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| **System requirement specification**  Systems Engineering**-Company E** |
| **COP** |
| Prepared for: |
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| System requirement specification | |
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# Introduction

This case will investigate the initial processes from the INCOSE Systems Engineering Handbook[1]. It has the purpose to educate the attendees in applying the technical processes be using them in a real life case with unreal companies involved. The case work will furthermore train the attendees in the art of systems engineering in general. The case work will also end with a description of the case unique requirements in order to develop the suggested Common Operation Picture (COP).

# Vision & Scope

In crisis situations coordination between authorities is very important. A train accident may require involvement from authorities such as traffic police, medicare, fire fighters and train-related authorities.

It is crucial that the commander in charge has the optimum situational awareness, which is also known as the Common Operations Picture (COP).

Systematic provides with its SitaWare solution a complete COP management system for military purposes.

Systematic wishes to extend its solution to the domestic area. The intention is to provide a COP collecting infrastructural, personnel and other important data to the commander in charge, such as a fire chief or similar.

The solution relies on data obtained from public databases but accessed using dedicated means of data transmission, as existing public data infrastructure may be absent or unstable.

The system is part of a mobile headquarter.

Power supply and redundancy is outside the scope of this specification.

Key features are:

* Collection, pre-processing and presentation of information about:
  + Weather
  + Hazardous Materials
  + Construction Work
  + Demographic Data
  + Actors within the COP
* Distribute Information to Actors
* Review information history
* Change information focus

The following sections describe the stakeholders involved and their requirements to the solution.

# Stakeholder needs

## Identify legitimate stakeholders

In order to identify legitimate stakeholders, an overview of the system and its subsystems working in its environment is necessary. This overview will make it possible to identify the most important stakeholders. A stakeholder is defined as a user or a regulatory agency that can directly influence the use and the design of the system. It is important to identify all the human stakeholders. By looking at Figure 1 very simple overview of the systems structure is shown. By understanding this structure, the most obvious subsystems can be identified, and how these individual subsystems can affect the main system. The stakeholders that use the system are the people in the command center and the people out in the field, in short, the users of the system. Another stakeholder to this system could be a regulatory agency for the radio communications, which this system uses for its communication. The list of stakeholders, also include the enabling systems that can impose constraints to the system. Such a stakeholder could be a weather forecast site, where information about the weather can be obtained. It is important to research this type of stakeholder to find the constraints this enabling system could impose to the main system.

The stakeholders that can be highlighted as the Users of the system.

* Staff at the command centre
* Maintenance crew for the system
* Headquarters protection and accessibility
* Police
* Armed forces
* Hospitals
* Emergency Management
* Fire-fighters

Stakeholders that can impose constraints to the system (non users)

* Handheld devices
* Various information websites(DMI)
* Communication sites(situation update blog)
* Radio communication regulative agencies

Other systems of interest that can impose constraints to the main system.

* GPS system
* Radio communication system
* Power supply system
* Water supply system
* Internet

Figure 1 - Stakeholder diagram

## Legitimate stakeholder needs

Police – Needs information about traffic, roads and infrastructure

Armed forces – Needs information about non-civil matters

Hospitals – Will be informed about casualties, water and energy supply.

Emergency Management – Energy and Water information

Fire Fighters – Information about water supplies and emergencies

Staff at headquarters – Freshwater supply and stable power supply, protection and accessibility

## Elicit requirements

In order to elicit the requirements it is important to understand the needs from each of the identified stakeholders. Table 1 shows the stakeholders in the case together with their level in the project and identifies if they have any decision power.

|  |  |  |
| --- | --- | --- |
|  | **Has decision power** | **Has no decision power** |
| **Directly involved stakeholder** | Systematic (Costumer)  The development team | Police, armed forces, hospitals etc. |
| **Not directly involved stakeholder** | The government  Legal parties | Commanders |

Table 1 - Stakeholder matrix

*Many tools and techniques can be used to elicit user requirements, such as marketing and technical questionnaires or surveys, focus groups, prototypes, and beta release of a product. Trade off analysis and simulation tools can also be used to evaluate mission operational alternatives and select the desired mission alternative[1]*.

It is therefore important to gather stakeholder inputs on “needs” and “wants” in order to define the system constraints. The customer might have limitation in the total budget, limitation in technology, and legal requirements. This process is initiated by studying both how it is done without any high tech solution and evaluate the amount off added technology compared with the added benefits of doing so.

### Existing systems

Each and every department has its own chain of command, where information will be managed from the top and down. The information is delivered through radio and details like location is plotted on an old fashion map. This system is well known and has proven its worth throughout the history, but of cause some major disadvantages can be highlighted.

