



D6.12



D6.12

Situation Assessment and Decision Support Configuration

Instrument	Collaborative Project
Call / Topic	H2020-SEC-2016-2017/H2020-SEC-2016-2017-1
Project Title	Multi-Hazard Cooperative Management Tool for Data Exchange, Response Planning and Scenario Building
Project Number	740689
Project Acronym	HEIMDALL
Project Start Date	01/05/2017
Project Duration	42 months
Contributing WP	WP 6
Dissemination Level	CO
Contractual Delivery Date	M39
Actual Delivery Date	31/07/2020
Editor	Monika Friedemann (DLR)
Contributors	Martin Mühlbauer, Fabian Henkel, Christian Böhnke (DLR)

Document History			
Version	Date	Modifications	Source
0.1	28/07/2020	First draft	DLR
0.2	29/07/2020	QA-reviewed version	CRI
1.0.D	01/08/2020	First Issue	DLR
1.0.F	03/08/2020	Approval for submission	DLR

Table of Contents

List of Figures.....	ii
List of Acronyms.....	
Executive Summary	2
1 Introduction	3
2 Overview of Configuration in WP6.....	4
3 Configuration Methods	6
4 Configuration.....	8
4.1 Impact Summary Service	8
4.1.1 Configuration of Input Data.....	10
4.1.2 AOI Configuration.....	11
4.1.3 Job Configuration	14
4.1.4 JSON and CSV Filters.....	17
4.2 Situation Report Generation Service	18
4.3 Decision Support Service	19
4.4 Scenario Matching Service.....	21
5 Conclusion	24
6 References.....	25

List of Figures

Figure 3-1: Configuration options at different steps of the service process workflow 7

List of Acronyms

AB	Advisory Board
AOI	Area of interest
CSV	Comma-separated values
DES	Decision Support Service
DLR	Deutsches Zentrum für Luft- und Raumfahrt e.V. (German Aerospace Center)
DSL	Domain-specific language
EDXL	Emergency Data Exchange Language
ELSI	Ethical, Legal and Social Issues
GOI	Geographical Object of Interest
ISAS	Impact Summary Service
JSON	JavaScript Object Notation
OGC	Open Geospatial Consortium
REST	Representational State Transfer
SITREP	Situation Report Generation Service
URI	Uniform Resource Identifier
WFS	Web Feature Service
WKT	Well-known text
YAML	YAML Ain't Markup Language

Intentionally blank

Executive Summary

This document gives first an overview on the applied customization and configuration of services and products developed in WP6 based on expert criteria and metrics elaborated in close interaction with WP3.

In the main part, the document provides configuration details for the Impact Summary Service (ISAS), Situation Report Generation Service (SITREP), Decision Support Service (DES) and Scenario Matching Service (SMAC) developed for the HEIMDALL project. This document is complementary to the Situation Assessment, Impact Summary Generation and sCOP/SITREP Specification and Implementation Report - Final detailed in D6.8 [3], the Decision Support Specification and Implementation Report - Final D6.11 [4] and the Scenario Specification, Scenario Management Specification and Scenario and Situation Metrics - Final described in D6.15 [5].

The focus of this document is on summarizing the technical specifics of configuration methods, used data resources and default settings.

1 Introduction

In order to reflect the internal diversity of end users the situation assessment and decision support services provide possibilities to customize criteria, rules and other definitions of process behaviour which are considered during the generation of situation assessment and decision support information. The customization possibilities have been elaborated and evaluated in close interaction with the end user partners. Experts in Ethical, Legal and Social Issues (ELSI) in the consortium have helped to identify requirements such as making the configuration visible in the results.

Customization forms a subject in the technical specification deliverables created in WP6. Therefore, this document is complementary to the Situation Assessment, Impact Summary Generation and sCOP/SITREP Specification and Implementation Report - Final detailed in D6.8 [3], the Decision Support Specification and Implementation Report - Final D6.11 [4] and the Scenario Specification, Scenario Management Specification and Scenario and Situation Metrics - Final described in D6.15 [5]. The focus of this document is on summarizing the technical specification of configuration methods, used data resources and default settings.

