Search & Rescue

Emerging technologies for the Early location of Entrapped victims under Collapsed Structures & Advanced Wearables for risk assessment and First Responders Safety in SAR operations

D4.11 Development of SOT DSS components, V2

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Executive Summary

The current document demonstrates the second version of the Technical implementation of SOT DSS. More specifically, it reports the additions in each Service that have been implemented, the process of the back-end requests for the necessary data, the back-end responses of SOT DSS, and the SOT DSS responses in COncORDE's SOT DSS screen. Additionally, the present document shows the Use Cases that the DSS will be tested and which Services per Use Case. Moreover, the SOT DSS dependencies of data from the other components and actors are presented.

The document is structured as follows:

- **Section 1** presents the scope of SOT DSS (Technical level) and the related Deliverables.
- **Section 2** shows the additions in each Service, the back-end and front-end process.
- Finally, **Section 3** describes the Use Cases in which the SOT DSS and its Services will be tested and the dependencies in order for SOT DSS to work properly.

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List of Abbreviations

Abbreviation	Explanation
API	Application Programming Interface
bp	Blood Pressure
D	Deliverable
DSS	Decision Support System
EMS	Emergency Medical Services
EU	European Union
fr	First Responder
hr	Heart rate
HTTP	Hypertext Transfer Protocol
JSON	JavaScript Object Notation
KT	Konnektable
lat	Latitude
lng	longitude
O	Oxygen
rr	Respiration rate
SA	Situation Awareness
SOT	Strategic Operational and Tactical
SnR	Search and Rescue
temp	Temperature
UC	Use Case
UTA	UTilités Additives
WP	Work Package

1 Introduction

1.1 Scope of the SOT DSS in the SnR (Technical Level)

SOT DSS wiil provide recommendations on Strategic, Operational, Tactical level. These recommendations concern the:

- Service 1 – Allocation of available EMS units to incidents, depending on estimated needs
- Service 2 - Allocation of patients to transport vehicles and first receivers (hospitals), based on given order of evacuation and triage results for present injuries
- Service 3 - Allocation of tasks to available actors on the field, given demand pre-defined by the field commander
- Service 4 - Estimation of expected casualties and demanded resources (EMS units), given historical data on emergency incident recordings

SOT DSS receives dummy incidents as input, from the COncORDE Platform, in order to provide results (recommendations) on the end-users. For this reason, D4.11:

- Analyses the given input from the data providers (COncORDE, Google API, PAGER API)
- Demonstrates the technical analysis from the DSS perspective
- Demonstrates SOT DSS responses
- Demonstrates SOT DSS output on the COncORDE Platform

Furthermore, the dummy incidents have been inspired by UC1 - Victims trapped under rubbles (Italy) and UC5 - Victims trapped under rubbles (France), where the SOT DSS will provide its services.

As a result, this document aims to highlight every technical aspect of the DSS itself, as well as its depended components/platforms.

1.2 Relationship with other Documents

The current deliverable is the second version of the document addressing the development of the SOT DSS components. The document provides the technical aspects of SOT DSS and the dependencies from the other SnR technologies, therefore is linked to the following deliverables:

- D3.1 Requirements to knowledge management and SA Model
- D3.7 Requirements to knowledge management and SA Model, V2
- D4.1 Data aggregation
- D4.2 Situational Analysis & Impact Assessment
- D4.3 Design of SOT DSS components
- D4.4 Design of PHYSIO DSS component
- D4.5 Development of SOT DSS component
- D4.8 Data aggregation, V2
- D4.10 Design of PHYSIO DSS component, V2
- D4.11 Development of SOT DSS component, V2
- D4.12 Development of PHYSIO DSS component, V2
- D6.6 Report on legacy systems and their connection to the S&R related technical characteristics

- D6.9 Report on legacy systems and their connection to the S&R related technical characteristics, V2

- D7.2 Architecture and Design Specifications of S&R platform

- D7.3 Component interface specifications for interoperability within S&R

- D7.4 Adapted S&R components and services

- D8.2 S&R Use Case 1: Victims trapped under rubble (Italy) - Pilot plan

- D8.8 S&R Use Case 7: Chemical substances spill (Spain) - Pilot plan

2 SOT DSS Services

2.1 Testing Use Cases in COncORDE

In order to test the SOT DSS Services, KT has made two Use Case instances (two separate incidents). More specifically, "dummy" input has been given to the COncORDE Platform, to feed the system with organisations, users, and two different incidents. Furthermore, before the creation of the two incidents the detected patients, organisations, and users were registered to the system. The following figures give to the system information about:

- The Organisations
- The Users
- The occurring incidents
- The patients of the incidents

More specifically, the two testing Use Cases produced the following information to the COncORDE Platform:

- The following data contain the *Registered Organisations* Details:

```
{
  "data": [
    {
      "organizationId": "1b00016b-46f1-44da-8da5-611feab54551",
      "organizationType": "EMS_STATION",
      "createdDate": "2021-11-15",
      "lastModifiedDate": "2021-11-15T11:20:14.571413Z",
      "name": "Poggioreale EMS",
      "telephoneNumber": "+000012233545",
      "lat": "37.7908822",
      "lng": "13.0206778",
      "location": "Poggioreale",
      "fleetSize": 30,
      "fleetTypeAVehicles": 10,
      "fleetTypeBVehicles": 20,
      "totalNumberOfParamedics": 25,
      "expertise": "ADVANCED_LIFE_SUPPORT"
    },
    {
      "organizationId": "245e4484-9748-4029-b7a2-a9cf90e5e7d2",
      "organizationType": "EMS_STATION",
      "createdDate": "2021-10-11",
      "lastModifiedDate": "2022-01-05T12:46:23.643753Z",
      "name": "Poggioreale EMS II",
      "telephoneNumber": "+000012233545",
      "lat": "37.7908",
      "lng": "13.02078",
      "location": "Poggioreale",
      "fleetSize": 15,
```

```
        "fleetTypeAVehicles": 10,
        "fleetTypeBVehicles": 5,
        "totalNumberOfParamedics": 25,
        "expertise": "ADVANCED_LIFE_SUPPORT"
    },
    {
        "organizationId": "d7582b25-dda6-40f1-a0c5-4efc4c57a64f",
        "organizationType": "EMS_STATION",
        "createdDate": "2022-01-05",
        "lastModifiedDate": "2022-01-05T13:06:09.687220Z",
        "name": "Centre Incendie,Secours Renforcé",
        "telephoneNumber": "+000012233545",
        "lat": "46.2378396",
        "lng": "1.4837828",
        "location": "La Souterraine,France",
        "fleetSize": 20,
        "fleetTypeAVehicles": 13,
        "fleetTypeBVehicles": 7,
        "totalNumberOfParamedics": 20,
        "expertise": "ADVANCED_LIFE_SUPPORT"
    },
    {
        "organizationId": "063ee412-a469-40ed-8cf4-256e8cbac010",
        "organizationType": "EMS_STATION",
        "createdDate": "2022-01-07",
        "lastModifiedDate": "2022-01-07T12:04:45.230626Z",
        "name": "C. Incendie,Secours Renforcé II",
        "telephoneNumber": "+000012233545",
        "lat": "46.24",
        "lng": "1.483",
        "location": "La Souterraine,France",
        "fleetSize": 18,
        "fleetTypeAVehicles": 10,
        "fleetTypeBVehicles": 8,
        "totalNumberOfParamedics": 20,
        "expertise": "ADVANCED_LIFE_SUPPORT"
    },
    {
        "organizationId": "9b2efbe6-557a-4540-9773-2002ba4f5796",
        "organizationType": "HOSPITAL",
        "createdDate": "2021-10-11",
        "lastModifiedDate": "2021-10-11T08:58:46.798399Z",
        "name": "Hospital Paolo Borsellino",
        "telephoneNumber": "+126912233545",
        "lat": "37.79",
        "lng": "12.48",
```

