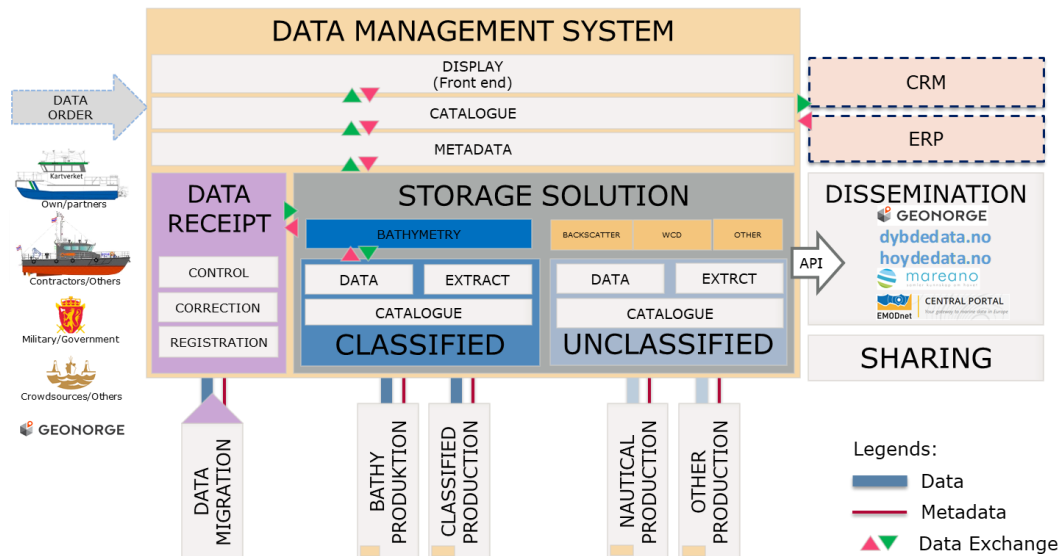


Figure 7 – The full NAUTILUS System – System Modules and submodules

This tender define a required support of bathymetric data and a comprehensive and integrated metadata management.

NHS believes that managing data effectively require control of good and exhaustive metadata for all the data being managed. Metadata management is defined within the requirements for this tender and it is expected that this is part of the systems core functionalities. Further descriptions are found within this document and as part of the requirement document, **Appendix 2**.