This document is structured as follows:

- Section 2 gives an overview of customization concepts elaborated in WP6
- Section 3 lists the different implemented methods for configuration
- Section 4 describes the specific configuration options for the Impact Summary Service (ISAS), Situation Report Generation Service (SITREP), Decision Support Service (DES) and Scenario Matching Service (SMAC)
- Section 5 concludes the document

2 Overview of Configuration in WP6

During the project lifetime co-design with the end user partners, Advisory Board (AB) members and ELSI experts has revealed the need for customization for most of the modules developed in WP6. Users shall always have the possibility to add and modify information, criteria and thresholds for situation assessment and decision support processes according to their individual knowledge, and their individual and organizational responsibility, needs and goals. The modules must reflect the internal diversity of end-users. The user is the one liable so all decisions and the underlying criteria and thresholds presented by the system must be visible to the user.

Based on these and module-specific requirements customization concepts have been elaborated and documented in the respective technical specification deliverables, namely D6.1 [1], D6.5 [2], D6.8 [3], D6.11 [4] and D6.15 [5].

Overall, customization needs include:

- Exposure (D6.1 and D6.5):
 - Exposed elements such as buildings, roads and other infrastructure need to be adaptable towards the specific end users priorities, e.g. significant infrastructure, vulnerable elements, priority action points, etc.
 - Exposed elements must be markable as potential sources for cascading effects and interacting hazards (e.g. landslide may cause a bridge to collapse which may cause a flash flooding)
 - Exposed elements need to be extendible and modifiable
- Impact assessment and summary (D6.5 and D6.8):
 - The assessed hazard type and exposure type needs to be customizable in order to allow for a distinct consideration
 - Thresholds need to be user-specific, e.g. catering for changes in policies
 - Areas of Interest (AOI)s need to be customizable in order to allow for a selective assessment of strategic areas, e.g. area around a flooded river
 - Geographical Objects of Interest (GOI)s to be considered for assessment need to be customizable
 - The list of affected GOIs needs to be sortable and filterable according to different user-specific attributes, e.g. the most populated buildings or shelter locations first
- Situation reporting (D6.8):
 - Situation reports need to have a common structure as well as provide extension mechanisms for scalable reports and community-specific information
 - End users must be able to select contents to be present in a situation report according to the emergency management resp. scenario phase, the receiver of the situation report and the information available, e.g. include selected what-if simulations
- Decision support (D6.11):
 - Areas, locations and points to be assessed as safe from the hazard event need to be customizable
 - Thresholds need to be configurable, e.g. the maximum hazard perimeter to be considered for the assessment
- Scenario management (D6.15):
 - Scenario parameters must be extendible towards organization-specific information, e.g.
 - Scenario parameters must be extendible towards hazard-specific information e.g. hazard behaviour, weather parameters

- Parameter value lists must be extendible towards organization-specific values, e.g. capabilities
- Response plans need to cater for organization-specific parts
- Representative snapshots of a scenario must be configurable
- Level of command terminology must be organization-specific
- Scenario matching (D6.15):
 - Filters must be definable, e.g. considered hazard type or scenario type, actual scenarios only or also training scenarios
 - Matching criteria must be selectable, e.g. include or omit scenario location to allow for a) area-specific matching or for b) matching of similar scenarios in other regions

3 Configuration Methods

Different methods to customize criteria, rules and other definitions of process behaviour have been identified. Table 3-1 list them. The table is repeated in the configuration specifications in section 4 with the methods provided by each module.

Table 3-1: Configuration methods

Method	Usage	Transparency	Format
Filtering	When a subset of the result shall be requested, e.g. list of affected buildings shall contain only critical infrastructures instead of all building types	No	URI query parameter
Request body	When custom elements to be assessed have to be provided to the services, e.g. specific list of vulnerable elements	Configuration is visible in the created job/result	Descriptive JSON
References in request body	When a specific HEIMDALL product has to be used, e.g. specific exposure data set providing buildings to be assessed	Configuration is visible in the created job/result	URI

The three configuration methods are used at different points in the process workflows of the situation assessment and decision support services as outlined in Figure 3-1. When needed, the request body contains references to the input products. In addition, resources can be specified in the request body of either the main job resource or in additional related data resources such as AOIs, vulnerable elements to be assessed and other configuration elements. Filtering is performed once products have been generated and stored. While configuration stored in data resources is persisted and visible in the respective data resource filters are valid only during the respective GET request. In contrast to job configurations before processing filtering does not modify the result.