    "location": "Poggioreale",
    "totalNumberOfBeds": 100,
    "emergencyMedicineBeds": 35,
    "criticalCareBeds": 12,
    "neurosurgeryBeds": 2,
    "burnsOrPlasticSurgeryBeds": 5,
    "pediatricsOrPediatricSurgeryBeds": 15,
    "vascularBeds": 34,
    "traumaBeds": 3,
    "opthalmologyBeds": 20,
    "resuscitationBeds": 2,
    "emergencyMedicineCare": "PRIMARY",
    "criticalCare": "SECONDARY",
    "neurosurgeryCare": "TERTIARY",
    "burnsOrPlasticSurgeryCare": "SECONDARY",
    "pediatricCare": "PRIMARY",
    "vascularCare": "PRIMARY",
    "generalTheaters": 2,
    "orthopaedicsTheaters": 0,
    "neurosurgeryTheaters": 0,
    "cardiothoracicTheaters": 2,
    "numberOfVentilators": 10,
    "numberOfCTorMRIScanners": 1,
    "decontaminationUnit": true,
    "helicopterLandingStation": false
  },
  {
    "organizationId": "a62b4976-506d-45d5-86bb-1312a0529d02",
    "organizationType": "HOSPITAL",
    "createdDate": "2022-01-05",
    "lastModifiedDate": "2022-01-05T12:49:46.179408Z",
    "name": "Hosptl Center De La Souterraine",
    "telephoneNumber": "+126912233545",
    "lat": "46.2309301",
    "lng": "1.4393303",
    "location": "France",
    "totalNumberOfBeds": 100,
    "emergencyMedicineBeds": 35,
    "criticalCareBeds": 12,
    "neurosurgeryBeds": 2,
    "burnsOrPlasticSurgeryBeds": 5,
    "pediatricsOrPediatricSurgeryBeds": 15,
    "vascularBeds": 34,
    "traumaBeds": 3,
    "opthalmologyBeds": 20,
    "resuscitationBeds": 2,

```json
        "emergencyMedicineCare": "PRIMARY",
        "criticalCare": "SECONDARY",
        "neurosurgeryCare": "TERTIARY",
        "burnsOrPlasticSurgeryCare": "SECONDARY",
        "pediatricCare": "PRIMARY",
        "vascularCare": "PRIMARY",
        "generalTheaters": 2,
        "orthopaedicsTheaters": 0,
        "neurosurgeryTheaters": 0,
        "cardiothoracicTheaters": 2,
        "numberOfVentilators": 10,
        "numberOfCTorMRIScanners": 1,
        "decontaminationUnit": true,
        "helicopterLandingStation": false
      }
  ],
  "timestamp": "2022-01-07T14:35:39.141125"
}
```

Figure 2-1 Registered Organisations on COncORDE Platform

The above JSON returned to the SOT DSS the:

- *Available EMS stations* (instances) from Poggioreale, Italy, and Limoge, France and details on their location, the overall fleet size, among others.
- *Available Hospitals* in Poggioreale and Limoge.

This input will be used by SOT DSS Services in combination with the following inputs.

- The following data is an instance of a *Registered User*:

```json
{
  "data": [
    {
      "id": "cb9eb855-0acb-45ef-891e-2b5e8506e2a4",
      "details": {
        "id": 8,
        "incident_details": [],
        "position": "HIGH",
        "specialExpertise": "MEDICAL_SKILLS",
        "organizationId": "245e4484-9748-4029-b7a2-a9cf90e5e7d2",
        "organizationType": "EMS_STATION",
        "role": "EMS",
        "EMSposition": "RETRIEVER",
        "enabled": true
      },
```

```
        "last_login": null,

        "username": "poggio_ems",

        "first_name": "",

        "last_name": "",

        "date_joined": "2021-12-01T09:08:40.216181Z",

        "createdBy": "concorde_admin",

        "firstName": "Salvo",

        "lastName": "Montalbano",

        "email": "smontalbano@gmail.com",

        "phoneNumber": "+353871234567",

        "avatar": null,

        "lastOnline": "2021-12-01T09:08:40.240611Z",

        "groups": []

    },
```

Figure 2-2 Registered Users on COncORDE Platform

After the registration of Organisations to the COncORDE Platform, organisations' users are registered and mapped to their team. The above figure depicted an EMS RETRIEVER from the Poggioreale EMS Station 2 (the user is mapped to his organisation by the organisations id). Following the above philosophy, SOT DSS requests the registered users, such as:

- EMS Runners
- EMS Rescuers
- EMS Retrievers

These information will function as parameter for the SOT DSS Services, especially Services 2 and 3.

- The following data contain the details from two occurring *incidents*:

```
{
   "data": {
      "id": 29,
      "hazardtype_set": [
         "BUILDING_UNDER_CONSTRUCTION_DEMOLITION",
         "CRUSH_INJURIES",
         "EXPLOSION",
         "FALLEN_AND_LOOSE_DEBRIS",
         "FALLEN_TREES",
         "FIRE",
         "PERSONS_TRAPPED",
         "SERIOUS_DISORDER"
      ],
     "created": "2022-01-07T09:49:20.549733Z",
      "lastModified": "2022-01-07T09:49:20.549788Z",
```

```json
    "incidentTimeOfAnnouncement": "2022-01-07T09:49:20.549803Z",
    "incidentStatusCode": "MAJOR_INCIDENT_CONFIRMED_DECLARED",
    "typeOfEmergency": "EARTHQUAKE",
    "priorityDispatchCard": "ABDOMINAL_PAIN_PROBLEMS",
    "priorityDispatchCode": "IMMEDIATE",
    "name": "Earthquake in Poggioreale",
    "description": "6.0 Richter earthquake , epicenter:  Northern Italy",
    "additionalInformation": "6.0 richter earthquake in Poggioreale. School collapsed",
    "hazardBackground": "Earthquake caused school and buildings to collapse. Children and teachers are trapped under rubble. Trees have fallen on cars causing explosions and Fire.",
    "numberOfAdultPatients": 25,
    "numberOfChildren": 5,
    "numberOfFatalities": 1,
    "areaType": "URBAN",
    "caller": "School Director",
    "callerFreeText": "School Director",
    "callerContact": "Phone",
    "lng": "13.0349738",
    "lat": "37.7631772",
    "location": "Poggioreale",
    "callerContactDetails": "School Director",
    "isActive": true,
    "notifiedHospitals": [
      "9b2efbe6-557a-4540-9773-2002ba4f5796"
    ],
    "notifiedHospitalCommanders": [
        16
    ]
  },
  "timestamp": "2022-01-07T09:54:09.916081"
}
```