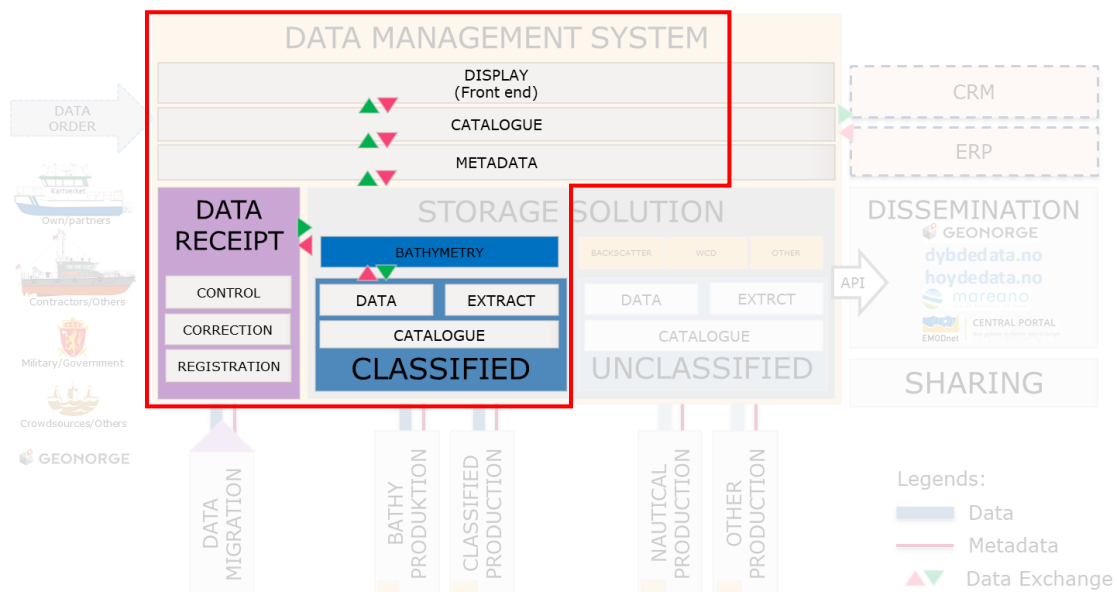


Figure 8 - Illustration of current scope – the new Data Management system

It is expected that the new data management system are extendable with new modules and features, allowing the system to grow by adding automation processes, process enhancements, interfaces, advanced processing features, fail/safe handling end more.

Further details to the different modules, covered by the scope of this tender, are given below.

5.1 Data receipt

Data receipt are the module for handling receipt and registration of all/any data that will be entered into system. This may be a manual receipt process or an integral and automatic processes.

Main features covered by the Data receipt would be:

- Data (receipt) management
 - o Metadata structure/template creation, maintenance and management
 - o Process control template(s)
 - o QC control template(s)
- Control
 - o Validation of received data
 - o QC processes
 - o QC report generation
- Correction
 - o Data, metadata or affiliated data sources are (automatically) corrected where/when possible
(This does not refer to data cleaning, modelling or other processing of the actual data)
 - o Rule based, allowing automatic processing and data/metadata enhancement
- Registration
 - o Storage of data



Figure 9 - Data receipt

Data receipt module should be providing, or allow support of, automatic processes and ensure different validation steps ensuring a minimum level of quality to the data and to the metadata. The process is expected to be controlled by tunable procedural steps which are defined globally and detailed for specific data formats/product specifications.

Metadata management and procedural control are core elements to this system part, ensuring that proper quality is controlled and meet, procedures are established, maintained and executed, possible automation and machine learning features are available, or min. supported by the solution. Specific metadata templates, incl. control of mandatory metadata tags/fields, are important feature to data receipt and processes by the system in general. Metadata are being used for validation of data content, setting quality and other quantifying attributes, process control and presenting details and metadata content to the users of the system.

The new Management system must support a standardized, common and rich metadata module, allowing management of the data that NHS manage.

5.1.1 Control

The “Control” phase is defined as a receipt control process, where data package content, data content, metadata content etc. are verified against predefined templates.

Metadata and procedural control are steering elements within this first receipt validation process. Received data are controlled against established metadata structure and content and the procedural methods are chosen based on predefined steps. Different procedural and success criteria's may exist for different datatypes and potentially also for same data types.

If any datasets are missing, data is corrupt etc. the process is expected to alert the user of any deficiencies detected, propose or perform corrective actions (where possible) and report to log. In other words, the control process is ensuring that any data planned for the system is meeting a minimum set of qualifiers.

5.1.2 Correction

The “Correction” process of Data Receipt is defined as a module/process for data enhancement and/or corrective actions, here inclusive of data package itself, the source data and its metadata. This will ensure, at least, that the minimum (defined) quality for the data package and content are met prior to registration and storage to the system.

This process must allow the operator to correct deficiencies and ensure the proper data quality prior to registration and storage. Automation and machine learning features are expected to be established as part of this process. E.g. where no metadata are available for the source data the process should, receipt/registration, allow creation of and guiding the user through metadata building processes. This process would be expected to follow a minimum metadata specification defined for the specific datatype being registered and stored.

5.1.3 Registration

Registration process is the last step of the data receipt process.

Data are only sent for registration and storage upon successful completion of earlier validation steps.

It is expected that the registration process do facilitate a final validation check, ensuring compliance before storage.

5.1.4 Data migration (bathymetric data)

Data migration will be a large and an important data contributor to the new system.

Data migration are being defined to follow a firm and fixed approach. Bathymetric data are planned entered into the system through the regular Data receipt process.