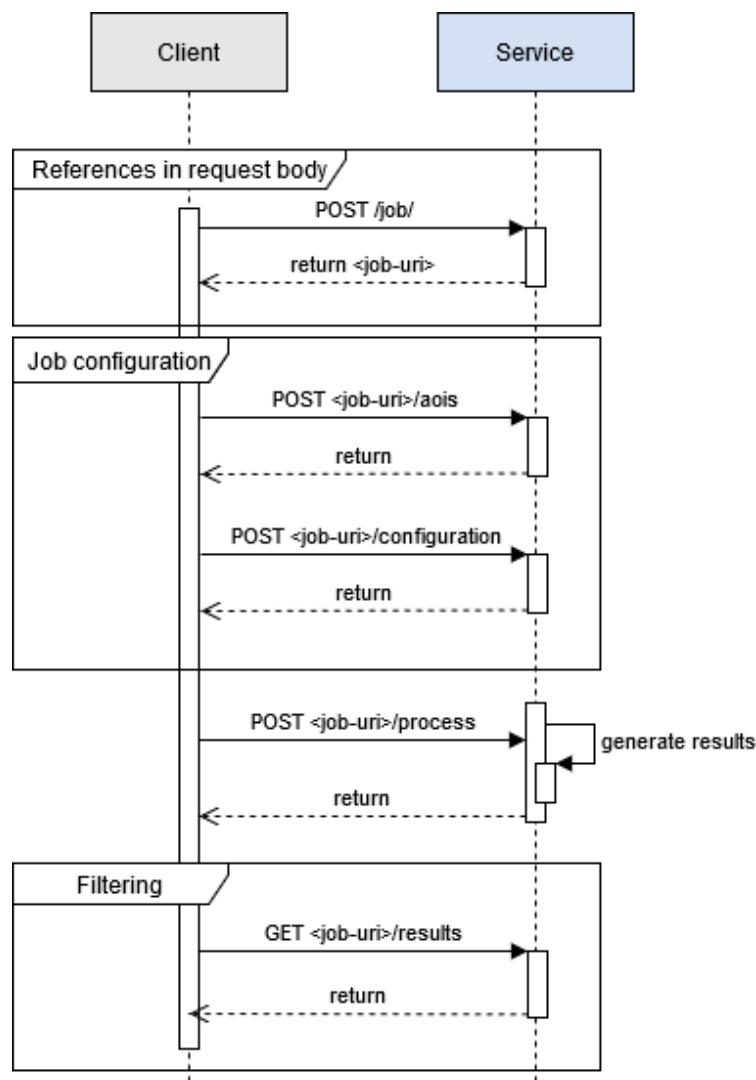


Figure 3-1: Configuration options at different steps of the service process workflow

4 Configuration

4.1 Impact Summary Service

Through a flexible RESTful configuration, clients can request an impact summary for both, exposed buildings and roads, and for all hazard types covered in HEIMDALL.

ISAS may be configured by means of query parameters, the request body and the referenced data (see Table 3-1). For most configuration options, using the server setup, sensible default values can be set.

Table 4-1: ISAS configuration methods

Method	Usage	Transparency	Format
Filtering	When result shall be filtered, e.g. list of affected buildings shall contain only critical infrastructures instead of all building types	No	URI query parameter
Request body	When custom elements to be assessed have to be provided to the services, e.g. specific list of vulnerable elements	Configuration is visible in the created job/result	Descriptive JSON
References in request body	When a specific HEIMDALL product has to be used, e.g. specific exposure data set providing buildings to be assessed	Configuration is visible in the created job/result	URI

In particular the following parameters can be configured:

- AOI (see section 4.1.2)
- To be used impact assessment result and exposure dataset (see section 4.1.1)
- Different configurations per impact assessment and exposure data models such as the considered hazard type and the exposed-element type (e.g. buildings) (see section 4.1.3)
- Different configurations per hazard type/exposed element type (due to different Impact Assessment outputs) such as specific parameters of impact assessment results to be analysed and hazard-behaviour thresholds used for the classification into hazard levels (e.g. threshold for hazard level “low” < 0.3m water level height) (see section 4.1.3)
- CSV filters for selecting types of GOIs at risk and GOI attributes to be exported in CSV format (see section 4.1.4)
- JSON Filters for selecting types of GOIs at risk returned by ISAS in JSON representation (see section 4.1.4)