Figure 2-3 Incident id: 29 - Earthquake in Poggioreale

```json
{
    "id": 30,
    "hazardtype_set": [
      "CRUSH_INJURIES",
      "EXPLOSION",
      "FIRE",
      "FLAMMABLE_GAS_EXPOSURE",
      "PERSONS_TRAPPED",
      "SMOKE",
      "SMOKE_FUMES",
      "UNSTABLE_VEHICLE"
    ],
     "patient_set": [
```

```
                "a9c92cf8-63d9-4687-8f05-f848f516e123",
                "bfd3f257-9d0a-4aa0-b9f7-79a1dd8f5379",
                "9c514016-f976-4005-8b05-a8c1e230fddd",
                "0da170ff-53c3-43b4-98a2-01642baa4daf"
            ],
            "created": "2022-01-07T10:35:25.343000Z",
            "lastModified": "2022-01-07T10:35:25.343031Z",
            "incidentTimeOfAnnouncement": "2022-01-07T10:35:25.343042Z",
            "incidentStatusCode": "MAJOR_INCIDENT_CONFIRMED_DECLARED",
            "typeOfEmergency": "VEHICLE_FIRE",
            "priorityDispatchCard": "ABDOMINAL_PAIN_PROBLEMS",
            "priorityDispatchCode": "IMMEDIATE",
            "name": "Fire in Limoge",
            "description": "Cars caught in fire in La Souterraine",
            "additionalInformation": "Vehicle fires from car machine explosions",
            "hazardBackground": "People injured, trapped in cars. Cars in the back exploding due to the
             heat of the fires. The atmosphere is gas-y and there's a lot of smoke",
            "numberOfAdultPatients": 20,
          "numberOfChildren": 5,
          "numberOfFatalities": 3,
            "areaType": "URBAN",
            "caller": "Civilian",
            "callerFreeText": "Civilian",
            "callerContact": "Phone",
            "lng": "1.482986",
            "lat": "46.239087",
            "location": "La Souterraine",
            "callerContactDetails": "Civilian",
            "isActive": true,
            "notifiedHospitals": [
               "a62b4976-506d-45d5-86bb-1312a0529d02"
            ],
            "notifiedHospitalCommanders": [
                17
            ]
        }
```

Figure 2-4 Incident id: 30 - Fire in Limoge

The above figures will sustain parameters on the two occurring incidents and their details for the SOT DSS Services. The two occurring incidents are:

- Earthquake in Poggioreale
- Fire in Limoge

The bold data from the above figure will feed the SOT DSS system.

- The following data contain details for the *patients* on two occurring incidents:

The first figure depicts instances of detected patients from *Poggioreale incident*.

```json
{
    "id": "dd4a700f-74f7-4def-ab52-c55915f2b5df",
    "createdBy": "commander_a",
    "creationTime": "2022-01-07T09:54:45.977012Z",
    "lastModified": "2022-01-07T09:54:45.977040Z",
    "location": "Poggioreale",
    "fr": "possible",
    "referred": "2022-01-07T10:51:07Z",
    "accepted": "2022-01-07T10:41:07Z",
    "vehicle": "vehicleB",
    "transportDepart": "2022-01-07T10:51:07Z",
    "time": "2022-01-07T10:51:07Z",
    "injuryDescription": "Patient trapped under rubbles",
    "refDG": "ref",
    "spec": "specs",
    "incident": 29,
    "triage1": {
        "id": 11,
        "triage_score": 10,
        "o2": "80.00",
        "temp": true,
        "breathing": "ABNORMAL_SOUNDS",
        "eyeOpening": "TO_PAIN",
        "motorResponse": "PAIN_WITHDRAWS",
        "verbalResponse": "CONFUSE",
        "patient": "dd4a700f-74f7-4def-ab52-c55915f2b5df"
    },
    "triage2": {
        "id": 11,
        "triage_score": 10,
        "o2": "84.34",
        "temp": true,
        "breathing": "ABNORMAL_SOUNDS",
        "eyeOpening": "TO_PAIN",
        "motorResponse": "PAIN_WITHDRAWS",
        "verbalResponse": "CONFUSE",
        "hr": "190 bpm",
        "skin": true,
        "pain": 7,
        "rr": "6-9",
        "bp": "50-75",
        "rightPupil": 5,
        "leftPupil": 5,
        "airway": true,
        "capillary": false,
        "patient": "dd4a700f-74f7-4def-ab52-c55915f2b5df"
```

```
        },
        "drug": [],
        "intervention": []
    },
    {
        "id": "35c88c15-a396-4481-9550-f4de953e3b1e",
        "createdBy": "commander_a",
        "creationTime": "2022-01-07T09:55:21.031880Z",
        "lastModified": "2022-01-07T09:55:21.031923Z",
        "location": "Poggioreale",
        "fr": "possible",
        "referred": "2022-01-07T10:45:07Z",
        "accepted": "2022-01-07T10:45:07Z",
        "vehicle": "vehicleA",
        "transportDepart": "2022-01-07T10:45:07Z",
        "time": "2022-01-07T10:45:07Z",
        "injuryDescription": "Patient with fractures due to fall from building",
        "refDG": "ref",
        "spec": "specs",
        "incident": 29,
        "triage1": {
            "id": 12,
            "triage_score": 13,
            "o2": "100.00",
            "temp": true,
            "breathing": "SHALLOW",
            "eyeOpening": "SPONTANEOUS",
            "motorResponse": "PAIN_WITHDRAWS",
            "verbalResponse": "ORIENTED",
            "patient": "35c88c15-a396-4481-9550-f4de953e3b1e"
        },
        "triage2": {
            "id": 12,
            "triage_score": 13,
            "o2": "90.00",
            "temp": true,
            "breathing": "SHALLOW",
            "eyeOpening": "SPONTANEOUS",
            "motorResponse": "PAIN_WITHDRAWS",
            "verbalResponse": "ORIENTED",
            "hr": "185 bpm",
            "skin": true,
            "pain": 8,
            "rr": "6-9",
            "bp": "50-75",
            "rightPupil": 5,
```

```
            "leftPupil": 4,
            "airway": true,
            "capillary": false,
            "patient": "35c88c15-a396-4481-9550-f4de953e3b1e"
        },
        "drug": [],
        "intervention": []
    }
```