The migration process also includes and define a “metadata only” approach. This is where e.g. the source data is too old, or the quality is too low so that the actual source data is excluded for registration and storage to the system. In cases like this, proper metadata are being created, with sufficient references to the source data and the metadata is then registered in the system.

The data migration process and work are NOT part of this tender.

The solution described within this tender must be capable of receiving the migrated data and metadata.

A simplified data migration process, incl. metadata establishment, can be:

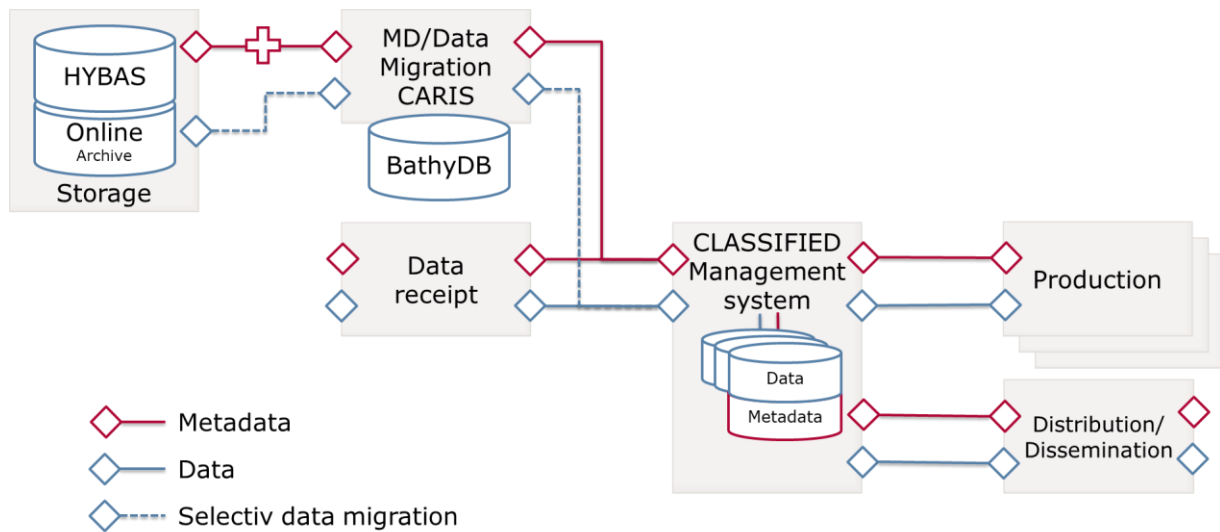


Figure 10 - Process flow - planned data migration process – Bathymetric data

Once the migrated data have been entered into the system, the data are expected to be supported and managed in the same manner as for any other data within the system.

5.2 Storage solution

The storage module is expected to support storage and management of all data, products and associated metadata being owned/managed or administered by NHS, however only bathymetric data and metadata is defined as mandatory features within this tender.

The Storage solution module of the system, because of NHS's classified setup, data requirements and/or other requirements, may be a distributed solution. We ask the supplier to present and propose his/her best possible solution to facilitate and meet defined requirements.

The storage solution module, covered within this tender, is expected to, effectively and in a controlled manner, allow support for:

- Metadata controlled process
- Datatype define storage type and location
- Storage solution(s) is (are) native to the system
- Metadata are stored and managed
- Defined data types
- Support data classification requirements
- Full geospatial support, incl. hor./ver. reference frames, datums etc.
- Processes defined for
 - Input (Data receipt →)
 - Output (→ Extract)

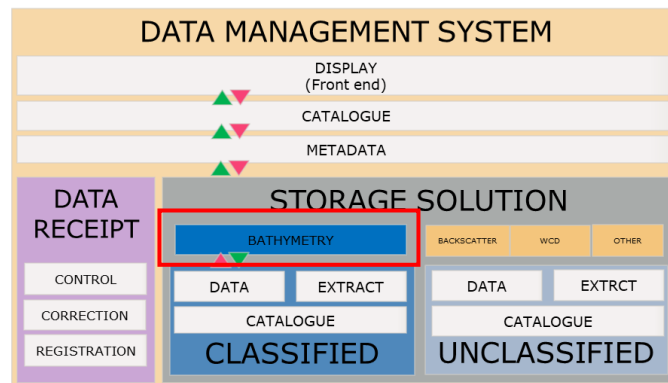


Figure 11 - Storage solution - Management system

5.2.1 Data – Bathymetry

Within this tender full support for bathymetric data is defined and expected.