The **default settings** will be applied if no configuration, either as job configuration resource or URI query parameters, is given. The settings must be set in the server settings by the administrator of the instance and must be specified in a valid YAML File. The file content may look like:

```
HAZARD_FIELD:  
    name: forcing_1  
    nodata: -9999  
    min: 0.3  
    medium: 0.9  
  
AFFECTED_FIELD:  
    name: indicator_1  
    threshold: 0.0  
  
ECONOMIC_LOSS:  
    name: indicator_80  
  
EXPOSURE_DATA:  
    join:  
        impact_assessment: heimdall_id  
        exposure_data: heimdall_id  
    population:  
        day: pop_day  
        night: pop_night  
        linear: pop_linear  
        fallback: pop_linear  
    function:  
        nodata: unspecified  
    buildings:  
        names:  
            - Level_4  
            - Level_3  
            - Level_2  
            - Level_1  
        nodata: unspecified  
    roads:  
        name: type  
        nodata: unclassified  
goi_type:  
    default: buildings
```

```
DEFAULT_CSV_FIELDS:
buildings:
  - the_geom
  - heimdall_id
  - function
  - physical_damage
  - pop_affected_day
  - pop_affected_night
  - pop_affected_linear
  - municipality
  - name
  - shelter
  - response
  - priority_action_point
  - potential_cascading_effect
roads:
  - the_geom
  - heimdall_id
  - function
  - physical_damage
  - name
  - potential_cascading_effect
```

Further, in the server settings, the default data model of the impact and exposure data is set. While the impact data model is customizable on a job basis, the exposure data model, the ID attribute and the default CVS filters are fixed per ISAS instance.

Most of the configuration is possible for each summary evaluation. It is split into the resources “job” and “job_configuration” (see D6.8 Configuration 5.2.4).

4.1.1 Configuration of Input Data

Input data for the impact summary generation is specified by reference in the job request body:

```
POST http://esb.heimdall.sp/services/isas/job
```

With header

```
Content-Type: application/vnd.api+json
```

With request body (example):

```
{
  "data": {
    }
```

```

    "type": "job",
        "id": "2b12a8c9-3d00-439d-bbb5-f09282229c48", //this is for
testing only (will fail if uuid is already in use)
        "attributes": {
"impact_assessment": "http://esb.heimdall.sp/services/rasorogc/ows?service=WFS&version=1.0.0&request=GetFeature&typeName=rasor:impact_636972303258305339&outputFormat=application/json",
            "exposure_data":
"http://esb.heimdall.sp/services/ogc/heimdall/ows?service=WFS&version=1.0.0
&request=GetFeature&typeName=heimdall:building_model_monesi&outputFormat=ap
plication/json"
        }
    }
}

```

The reference to the impact assessment data set is specified in the *attributes.impact_assessment* element whereas the exposure data set link is specified in the *attributes.exposure.data* element.

4.1.2 AOI Configuration

For every ISAS job the client can specify at least one AOI. These areas are used to pre-select the GOIs provided in the exposure dataset used in the impact summary generation process.

The following example shows how to configure one AOI:

```
POST /isas/job/2b12a8c9-3d00-439d-bbb5-f09282229c48/aois HTTP/1.1
Content-Type: application/vnd.api+json
Accept: application/vnd.api+json
```

With the body:

```
{
  "data": {
    "type": "aoi",
    "attributes": {
      "location": {
        "coordinates": [
          [
            [
              [
                2.818047687454907,
                42.430909216561446
              ],
              [
                [
                  2.8159791793928264,
                  42.38050627921706
                ]
              ]
            ]
          ]
        ]
      }
    }
  }
}
```

```
  ],
  [
    2.9107168486172554,
    42.37989508612668
  ],
  [
    2.909062042167591,
    42.42907709200111
  ],
  [
    2.818047687454907,
    42.430909216561446
  ]
],
],
"type": "Polygon"
}
}
}
}
```

The response could look like:

```
HTTP/1.1 201 Created
Location: http://esb.heimdall.sp/services/rest/isas/aois/2b12a8c9-3d00-
439d-bbb5-f09282229c48
Content-Type: application/vnd.api+json
```