Figure 2-5 Detected Patients on Incident id: 29 - Earthquake in Poggiorelae

The second figure depicts instances of detected patients from *Limoge incident*.

```
{
        "id": "a9c92cf8-63d9-4687-8f05-f848f516e123",
        "createdBy": "commander_a",
        "creationTime": "2022-01-07T10:37:39.518636Z",
        "lastModified": "2022-01-07T10:37:39.518673Z",
        "location": "La Souterraine",
        "fr": "possible",
        "referred": "2022-01-07T11:55:39Z",
        "accepted": "2022-01-07T11:55:39Z",
        "vehicle": "vehicleB",
        "transportDepart": "2022-01-07T11:55:39Z",
        "time": "2022-01-07T11:55:39Z",
        "injuryDescription": "Patient with extreme burns",
        "refDG": "ref",
        "spec": "specs",
        "incident": 30,
        "triage1": {
            "id": 13,
            "triage_score": 13,
            "o2": "85.67",
            "temp": true,
            "breathing": "SHALLOW",
            "eyeOpening": "SPONTANEOUS",
            "motorResponse": "PAIN_WITHDRAWS",
            "verbalResponse": "ORIENTED",
            "patient": "a9c92cf8-63d9-4687-8f05-f848f516e123"
        },
        "triage2": {
            "id": 13,
            "triage_score": 13,
            "o2": "88.70",
            "temp": true,
            "breathing": "SHALLOW",
            "eyeOpening": "SPONTANEOUS",
            "motorResponse": "PAIN_WITHDRAWS",
```

```
            "verbalResponse": "ORIENTED",
            "hr": "170 bpm",
            "skin": true,
            "pain": 8,
            "rr": "6-9",
            "bp": "50-75",
            "rightPupil": 5,
            "leftPupil": 4,
            "airway": true,
            "capillary": false,
            "patient": "a9c92cf8-63d9-4687-8f05-f848f516e123"
        },
        "drug": [],
        "intervention": []
    },
    {
        "id": "bfd3f257-9d0a-4aa0-b9f7-79a1dd8f5379",
        "createdBy": "commander_a",
        "creationTime": "2022-01-07T10:40:54.305784Z",
        "lastModified": "2022-01-07T10:40:54.305812Z",
        "location": "La Souterraine",
        "fr": "possible",
        "referred": "2022-01-07T11:59:39Z",
        "accepted": "2022-01-07T11:59:39Z",
        "vehicle": "vehicleA",
        "transportDepart": "2022-01-07T11:59:39Z",
        "time": "2022-01-07T11:59:39Z",
        "injuryDescription": "Patient trapped in car",
        "refDG": "ref",
        "spec": "specs",
        "incident": 30,
        "triage1": {
            "id": 14,
            "triage_score": 8,
            "o2": "84.7",
            "temp": true,
            "breathing": "SHALLOW",
            "eyeOpening": "SPONTANEOUS",
            "motorResponse": "PAIN_FLEXES",
            "verbalResponse": "NO_RESPONSE",
            "patient": "bfd3f257-9d0a-4aa0-b9f7-79a1dd8f5379"
        },
        "triage2": {
            "id": 14,
            "triage_score": 8,
            "o2": "88.70",
```

```
        "temp": true,
        "breathing": "SHALLOW",
        "eyeOpening": "SPONTANEOUS",
        "motorResponse": "PAIN_FLEXES",
        "verbalResponse": "NO_RESPONSE",
        "hr": "145 bpm",
        "skin": true,
        "pain": 3,
        "rr": "6-9",
        "bp": "50-75",
        "rightPupil": 5,
        "leftPupil": 4,
        "airway": true,
        "capillary": false,
        "patient": "bfd3f257-9d0a-4aa0-b9f7-79a1dd8f5379"
    },
    "drug": [],
    "intervention": []
}
```

Figure 2-6 Detected Patients on Incident id: 30 - Fire in Limoge

The above data are going to get consumed by the SOT DSS Services, to provide recommendations using the SOT mechanisms.

In the following chapters, a demonstration of the:

- SOT mechanisms in Technical Analysis Chapters
- SOT DSS responses in the back-end
- SOT DSS responses in the front-end,

is provided, in order to give a complete image of how SOT DSS corresponds to these inputs.

2.2 Service 1 - Allocation of available EMS units to incidents, depending on estimated needs

2.2.1 Technical Analysis

This chapter demonstrates how the SOT DSS Service 1 customises the given input and finally produces the relevant recommendations.

As mentioned in the D4.5 "Development of SOT DSS components" the model of this Service is a Transportation problem. Two classes have been created, the *EMSStation* and the *Incident,* in order to insert the data in a correct form as is shown in the figure below [5]:

```
class EMSStation:

    def __init__(self, id: int, fleet_size: int, location: Tuple[float, float], name: str = ""):

        self.id = id
        self.location = location # (lat, lon)
        self.fleet_size = fleet_size # This is the supply
        self.name = name

class Incident:

    def __init__(self, id: int, demand: int, location: Tuple[float, float], name: str = ""):

        self.id = id
        self.location = location # (lat, lon)
        self.demand = demand # From Service #4
        self.name = name
```

Figure 2-7 EMSStation and Incident models in EMSAllocation package.

In the current version, an addition of the Service 1 is the use of the Google API instead of haversine distance for the calculation of the cost function between the EMS station and the incident. [1] This modification provides a more realistic approach to the results of Service 1 because calculates the time of a vehicle from one point to another by taking into account the traffic in real-time of the roads as described in the D4.9. To achieve this, Python's googlemaps library is used to call the Google maps client in order to take the distance matrix by giving the latitude and longitude of the areas. The process is:

- The SOT DSS calls the Google API through a googlemap client by giving the latitude and longitude of EMS units and the hospitals.
- The Google client returns the distance matrix between the EMS unit and every hospital
- The *EMSAllocation* class provides the *allocate* method which calculates the cost matrix function based on the distance matrix and the availability of beds of the hospitals. So returns the resulting allocation solution, as well as a Boolean variable indicating if the demand has been reduced or not.

Figure 2-8 Google Maps client

TransportationProblem class: Moreover, an addition compared to the first version of the DSS (D4.5 "Development of SOT DSS components") is that the "adding dummy nodes" is set as the default method in the TransportationProblem and use the _reduce_demand() method explicitly in EMSAllocationProblem or other problems that may be necessary.

2.2.2 Back-end Instances

This chapter aims to demonstrate the back-end requests to the COncORDE Platform, but also the SOT DSS Service 1 responses.

Following the design of D4.9 "Design of SOT DSS components V2" and the data flow of the DSS component, the final system consumes and produces the following code:

- Requests to COncORDE Platform:

SOT DSS Service 1 requests input from the COncORDE Platform, [2] in order to feed its system with parameters and produce the final recommendations. More specifically, the required parameters are:

Details on the registered organisations, such as their name, location, and fleet size. These organisations were provided in the previous chapter.

```
{
  "EMSStationList": [
    {
      "organizationId": "1b00016b-46f1-44da-8da5-611feab54551",
      "location": [
        37.7908822,
        13.0206778
      ],
      "name": "Poggioreale EMS",
      "fleet_size": 30
    },
    {
      "organizationId": "245e4484-9748-4029-b7a2-a9cf90e5e7d2",
```

```
        "location": [
            37.7908822,
            13.0206778
        ],
        "name": "Poggioreale EMS II",
        "fleet_size": 15
    },
    {
        "organizationId": "d7582b25-dda6-40f1-a0c5-4efc4c57a64f",
        "location": [
            46.2378396,
            1.4837828
        ],
        "name": "Centre Incendie,Secours Renforcé",
        "fleet_size": 20
    },
    {
        "organizationId": "063ee412-a469-40ed-8cf4-256e8cbac010",
        "location": [
            46.24,
            1.48
        ],
        "name": "Centre Incendie,Secours Renforcé II",
        "fleet_size": 18
    }
```

Figure 2-9 SOT DSS Service 1 EMS Station List

In the above figure, SOT DSS retrieves the available organisations from Poggioreale and Limoge.