This means that bathymetric data, new, old and migrated must be supported for registration and storage within the system. Geospatial and metadata support will allow any user to correctly view all data records and with present data information.

Please refer to Data format list which define NHS's expectations to mandatory and optional data formats supported by the system, ref. **Appendix 1 - Annex 1 – NHS Data Formats**.

5.3 Storage - Classified.

Storage – Classified is defined as the storage management part of the system located within the classified network.

All NHS data will be registered and stored in the classified system, allowing effective processing of data and data products from the best available source.

Data on classified storage will not have any limitation to resolution, content, grid size or other. Metadata for classified data, on classified system, are expected to be comprehensive and complete, including also classified metadata tags where applicable.

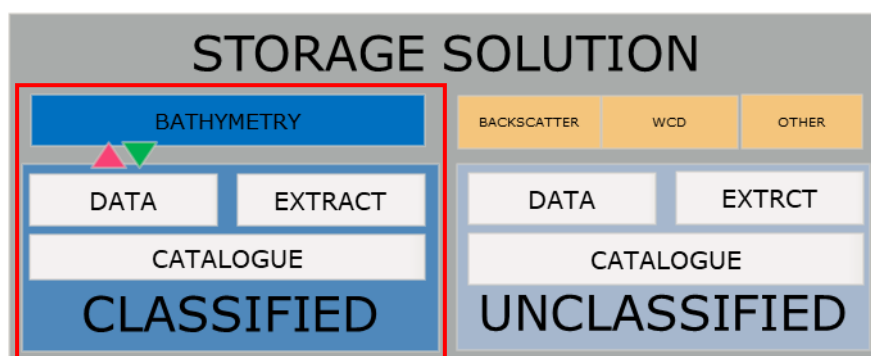


Figure 12 - Classified storage - Management system

The classified part of the system is believed to be the first stage of a multiple staged program, where user interface, functions and/or operations could be transferable to unclassified system.

No unclassified systems or systems part are included as part of this tender.

5.3.1 Metadata

Metadata on classified system and/or describing classified data, are expected to contain classified data descriptive segments, which shall be possible to remove on data extract.

These metadata tags will be defined within a specification, clearly identified, allowing automatic creation of a parallel unclassified metadata definition during an export data operation.

5.3.2 Import/storage on classified system

No immediate limitations to import and storage on classified system are defined at current point in time. As mentioned above changes to this may happen in the future.

5.3.3 Extract

Extract from classified system must be possible for all data managed by the system. The export process must allow the user to define extract purpose (classified or unclassified) whereas the process should prepare proper metadata accordingly, meaning removing all defined classified metadata tags if the extract is for unclassified use or purpose. This is expected to be an integral and automatic process.

5.4 Catalogue

The Catalogue part of the system is defined as the user entry level to the solution, allowing access to and full exploration of the systems content.

Catalogue will access, display and present all available system content.

Description below are provided to allow a better understanding:

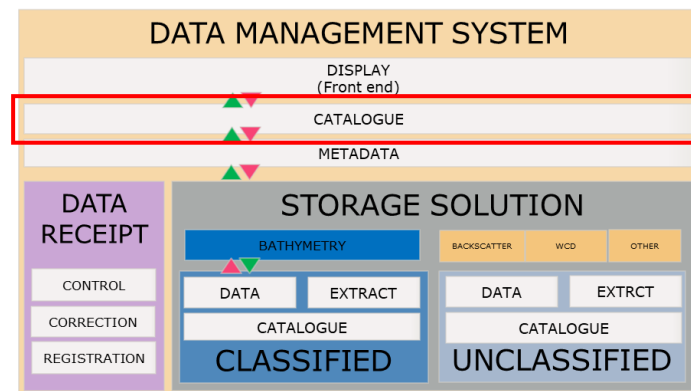


Figure 13 - Catalogue - Management system

Catalogue are understood as a geospatial based catalogue tool, allowing geospatial presentations, provision, listing and presentation of metadata contents, data & product types etc.