With the body:

```
{
  "data": {
    "type": "aoi",
    "id": "d1e17e29-8ca8-49fd-b58b-06a14a8a83d8",
    "attributes": {
      "creationtime": "2020-02-27T12:46:19.461406Z",
      "location": {
        "type": "Polygon",
        "coordinates": [
          [
            [
              [
                2.818047687454907,
```

```
        42.430909216561446
    ],
    [
        2.8159791793928264,
        42.38050627921706
    ],
    [
        2.9107168486172554,
        42.37989508612668
    ],
    [
        2.909062042167591,
        42.42907709200111
    ],
    [
        2.818047687454907,
        42.430909216561446
    ]
]
],
}
},
"relationships": {
    "job": {
        "data": {
            "type": "job",
            "id": "2b12a8c9-3d00-439d-bbb5-f09282229c48"
        },
        "links": {
            "related": "http://esb.heimdall.sp/services/rest/isas/job/2b12a8c9-3d00-439d-bbb5-f09282229c48"
        }
    }
},
"links": {
    "self": "http://esb.heimdall.sp/services/rest/isas/aoi/d1e17e29-8ca8-49fd-b58b-06a14a8a83d8"
}
```

```

    }
}
```

4.1.3 Job Configuration

Following the concepts of REST we have identified a job configuration resource added to an ISAS job request to be the most flexible for HEIMDALL. This design allows for improved (a) applying of many configuration options, (b) customizing ISAS behaviour according to user needs and goals, (c) for transparency of configurations, (d) for an association of configurations to the respective jobs and results and thus (e) for history management of configurations. It's up to the client to specify a job configuration according to specific needs. However, it makes sense to define a couple of useful configuration options for a wide range of users. These options have been incrementally developed and evaluated in collaboration with the end user partners. The following configuration options have been identified:

- Different configurations depending on the impact assessment data model
- Pre-selection of conditions for the ISA generation process such as pre-selection of to-be-examined GOIs according to the exposure data model e.g. roads, buildings
- Different hazard-behaviour thresholds per hazard type (due to different impact assessment outputs) to be applied at GOI level used for the classification into hazard levels; this configuration is handled in the final release by the Service Platform (SP) acting as ISAS client

As an example, the following configuration resource could be used for the assessment of GOIs at risk:

```
POST      http://esb.heimdall.sp/services/isas/job/2b12a8c9-3d00-439d-bbb5-f09282229c48/configuration
```

With request body (example):

```
{
  "data": {
    "type": "job_configuration",
    "attributes": {
      "affected_field_name": "indicator_1",
      "affected_threshold": 0.0,
      "hazard_field_name": "forcing_29",
      "hazard_max_threshold": 3.0,
      "hazard_medium_threshold": 2.0,
      "hazard_min_threshold": 1.0,
      "hazard_nodata_value": -9999.0,
      "economic_damage_field_name": "indicator_80",
      "goi_type": "<buildings | roads>"
    }
  }
}
```

```
}
```

When requesting an impact summary from the ISAS module the client must configure the job according to the hazard type and the exposure type (buildings or roads) of the active scenario.

4.1.3.1 Configuration for Hazard Type Forest Fire

Job configuration for hazard type **forest** fire/exposure type buildings:

```
{
  "data": {
    "type": "job_configuration",
    "attributes": {
      "affected_field_name": "indicator_1",
      "affected_threshold": 0.0,
      "hazard_field_name": "forcing_30",
      "hazard_medium_threshold": 85,
      "hazard_min_threshold": 2.5,
      "hazard_nodata_value": -9999.0,
      "economic_damage_field_name": "indicator_80",
      "goi_type": "buildings"
    }
  }
}
```

Job configuration for hazard type **forest** fire/exposure type **roads**:

```
{
  "data": {
    "type": "job_configuration",
    "attributes": {
      "affected_field_name": "indicator_97",
      "affected_threshold": 0.0,
      "hazard_field_name": "forcing_30",
      "hazard_medium_threshold": 85,
      "hazard_min_threshold": 2.5,
      "hazard_nodata_value": -9999.0,
      "goi_type": "roads"
    }
  }
}
```

```
}
```

4.1.3.2 Configuration for Hazard Type Flood¶

Job configuration for hazard type **flood**/exposure type **buildings**:

```
{
  "data": {
    "type": "job_configuration",
    "attributes": {
      "affected_field_name": "indicator_1",
      "affected_threshold": 0.0,
      "hazard_field_name": "forcing_1",
      "hazard_medium_threshold": 0.9,
      "hazard_min_threshold": 0.3,
      "hazard_nodata_value": -9999.0,
      "economic_damange_field_name": "indicator_80",
      "goi_type": "buildings"
    }
  }
}
```