Another request to the COncORDE Platform is the occurring incidents list, meaning the active incidents which require recommendations from the DSS. The incident list provides to the system details on the demand, the incident's id, its location, the time, and the event type.

```
"IncidentList": [
    {
        "id": 29,
        "demand": 30,
       "event_type": "EARTHQUAKE",
        "location": [
            37.7631772,
            13.0349738
        ],
        "timestamp": "2022-01-07T09:49:20.549733Z"
    },
    {
        "id": 30,
        "demand": 25,
       "event_type": "VEHICLE_FIRE",
```

```
    "location": [
        46.239087,
        1.482986
    ],
    "timestamp": "2022-01-07T10:35:25.343000Z"
  }
```

Figure 2-10 SOT DSS Service 1 Occurring Incidents

- Responses from SOT DSS Service 1: Finally, SOT DSS Service 1 processed the requested input (for Service 1) and recommended the allocation of the available EMS Units to the occurring incidents.

In Poggioreale:

```
"DSS_output": [
    {
        "incident_id": "29",
        "ems_allocation": "Send 15 EMS unit(s) from EMS station: Poggioreale EMS"
    },
    {
        "incident_id": "29",
        "ems_allocation": "Send 15 EMS unit(s) from EMS station: Poggioreale EMS II"
    }
 ]
```

Figure 2-11 SOT DSS Service 1 Responses on Incident 29 - Earthquake in Poggioreale

In Limoge:

```
{
        "incident_id": "30",
        "ems_allocation": "Send 7 EMS unit(s) from EMS station: Centre Incendie,Secours Renforcé"
    },
    {
        "incident_id": "30",
        "ems_allocation": "Send 18 EMS unit(s) from EMS station: C. Incendie,Secours Renforcé II"
    }
```

Figure 2-12 SOT DSS Service 1 Responses on Incident 30 - Fire in Limoge

2.2.3 Front-end Instances

Finally, COncORDE receives the recommendations on the allocation of the available EMS Units from SOT DSS Service 1, as is shown in the figures above. These responses are available in COncORDE's SOT DSS screen, as the following figure demonstrates.

Figure 2-13 SOT DSS Service 1 Allocation of available EMS Units to Incidents

2.3 Service 2 - Allocation of patients to hospitals

2.3.1 Technical Analysis

In the first version of the SOT DSS, the allocation of patients to EMS units has been demonstrated. In the current version, an extension is the allocation of EMS units to hospitals. In the *PatientAllocation* package, a new model has been created the *FirstReceiver* model, except for the *EMSUnit* and *Patient* models (D4.5). The attributes of *FirstReceiver* are:

- The unique id of the First Receiver
- The number of beds of the hospital
- The location of the First Receiver
- The name of the First Receiver (hospital)

Moreover, the attributes of *Patient* are:

- ID: The unique identifier
- Physiological Score: A score indicating the physiological state of the patient
- Evacuation Order: The order of evacuation among other patients
- Child: Indicates if the patient is a child
- Location: The location of the patient in the field

The attributes of *EMSUnit* are:

- ID: The unique identifier
- Location: The location of the EMS unit.

```python
class Patient:

    def __init__(self, id: int,
                 physiological_score: int,
                 evacuation_order: int,
                 is_child: Literal[0, 1],
                 location: Tuple[float, float]):

        self.id = id
        self.physiological_score = physiological_score
        self.evacuation_order = evacuation_order
        self.is_child = is_child
        self.location = location

class EMSUnit:

    def __init__ (self, id: int, location: Tuple[float, float]):

        self.id = id
        self.location = location


class FirstReceiver:

    def __init__(self, id: int,
                 beds: int,
                 location: Tuple[float, float],
                 name: str = ""):

        self.id = id
        self.beds = beds
        self.location = location
        self.name = name
```

Figure 2-14 Patient, EMSUnit, and FirstReceiver models of PatientAllocation package

The *PatientAllocation* class requires a list of *EMSUnit* and *FirstReceiver* objects in order to do the allocation of the patient to hospitals.

Furthermore, another addition in Service 2 is that the cost function for the allocation of the patient to hospitals has been calculated through the Google API which gives the duration in minutes from the EMS unit location to hospitals. [1] The process is:

- The SOT DSS calls the Google API through a googlemap client as is described in subchapter 2.2.1 by giving the latitude and longitude of EMS units and the hospitals.
- The Google client returns the distance matrix between the EMS unit and every hospital
- The *PatientAllocation* class provides the *allocate* method which calculates the cost matrix function based on the distance matrix and the availability of beds of the hospitals. The returned result is a dictionary that has the EMS unit IDs as key and the hospitals' IDs as values. In case

of excess demand, i.e., more hospitals than EMS units, an item with key -1 and value a list of IDs of the remaining hospitals is returned too.

2.3.2   Back-end Instances

This chapter aims to demonstrate the back-end requests to the COncORDE Platform, but also the SOT DSS service 2 responses.

Following the design of D4.9 "Design of SOT DSS components V2" and the data flow of the DSS component, the final system consumes and produces the following code:

- Requests to COncORDE Platform:

SOT DSS Service 2 requests input from the COncORDE Platform, [2] in order to feed its system with parameters and produce the final recommendations.

Details on the nearest Hospitals (First Receivers list), their name, the available beds, and their location are retrieved from the SOT DSS Service 2. Furthermore, EMS List is consumed again, to detect if there will be an available EMS Unit for the patient's transfer to the nearest hospital.

```
{
    "FirstReceiverList": [
        {
            "id": 2,
            "organizationId": "9b2efbe6-557a-4540-9773-2002ba4f5796",
            "beds": 100,
            "location": [
                37.79,
                12.48
            ],
            "name": "Hospital Paolo Borsellino"
        },
        {
            "id": 3,
            "organizationId": "a62b4976-506d-45d5-86bb-1312a0529d02",
            "beds": 100,
            "location": [
                46.2309301,
                1.4393303
            ],
            "name": "Hospital Center De La Souterraine"
        }
    ],
"EMSStationList": [
        {
            "organizationId": "1b00016b-46f1-44da-8da5-611feab54551",
            "location": [
                37.7908822,
                13.0206778
            ],
```

```
        "name": "Poggioreale EMS",
        "fleet_size": 30
    },
    {
        "organizationId": "245e4484-9748-4029-b7a2-a9cf90e5e7d2",
        "location": [
            37.7908822,
            13.0206778
        ],
        "name": "Poggioreale EMS II",
        "fleet_size": 15
    },
    {
        "organizationId": "d7582b25-dda6-40f1-a0c5-4efc4c57a64f",
        "location": [
            46.2378396,
            1.4837828
        ],
        "name": "Centre Incendie,Secours Renforcé",
        "fleet_size": 20
    },
    {
        "organizationId": "063ee412-a469-40ed-8cf4-256e8cbac010",
        "location": [
            46.24,
            1.48
        ],
        "name": "Centre Incendie,Secours Renforcé II",
        "fleet_size": 18
    }
}
```