Catalogue must support querying on metadata records, data contents, spatial records and details etc., preferably using spatial queries (point, points, lines, areas etc.), filtering, statistical operations and other management descriptive data fields allowing tuning the content to be explored and/or viewed.

It is expected that the different operators would easily be able to distinguish between different data types, data product types, products, production history, versioning etc.

Catalogue is also believed to be supporting loading and displaying external data, in parallel and together with any internal data loaded, e.g. loading of external files etc.

5.5 Metadata

Metadata support is an essential and integral part of the system.

Metadata is expected to be controlling a number of the processes, allowing quality control, validation processes or others.

NHS emphasize that no data are allowed entered into the system, from either system parts, without the data meeting a minimum metadata standard/content. This is defined by the management part where different system processes validate and verify the metadata content, against its source, to ensure compliance. Where metadata are missing it is assumed that the system will guide the operator through the processes identifying the missing parts and allowing him/her to properly assign correct values to the missing metadata fields.

As the requirements defined, the metadata standards required supported by the system are, minimum, ISO 19115, ISO 19135 and ISO 19139¹.

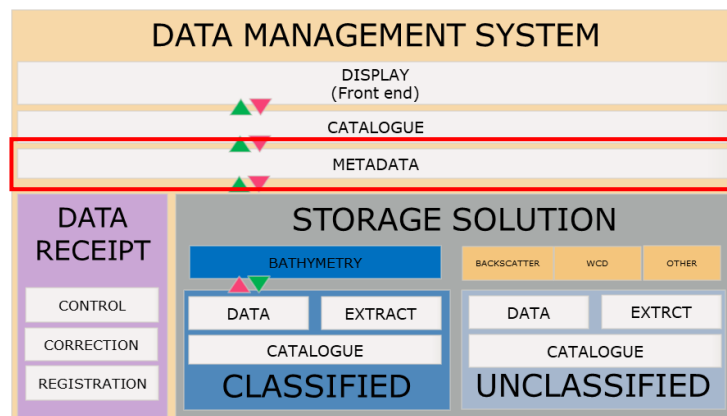


Figure 14 - Metadata - Management system

Metadata are believed to be a controlling feature of the system, allowing many features to operate faster, more controllable and efficient by utilizing metadata (over actual source data). More details are given within the technical requirements.

The supplier is emphasized to review and provide as comprehensive answers as possible to the metadata parts and the systems use of metadata. NHS believe to have defined requirements ensuring an efficient handling and use of metadata.

5.6 Display

The Display component is very much defined by the catalogue part of the system and being the “front end”.

“Display” requirements are found as part of “Catalogue” and “Metadata” section of the requirement collection.

Below descriptions are provided to further explain display related requirements.

¹ ISO 19139 may be supported through ISO 19115-3, Geographic information - Metadata - Part 3: XML schema implementation for fundamental concepts

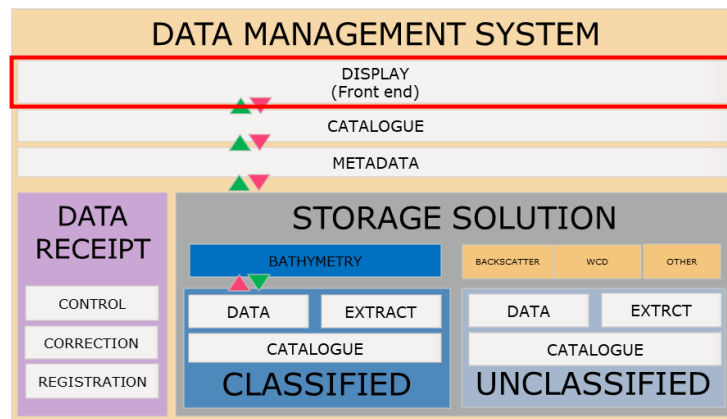


Figure 15 – Display (Front end) - Management system

Display are mainly identified to define Background layer handling, some geospatial requirements, and data ordering process.