Job configuration for hazard type **flood**/exposure type **roads**:

```
{
  "data": {
    "type": "job_configuration",
    "attributes": {
      "affected_field_name": "indicator_97",
      "affected_threshold": 0.0,
      "hazard_field_name": "forcing_1",
      "hazard_medium_threshold": 0.9,
      "hazard_min_threshold": 0.3,
      "hazard_nodata_value": -9999.0,
      "goi_type": "roads"
    }
  }
}
```

4.1.3.3 Configuration for Hazard Type Landslide¶

Job configuration for hazard type **landslide**/exposure type **buildings**:

```
{
  "data": {
    "type": "job_configuration",
    "attributes": {
      "affected_field_name": "indicator_1",
      "affected_threshold": 0.0,
      "hazard_field_name": "forcing_29",
      "hazard_max_threshold": 3.0,
      "hazard_medium_threshold": 2.0,
      "hazard_min_threshold": 1.0,
      "hazard_nodata_value": -9999.0,
      "economic_damage_field_name": "indicator_80",
      "goi_type": "buildings"
    }
  }
}
```

Job configuration for hazard type **landslide**/exposure type **roads**:

```
{
  "data": {
    "type": "job_configuration",
    "attributes": {
      "affected_field_name": "indicator_97",
      "affected_threshold": 0.0,
      "hazard_field_name": "forcing_1",
      "hazard_medium_threshold": 0.9,
      "hazard_min_threshold": 0.3,
      "hazard_nodata_value": -9999.0,
      "goi_type": "roads"
    }
  }
}
```

4.1.4 JSON and CSV Filters

The list of affected GOIs can be filtered using a domain-specific language (DSL) developed by DLR [6]. This package provides a DSL for filtering and sorting the views provided using Django REST framework by GET parameters. All attributes besides 'location' can be used in the query. In addition to filtering and sorting capabilities the user can specify the field names to be included in the CVS export. A sample query may look like:

```
filter=priority_action_point =
'vuln'&field_name=heimdall_id&field_name=function&field_name=name
```

The GOI's location can be exported by means of the field name "the_geom". Using this field name will include the geometry of each GOI as OGC Well-known text (WKT).

4.2 Situation Report Generation Service

SITREP receives its configuration in the request body as described in Table 4-2. It is implemented in a way that does not require any mandatory values in the JSON that is posted to its interface. Only the JSON structure is predefined (corresponds to the data structure of a scenario snapshot). This way, the values included or not included into the JSON depend on the request of the client. A value that is set in the JSON will automatically be mapped to its equivalent in EDXL. However, values that are not set in the JSON will be skipped during the process of the generation of the EDXL. This simple approach allows for maximum flexibility on the client side.

Table 4-2: SITREP configuration methods

Method	Usage	Transparency	Format
Request body	The client decides on the values that are set in the request body. These values will automatically be mapped to its equivalent in EDXL. However, values that are not set in the JSON will be skipped during the process of the generation of the EDXL	Configuration is not visible in a specific data resource. In contrast, selected values are visible in the counterpart elements of the generated EDXL	Descriptive JSON mapped to XML

Accordingly, the client is able to specify exactly the parts of a scenario including associated information that shall be mapped to EDXL. Associated information includes:

- Simulation results reference
- Simulation image reference
- Impact assessment for buildings image reference
- List of affected buildings (ISAS data resource) reference
- List of affected roads (ISAS data resource) reference
- Impact summary results reference
- Total number of affected people (as specified in ISAS results, yet customizable)
- A list of what-if simulations each being composed of all of the above elements

The JSON data structure in the request body looks as follows:

```
{
  "scenario": {...},
  "simulation": {
    "sim_results_uri": "...",
    "sim_image_uri": "...",
    "impactbuildings_image_uri": "...",
    "impactroads_image_uri": "...",
    "isas_affectedbuildings_json": {
```

```

    "resource_uri": "..."

},
"isas_affectedroads_json": {
    "resource_uri": "..."

},
"isas_results_uri": "...",
"isas_popaffected_total": 0

},
"whatifsimulations": [
{
    "sim_results_uri": "...",
    "sim_image_uri": "...",
    "impactbuildings_image_uri": "...",
    "impactroads_image_uri": "...",
    "isas_affectedbuildings_json": {
        "resource_uri": "..."

    },
    "isas_affectedroads_json": {
        "resource_uri": "..."

    },
    "isas_results_uri": "...",
    "isas_popaffected_total": 0
}
]
}
}

```

4.3 Decision Support Service

The DES API offers the possibility to pre-filter the desired information by explicitly selecting the AOI and GOIs in the GUI. The configuration methods provided by the DES are shown in Table 4-3.