Figure 2-15 SOT DSS Service 2 First Receiver & EMS Unit List

Another input for Service 2 is the *patient* list. This list contains all the patients, detected on the field. This list is available to the COncORDE Platform via the Triage app from KT. More specifically, the registered EMS Runners track down the patients on the field and update the triage app with their health status. In the following figure, COncORDE retrieves only the required parameters to feed the SOT DSS Service 2. The following figure contains patients detected on both emergency sites.

```
"PatientList": [
    {
        "id": 10,
        "patient_id": "dd4a700f-74f7-4def-ab52-c55915f2b5df",
        "incident_id": 29,
        "physiological_score": 10,
        "evacuation_order": 1,
        "is_child": 0,
```

```json
      "location": [
          37.7620964,
          13.0343176
      ]
    },
    {
      "id": 12,
      "patient_id": "35c88c15-a396-4481-9550-f4de953e3b1e",
      "incident_id": 29,
      "physiological_score": 7,
      "evacuation_order": 2,
      "is_child": 0,
      "location": [
          37.7620964,
          13.0343176
      ]
    },
    {
      "id": 9,
      "patient_id": "bfd3f257-9d0a-4aa0-b9f7-79a1dd8f5379",
      "incident_id": 30,
      "physiological_score": 3,
      "evacuation_order": 4,
      "is_child": 0,
      "location": [
          46.239087,
          1.482986
      ]
    },
    {
      "id": 11,
      "patient_id": "9c514016-f976-4005-8b05-a8c1e230fddd",
      "incident_id": 30,
      "physiological_score": 8,
      "evacuation_order": 5,
      "is_child": 0,
      "location": [
       46.239087,
       1.482986
      ]
    }
  ],
  "UseUTA": True
}
```

Figure 2-16 SOT DSS Service 2 Patient List

By default, Service 2 uses the UTA method ("UseUTA": True) to calculate the cost matrix. UTA is a multi-criteria decision analysis method that uses linear programming techniques in order to optimally infer additive value/utility functions so that these functions are as consistent as possible with the global decision-maker's preferences (inference principle). [3]

As a result, SOT Service 2 depends on EMS Runners and the triage inputs, as well as the EMS Retrievers, who are assigned to transfer the patients from the field to their EMS Units and then to the recommended hospital.

- Responses from SOT DSS Service 2: Finally, SOT DSS Service 2 recommends the allocation of patients to hospitals.

```
{
   "DSS_output": {
"patient_allocation": [
        {
           "incident_id": "29",
           "alloc": "Send Patient 10 from Location [37.7620964, 13.0343176] to Hospital Paolo
Borsellino"
        },
        {
           "incident_id": "29",
           "alloc": "Send Patient 9 from Location [37.7620964, 13.0343176] to Hospital Paolo
Borsellino"
        }
      {
           "incident_id": "30",
           "alloc": "Send Patient 12 from Location [46.2383347, 1.4861387] to Hospital Paolo
Borsellino"
        },
        {
           "incident_id": "30",
            "alloc": "Send Patient 11 from Location [46.2383347, 1.4861387] to Hospital Center De La
           Souterraine"
        }
      ]
```

Figure 2-17 SOT DSS Service 2 Responses

2.3.3   Front-end Instances

Incident 29 is an additional emergency happen in Poggioreale, as long as incident 30 for Limoge. The following figure demonstrates the final output of SOT DSS Service 2.

ALLOCATION OF PATIENTS TO HOSPITALS

Incident 23	Send Patient 7 from Location [46.2383347, 1.4861387] to Vittorio Emanuele II
Incident 23	Send Patient 8 from Location [46.2383347, 1.4861387] to Vittorio Emanuele II
Incident 30	Send Patient 14 from Location [46.2383347, 1.4861387] to Hosptl Center De La Souterraine
Incident 30	Send Patient 12 from Location [46.2383347, 1.4861387] to Hosptl Center De La Souterraine
Incident 29	Send Patient 10 from Location [37.78540205, 13.048542531239187] to M.I. Longo Hospital Mussomeli
Incident 30	Send Patient 13 from Location [46.2383347, 1.4861387] to Ospedale Ingrassia, Cral
Incident 29	Send Patient 9 from Location [37.78540205, 13.048542531239187] to Vittorio Emanuele II
Incident 30	Send Patient 11 from Location [46.2383347, 1.4861387] to Hospital Paolo Borsellino

Figure 2-18 SOT DSS Service 1 Allocation of available EMS Units to Incidents

2.4 Service 3 - Allocation of tasks to available actors on the field, given demand pre-defined by the field commander

2.4.1 Technical Analysis

The *TaskAllocation* package implements Service 3 of the SOT DSS by using the *TransportationProblem* package as described in the D4.5. The data models for this package are *Actor* and *Task*.

In the current version, the roles will be received through the **COncORDE** API as a Dictionary of List which contains the data for the roles tree by using the _get_roles_tree() method. Each key represents a node and each value represents its edges.


```python
def _get_roles_tree(self, roles_tree_data: Dict[str, List[str]]) -> nx.DiGraph:

    ...
    ...
```

Figure 2-19 get_roles_tree method

Also, the **Google API** is used again in order to receive the distance matrix about the duration of the actors to go to the tasks as is described in subchapter 2.3.1. Furthermore, the cost formula changes. More details of this are presented in the D4.9. By using the selected cost matrix calculation method, the SOT DSS returns the recommended allocation, as well as a Boolean variable indicating if the demand had been reduced or not. The cases of excess demand are treated like Service 2, i.e., a dummy supply node with zero cost is added.

2.4.2 Back-end Instances

This chapter aims to demonstrate the back-end requests to the COncORDE Platform, but also the SOT DSS Service 3 responses.

This service receives similar input as the previous one, but also with the addition of the Field Commander's input.

The Field Commander is the leader on the field and his role is to update the Common Incident Space with markers, in order to inform the rest users with the following:

- The actual emergency (e.g fire, collapsed buildings, etc). This marker is called "Danger".
- The location where victims are detected. This marker is called "Patient".
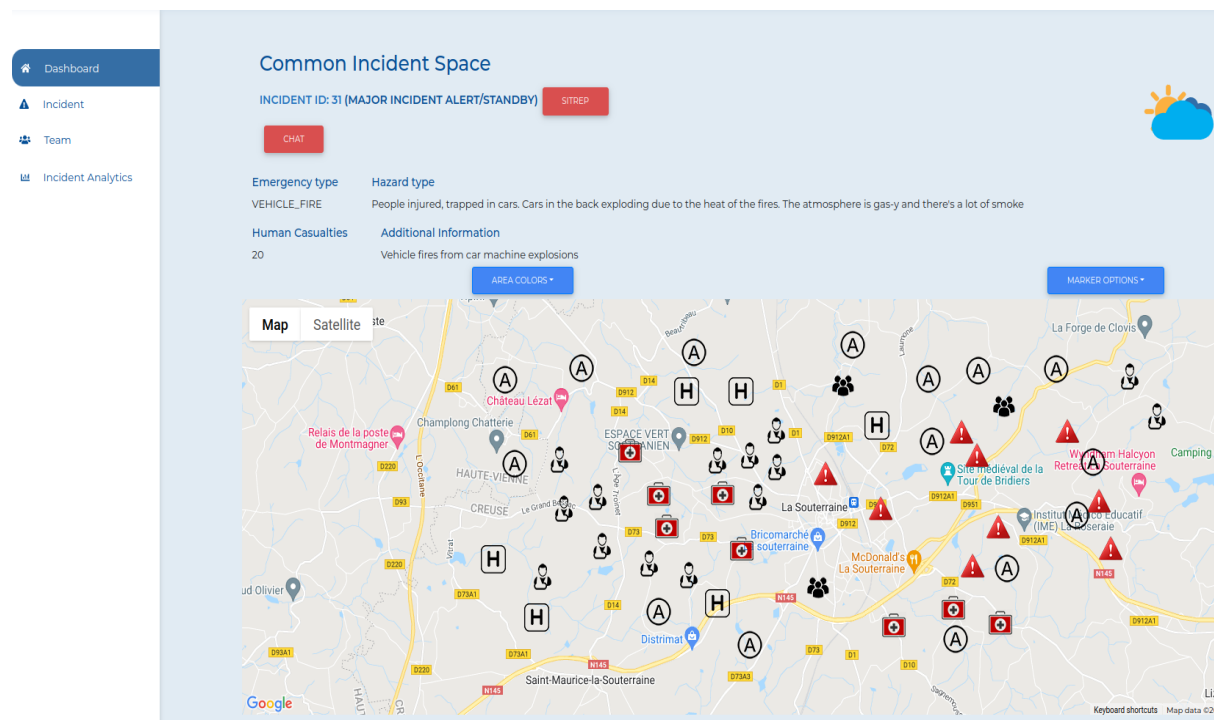- The location where there is the need of medical care. This marker is called "Medical".

Figure 2-20 Field Commander's Common Incident Space (Markers)

As a result, after the above input by the field commander, the back-end receives the following data:

```
"created": "2022-01-10T13:31:59.525829Z",
"lastModified": "2022-03-07T21:59:07.591288Z",
"incidentTimeOfAnnouncement": "2022-01-10T13:31:59.525885Z",
"incidentStatusCode": "MAJOR_INCIDENT_CONFIRMED_DECLARED",
"typeOfEmergency": "VEHICLE_FIRE",
"priorityDispatchCard": "ABDOMINAL_PAIN_PROBLEMS",
"priorityDispatchCode": "IMMEDIATE",
"name": "Fire in Limoge",
"description": "Cars caught in fire in La Souterraine",
"additionalInformation": "Vehicle fires from car machine explosions",
"hazardBackground": "People injured, trapped in cars. Cars in the back exploding due
    smoke",
"numberOfAdultPatients": 20,
"numberOfChildren": 5,
"numberOfFatalities": 3,
"areaType": "URBAN",
"caller": "Civilian",
"callerFreeText": "Civilian",
"callerContact": "Phone",
"lng": "1.482986",
"lat": "46.239087",
"location": "La Souterraine",
"callerContactDetails": "Civilian",
"isActive": true,
"polygons": "{}",
"markers": "{\"1643722524263\": \"{\\\"position\\\":{\\\"lat\\\":46.241026215074825,\
```


Figure 2-21 Markers Responses

Finally, COncORDE users have enough input to be assigned in specific tasks. The user actors to go to the specified incident are:

- EMS Rescuers. These actors are going to the location of "Danger", in order to respond. This role is mainly for firefighters, policemen, etc.
- EMS Runners. These actors are going to the location of "Medical", where is the need to treat the victims. This role is mainly for the medical experts on the field.
- EMS Retrievers. These actors are going to the location of "Patients", where is the need of transferring the patients to the closest EMS Unit and then to the hospital.

```
"task_allocation": [
    {
        "incident_id": "29",
```

```
        "alloc": "Send EMS 12 (Retriever) of EMS Station Vigili Del Fuoco (Fire Dept) to Patient
9           in Location [37.78540205, 13.048542531239187]"
    },
    {
"incident_id": "30",
            "alloc": "Send EMS 8 (Retriever) of EMS Station C. Incendie,Secours Renforcé II to
Patient 14 in Location [46.2383347, 1.4861387]"
```

Figure 2-22 SOT DSS Service 3 Responses - EMS Retrievers Task Allocation

2.4.3   Front-end Instances

The following figure demonstrates the final output of SOT DSS Service 3 with the assignments of the field actors to tasks.

Figure 2-23 SOT Service 3 Allocation of Tasks to Available Actors on the field

The above figure demonstrates assignments to EMS Runners, Rescuers and Retrievers for incidents 29, 30, 31.

2.5 Service 4 - Estimation of expected casualties

2.5.1   Technical Analysis

In the first version of the SOT DSS, it had been already analysed the solution which has been used for the implementation of Service 4. At this stage, the extension is the response from the PAGER API, where the pdf which includes earthquake casualties' estimation is extracted in JSON format and finally provided in SOT DSS Service 4. A remarkable observation is that even though legacy earthquake data from PAGER (D6.6 "Report on legacy systems and their connection to the S&R related technical characteristics ") are used by Service 4 for its improvement, PAGER product is able to provide real-time

earthquake data and as a result real-time casualties estimation. [4] For instance, the SOT DSS Service 4 for a specific earthquake incident takes data through a onePAGER URL such as the following:

"https://earthquake.usgs.gov/product/losspager/us2000ixky/us/1549575339140/onepager.pdf".

2.5.2 Back-end Instances

SOT DSS Service 4 produces the estimation of expected casualties in earthquake incidents. To manage this, HTTP requests are made to the PAGER Public API. PAGER is a legacy system, EU Compatible. More details for PAGER are provided in D6.2 "Voice, data and services interoperability frameworks", D6.6 "Report on legacy systems and their connection to the S&R related technical characteristics", and D6.9 "Report on legacy systems and their connection to the S&R related technical characteristics, V2".

PAGER can produce real-time and historical data. However, since there is not going to be a real earthquake in the SnR Use Cases, only the historical data will be used.

For this reason, COncORDE gets input on the event type of the Earthquake, the location of the area and makes HTTP requests to the PAGER API, in order to get a response to the recently detected earthquake disaster in the closest area.

As a result, the following figure constitutes the input of incident 29 for the request to PAGER API.

```
{
     "event_type": "Earthquake",
     "id": 29,
     "lat": 37.7631772,
     "lon": 13.0349738,
     "stime": "2016/01/25",
     "etime": "2016/01/30"
}
```

Figure 2-24 SOT DSS Service 4 Input for PAGER API

Finally, the PAGER API produces a probability matrix of human casualties, considering past historical incidents. This data is consumed by the SOT DSS Service 4.

```
{
     "incident_ID": 29,
     "casualty_estimation": [
        "There is a 38% chance for 1-10 human casualties.",
        "There is a 39% chance for 10-100 human casualties.",
        "There is a 19% chance for 100-1000 human casualties.",
        "There is a 4% chance for 1000-10000 human casualties."
     ],
     "pager_URL":
     "https://earthquake.usgs.gov/product/losspager/us2000ixky/us/1549575339140/onepager.pdf",
     "historical_EQ": "5.0 Richter Earthquake, Trecastagni, Italy, 2018-12-26 02"
  }
```

Figure 2-25 SOT DSS Service 4 Response

SOT DSS Service 4 is used only on incident 29 instance, since it is an Earthquake incident.