Requirements for **Background layer** handling are defined to identify NHS's expectations to the proposed system for supporting loading and displaying of background data. With this NHS refer to the ability to load misc. data types and formats, simultaneously and in the background of data loaded from the system storage, here both data and metadata.

As the scope of this tender is for the classified system part, NHS have requested information as to possible or existing capabilities of loading misc. external data from different services. NHS emphasis that network limitations will prevent all external services.

Management of and storage of defined user layers are believe managed for individual users and as global settings.

For NHS it is imperative that the new system have a solid, rich and user friendly user interface for **geospatial presentation, representation and displaying** of data and metadata.

This is expected to be an interactive feature, where users can explore both data and descriptive information of the loaded data. Multiple geospatial references must be supported allowing loading of different source data in parallel. This will most likely imply that data transformations are carried out on-fly, while loading the data.

6 Solution Connections/Interfaces

The system is expected to be modular and component based, it must support a classified setup and data extracts from the system are expected to be as simple, secure and as effective as possible.

The supplier are asked to explain and describe how their different system components will communicate, interact and ensure an effective data transfer within the full system, including description of synchronization between classified and unclassified system parts.

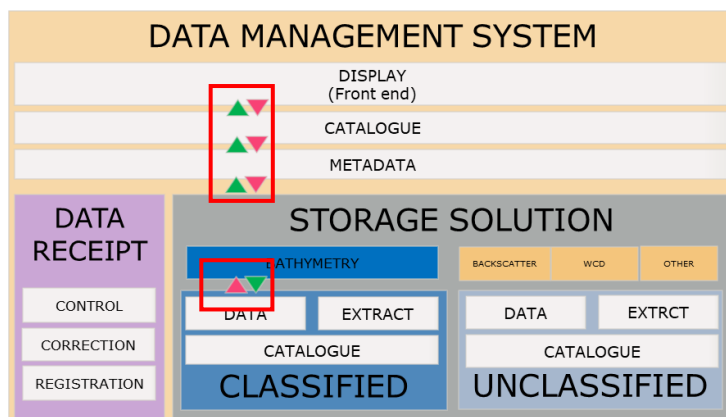


Figure 16 - Connections/Interfaces - Management system ²

NHS are expecting that most of the interfaces between different system components are invisible to and ignorant of the user, that system configurations and setup are an admin task and not a user task and that underlying system components are invisible to the user.

Settings and user controls should be managed preferably from a common interface, where the user would only need to manage its local settings. Global settings would be expected managed from a System Administrator role/function.

7 System & Technology Requirements

NHS are expecting a forward looking and modern setup, scalable both for content and usage, and with a flexible infrastructure allowing easy support for new data feeds and sharing services.

7.1 System requirements

7.1.1 Storage solution

Given the explanations above and requirements put forth in **Appendix 2**, it would be expected that a detailed description from the supplier how data are planned stored is given, as responses to the relevant requirements.

7.1.2 Machine Learning (ML) and Artificial Intelligence (AI)

The supplier are asked to explain and describe their support, plans and approach to ML and AI, through the system components, ref. requirement *I-ITR:126* in **Appendix 2** (*other requirements may also be relevant*).

It is requested that references are made to the different requirements where this is found relevant.

7.1.3 Required security statement of the supplier

The supplier, and all its subordinates, must confirm to Kartverkets regulations towards secure software development and system architecture, ref. **Appendix 1 Annex 4 - Sikker systemutvikling for eksterne konsulenter** and Security requirements for Suppliers, ref. **Appendix 1 Annex 3 - Bilag for sikkerhetskrav til leverandører**.

These documents are only available in Norwegian language, and Norwegian version must be signed for the successful tenderer.

² Connections/Interfaces on the schematic are only indicative and illustrative.