Table 4-3: DES configuration methods

Method	Usage	Transparency	Format
Request body	The client decides on the values that are set in the request body. The client is able to pre-define an AOI and GOIs. GOIs will be assessed as “safe until” or “not safe” depending on the perimeter of the incident at that time. In addition client is able to customize the threshold	Configuration is partly visible in the parameters to be set. The configuration of assessed GOIs is visible in the created results.	Descriptive JSON

	for the maximum ETA to be considered.		
References in request body	Applies to “safe roads” functionality; When a specific HEIMDALL product has to be used, e.g. specific exposure data set providing roads to be assessed as safe or not	The URLs of the datasets to be assessed are not visible in the final result.	URI

In particular, the following parameters can be configured:

- Safe areas
 - Pre-selected GOIs to be assessed
 - Hazard simulation perimeters
- Safe roads
 - AOI, specified as bounding box, to spatially filter the WFS reference of the exposure dataset as well as the impact assessment results

In addition, the `safe_areas` sub module contains a “`max_eta`” (maximum time of arrival), which is set to a value of 100,000 by default and cannot be configured externally.

The JSON structure of the request body for the `safe_areas` sub module is defined as follows:

```
{
  "type": "FeatureCollection",
  "features": [
    "area": [
      {
        "type": "Feature",
        "properties": {
          "heimdall_id": "...",
          "area_type": "..."
        },
        "geometry": {
          "type": "MultiPolygon",
          "coordinates": ...
        }
      }
    ],
    "per": [
      {
        "type": "Feature",
        "properties": {
          "heimdall_id": "...",
          "perimeter": ...,
          "area_type": "..."
        }
      }
    ]
  ]
}
```

```

        },
        "geometry": {
            "type": "MultiPolygon",
            "coordinates": ...
        }
    ]
}
}
```

The JSON structure of the request body for the safe_roads sub module is defined as follows:

```
{
    "aoi": {
        "type": "Polygon",
        "coordinates": ...
    },
    "impact_assessment":
    "http://esb2.heimdall.sp/services/rest/simulations/<impact assessment>",
    "exposure_data":
    "http://esb.heimdall.sp/services/ogc/heimdall/<WFS exposure layer> "
}
```

4.4 Scenario Matching Service

By evaluating different types of criteria and using information derived from the comparison of historic or simulated data with the current situation (specified by the user based on alerts and observations), the uncertainty in the situation can be reduced drastically.

The SMAC performs a ranking of scenarios based on the mutual similarity. Distance measures are applied to individual scenario parameters used for matching, the so-called matching criteria. Suitable matching criteria have been identified and formalized by the end user partners, practitioners in the AB and ELSI experts involved in the project.

Implemented matching criteria are as follows:

- Weather conditions and synoptic situation
- Landscape area
- Incident location (i.e. spatial matching)
- Hazard type and sub-hazard type
- Scenario status and urgency (e.g. actual vs. fictional, immediate vs. historic),
- Stressed capabilities (e.g. incident command organization, information management, community involvement, etc.)
- Challenge
- Hazard behaviour criteria:
 - Flame length

- Fire propagation velocity
- Distance to secondary focus

For every criterion a mismatch is computed which represents the distance of a given value to a scenario parameter value in such a way, that the scenario parameter value corresponds exactly to the compared situation when the distance is zero. For example, the spatial mismatch is calculated by applying the geodesic distance computation to the centroids of the flood location geometries [7]. The mismatch of stressed capabilities in the compared situations is computed using the Jaccard similarity [8]. The metric measures the similarity between finite sample sets.

The individual mismatches are combined using the Simple Additive Weighting approach [9][10][11]. The matching can be influenced by adding weights to each criterion. Matching criteria and metrics need to be (re-)evaluated in consecutive tests with the end users while the scenario database gets more and more populated with historic and new scenarios. Therefore, the combination of recording and matching scenarios including lessons learnt from prior incidents can improve the ability of stakeholders to learn and evolve from complex situations and thereby allow them to respond more effectively and operate more efficiently during disasters.

SMAC may be configured by the methods presented in Table 4-4.

Table 4-4: SMAC configuration methods

Method	Usage	Transparency	Format
Request body	Configuration of filters and matching criteria weights before scenario matching is started	Configuration is visible in the created job/result	Descriptive JSON

SMAC assumes default weights for the developed criteria. In the POST request body the default weights can be replaced with the user's selection.