2.5.3   Front-end Instances

Finally, the end-user can have an estimation for incident 29 with a range of probabilities.

Incident 29   There is a 38% chance for 0-1 human casualties.,There is a 39% chance for 1-10 human casualties.,There is a 19% chance for 10-100 human casualties.,There is a 4% chance for 100-1000 human casualties.

Figure 2-26 SOT DSS Service 4 Expected Casualties

3 SOT DSS in Use Cases

3.1 Use Cases to be tested

In this section will be presented the Services of SOT DSS in the Use Cases. More specifically the SOT DSS will be tested in the following UC based on the WP8 deliverables for Pilots plan:

- **Use case 1: Victims trapped under rubble (Italy)**
  The first Use Case will take place in Poggioreale, a community in Italy, in April 2022, organised by CNR, as UC leader, and in close collaboration with the Regional Department of Civil Protection of Sicily (DRPC), the Regional System of Civil Protection, the Fire Department, and the Municipality of Poggioreale. The situations which will be simulated to test the several S&R components and especially SOT DSS are the following:
  - o people trapped under the rubble and / or in premises not reachable as a consequence of the earthquake;
  - o the release of gases and / or other toxic substances;
  - o blocked roads preventing traditional vehicles to reach the area

  During the implementation of the UC1, SOT DSS will execute its four Services. In more details, it will provide:
  1. a recommendation of the available EMS units to the incident
  2. a recommendation of allocation of patients to EMS units
  3. a recommendation of allocation of tasks to available actors on the field.
  4. an estimation of casualties (PAGER)

- **Use Case 2: Plane crash, mountain rescue, non-urban (Greece)**
  The second Use Case will take place in Chortiatis, a mountainous area in Thessaloniki in November 2022, organised by HRT. The Use Case consists of aircraft crashes in a remote location of the Chortiatis, participating HRT first responders. In this case, SOT DSS will execute the Service 1, Service 2 and Service 3. Especially the technology will provide:
  1. a recommmentation of the available EMS units to the incident
  2. a recommmentation of allocation of patients to EMS units
  3. a recommmentation of allocation of tasks to available actors on the field.

- **Use Case 3: Earthquake/ heavy storms between Vienna Rail Station & Kufstein railway station heavy damages in the rail station (Cross-border pilot, Austria-Germany)**
  Use Case 3 will take place in at the NÖ Feuerwehr-und Sicherheitszentrum, Tulln, Austria organised by JOAFG/JUH and supported by the Vienna Command Center. The UC consists of a derail of a train in Kufstein railway station due to an uprooted tree that will have been fallen on the tracks from a heavy storm. In this case, SOT DSS will execute the four Services. Especially:
  1. a recommendation of the available EMS units to the incident
  2. a recommendation of allocation of patients to EMS units
  3. a recommendation of allocation of tasks to available actors on the field.
  4. an estimation of casualties (PAGER)

- **Use Case 5: Victims trapped under the rubble (France)**

  Use Case 5 will take place in a small town called "La Souterraine", in Creusedepartment (Nouvelle Acquitaine) in the center of France, in June 2022, organised by PUI and supported by technical partners of the S&R. The exercise site consists of collapsed buildings close to abandoned hydrocarbon storage. In this case, SOT DSS will execute the four Services. Especially:

  1. a recommendation of the available EMS units to the incident
  2. a recommendation of allocation of patients to EMS units
  3. a recommendation of allocation of tasks to available actors on the field.
  4. an estimation of casualties (PAGER)

- **Use Case 7: Chemical substances spill (Spain)**

  Use Case 7 will take place in the National School of Civil Protection in Rivas Vaciamadrid, Madrid, Spain, in November 2022, organised by SUMMA 112 and ESDP. The exercise site consists of a scenario where a simulated earthquake will cause a gas leak and as a result, an explosion spreading a huge amount of leak of ammonia. In this case, SOT DSS will execute Service 1 and Service 4. Especially:

  1. a recommendation of the available EMS units to the incident
  2. an estimation of casualties (PAGER)

Based on the above, it can be observed how useful the SOT DSS is, throughout the process of each Use Case.

3.2 Requirements

In order to work properly the SOT DSS a number of parameters should be satisfied. In the following Tables the requirements are presented and the source that should give them:

COncORDE	
Variable	**Description**
Fleet size	Number of available EMS Units (Should be updated when an EMS used)
Incident Location	Location of the incident
EMS station Location	Location of the EMS station
EMS Unit Location	Location of EMS Unit
Hospital Location	Location of the Hospital
Patient Location	Location of the Patient
Name	Name of the EMS Station
Demand	The number of EMS units that the Incident needs.
Child	If the patient is child or not
Roles	The COncORDE roles
Number of Beds	The available number of beds

Table 3-1 COncORDE Inputs for SOT DSS

	Triage
Variable	**Description**
Triage Score (Severity of patients' injuries)	A scale for the measurement of patient's injuries (slightly injured, severely injured, etc.)

Table 3-2 Triage Input for SOT DSS

Even though all this information will be received from COncORDE and Triage, some people are responsible to insert this information. First of all, COncORDE receives inputs from the **Hospital Commander** who is responsible to provide information from the hospital (Available EMS Units, Number of beds, etc.). Furthermore, the **First Responders** are responsible to insert specific information to COncORDE about the patients (Location, etc.) and by using the **Triage** application to provide inputs about the patient's condition (The triage score, etc.). Moreover, the **Field Commander** is responsible to insert the information about the incident (Demand of EMS Units, etc.) to COncORDE. [2]

Additionally, in the COncORDE should be registered the roles of the available first responders and the roles that are needed for the incident.

To summarise, all this information consists of a determining factor for the effective SOT DSS results and they will be provided via the training sessions by every Use Case leader and the end-users who request SOT DSS responses.

4 Conclusions

Technical details of the SOT DSS development was presented in this report. First of all, for the examination of the SOT DSS service, and providing dummy input to the COncORDE, two different incidents were created. In this case, the data were consumed by the SOT DSS providing the necessary recommendation. The report also has demonstrated a technical analysis, presenting the extensions that have been implemented to each of SOT DSS Services. For each of the Services also front-end and back-end examples were analysed.

Finally, the report is concluded by emphasising the importance of the usage of the SOT DSS in the implementation of the S&R Use Cases given a detailed description of their implementation and presenting the requirements which SOT DSS needs in order to work properly. To conclude, SOT DSS will continue to be adapted to the required needs until the end of the project.

Annex I: References

[1] https://developers.google.com/docs/api/how-tos/overview

[2] KT's Technical Documentation CONCORDE v0.2

https://alfresco.epu.ntua.gr/share/page/site/search-rescue/document-details?nodeRef=workspace://SpacesStore/bf0c1995-674c-4102-89be-e2f05b8a78d0

[3] Jacquet-Lagreze, E., & Siskos, J. (1982). Assessing a set of additive utility functions for multicriteria decision-making, the UTA method. European journal of operational research, 10(2), 151-164.

[4] https://earthquake.usgs.gov/data/pager/onepager.php

[5] «SnR Gitlab,» Available: https://gitlab.com/konnektable-devops/horizon-2020/s-r-central-repo-group/sot_dss.