The weights can be an arbitrary number. As a current convention the value [0..9] can be used. If the user sets a weight to 0, this criterion will be ignored.

Criteria with an omitted weight will not get processed.

If a filter is specified the alternatives are filtered prior to the rank calculation. Filtering is done on a per-property basis. The name of the property is used to fetch the field from the alternative scenario. If any of given list item matches the category, the name or the value of the scenario field the filter evaluates true. All properties in the filter must evaluate true for a scenario to pass the filter, e.g.:

```
"filter": {
    "hazardcategory": [1, 2],
    "status": [1]
}
```

Using this filter, only alternatives where the "hazardcategory" is "Forest fire" or "Flood" and "status" is "Actual" will be evaluated true. The JSON structure could look like:

```
{
    "current_scenario_url": "/services/sm/scenariomatchingquery/{id}/",
```

```

"alternatives":"http://esb2.heimdall.sp/services/sm/scenariomatchingquery/"
,
  "as_landscape": false,
  "limit": 10,
  "weights": {
    "location": 1,
    "accrainfall24h": 1,
    "rainfallintensity": 1,
    "winddirection": 1,
    "windspeed": 1,
    "flamelength": 1,
    "propagationvelocity": 1,
    "distancetosecondaryfocus": 1,
    "capabilities": 1
  },
  "filter": {
    "hazardtype": [1, .., 19],
    "hazardcategory": [1, .., 3],
    "status": [1, .., 3],
    "urgency": [1, .., 5],
    "synopticsituation": [1, .., 7],
    "firertype": [1, .., 10],
    "firepropagationtype": [1, .., 7]
  }
}

```

Default values like weights and limit can be set on an instance basis using a settings file. The settings must be set in the server settings by the instance's administrator and must be specified in a valid YAML File. The file content may look like:

```

DEFAULT_LIMIT: 10

DEFAULT_WEIGHTS:
  location: 1

ALTERNATIVES_URL:
  http://esb2.heimdall.sp/services/sm/scenariomatchingquery/

```

5 Conclusion

In the present deliverable, elaborated requirements for customization and configuration of services and products developed in WP6 have been presented. Configuration methods, used data resources and default settings for ISAS, SITREP, DES and SMAC have been described. A detailed introduction to customization concepts can be found in the technical specification deliverables of the modules.

6 References

- [1] Knopp, C. (2018), HEIMDALL D6.1: Concept design for risk analysis methods and components – Detailed concept design and documentation of methods on risk analysis
- [2] Mendes, M. (2020), HEIMDALL D6.5: Technical Specifications on Hazard, Scale and User-Specific Risk Assessment Information, Products and Service Workflows - Final
- [3] Friedemann, M. (2020), HEIMDALL D6.8: Situation Assessment, Impact Summary Generation and sCOP/SITREP Specification and Implementation Report – Final
- [4] Friedemann, M. (2020), HEIMDALL D6.11: Decision Support Specification and Implementation Report - Final
- [5] Friedemann, M. (2020), HEIMDALL D6.15: Scenario Specification, Scenario Management Specification and Scenario and Situation Metrics – Final
- [6] Mandery, N. (2019). A filtering and sorting DSL for the Django REST framework. Available at: https://github.com/dlr-eoc/rest_framework_filterdsl [last accessed: July 2020]
- [7] Karney, C.F.F. (2013). Algorithms for geodesics. Journal of Geodesy 87, pp. 43-55, doi:10.1007/s00190-012-0578-z.
- [8] Han, J., M. Kamber and J. Pei (2006). Data Mining: Concepts and Techniques. Elsevier Science & Technology, Burlington, United States.
- [9] Behrens, J., A. Androsov, A.Y. Babeyko, S. Harig, F. Klaschka and L. Mentrup (2010). A new multi-sensor approach to simulation assisted tsunami early warning. Natural Hazards and Earth System Sciences 10, pp. 1085-1100, doi:10.5194/nhess-10-1085-2010.
- [10] De Brito, M.M. and M. Evers (2016). Multi-criteria decision-making for flood risk management: a survey of the current state of the art. Natural Hazards and Earth System Sciences, 16(4), pp. 1019-1033.
- [11] Goodridge, W.S. (2016). Sensitivity analysis using simple additive weighting method. International Journal of Intelligent Systems and Applications, 8(5), 27.

End of document