* Misinterpretation of information since it is verbally translated
* Lack of cross compatibility between existing systems and involved parties
* Information overload in some parts in the chain of command

The development team has recognized that these three issues is to be improved be using new technology to handle emergency situations and establishing the COP.

The Systematic’s SitaWare suite provides the capability to establish situational awareness. As diverse as this system is, it has been developed for military purposes, and is not in the current form directly applicable to civilian scenarios. Most likely several parts of the existing system, both physical and procedural, can be used with little modification, and other parts can be used for inspiration, but the differences in organizational structure and operational scenarios require the system be extended.

### Mission analysis

The success of the mission might depend of using just the right amount of added technology. The mission might be corrupted by adding too much technology, which could make it almost impossible to operate. The development team has considered the mission performance versus the amount of added technology.

In order to handle an emergency situation without automatic and intelligent systems to filter information and share important knowledge it can be quite a challenge to make an emergency operation run smoothly. The commanders face this exact challenge today.

It is of highest importance that the commanders feel that they are in charge, when they use the system and that they control the important stream of information. The system might suggest and point out critical elements, but it is the development team believes that an emergency situation is dynamic and cannot be controlled by a computer. The COP should provide the right amount of information, and ensure that everything is updated. The COP might be able to filter out some of the less critical information, by correlating some emergency facts with information available. This will help the commander focus on what is important, without being under informed.

The system might be even a bigger help for the people in the field, because they might experience “a hectic life” and they do not need to feel in command, but need to be commanded. The system will therefore help them filter the information based on their location. The sum of this analysis is three subsystems within the system of interest, which must be implemented be means of added technology.

* Redundant communication interface to ensure information exchange between involved parties
* Location tracking system
* Critical information back-up system

### User requirements

The development team has collected user requirements by means of questionnaires, interviews and by discussing the customer produced document in which they present their view on the problem. These investigations have led to the build scenarios, which will help define the project requirements.

## System solution constraints

See *Project plan*[2] for description.

# Concept documents

## Concept of operation

* Document the purpose of the system
* Identify the business needs that the system will satisfy
* Document user expectations
* Describe the basic concepts behind the system
* Describe the system's characteristics and behaviours from a user's point of view
* Indicate a range of acceptable solutions

# Requirements specification, Primary

This chapter characterizes the requirements according to satisfy the system functionality and performance.

The purpose of this chapter is to specify the requirements and qualifications provisions to the system in order to obtain product acceptance.

This Requirements specification is used to gain overview of the functionality and demands there are to the COP.

All the requirements have the unique prefix identifier SCOP with a four-digit suffix.

## Functional requirements

1. The COP shall display demographic data, which in this case includes: Language, nationality, religion, and population.
2. The COP shall display geographic data, which in this case is available GPS information.
3. The COP shall display fresh water supplies with GPS coordinates
4. The COP shall display hazardous matters by means of location and type.
5. The COP shall display construction work by means of location and type.
6. The COP shall display the involved actors by means of location, type, speed, orientation, identity, group, and role.
7. The COP shall be able to communicate observations by means of text and speech.
8. The COP shall display weather information by means of temperature, humidity, wind speed and direction.
9. The COP shall be able to log all information contained by the system.
10. The COP shall display and send events from/to all involved actors.
11. The COP shall be able to prioritize all events to all involved actors.
12. TheCOP shall be able to interface with every existing communication systems within the involved domains.

## Non-functional requirements

1. The mobile head quarter shall perform according to IP-69 classification.
2. It shall be possible to interface all functionality of the COP by using your hands only.
3. All documentation developed must comply with MIL-STD-498.
4. The COP shall be portable between different hardware platforms.
5. The mobile head quarter shall be fully operational in the temperature range of: -25 – 80 oC.
6. The COP shall consist of one screenwith thesizeof 22” and shall in all cases comply with the 16:10 format.

## Performance requirements

1. The COP shall be able display at least three layers of information simultaneously.

# Architectural constraints

There is no directly defined system architecture, since no particular hardware or programming language is defined, but SitaWare could be great platform to meet the system architectural constraints. The main problem is to implement a cross compatible COP system, it must of course be able to handle the specific data communication standards.

The handheld device should contain some sort of processor and memory storage in order to process the software that will present the common operation picture.

The flexibility of the system relates to the number handheld devices that the system supports.

As the system is designed on a specific hardware platform, it should be possible to reuse the system on another platform.

Therefore, it is a design goal to use none hardware specific elements.

# Verification strategy/Qualifications provisions

This chapter will describe how project unique requirements shall be verified.

## Qualification Methods

The qualification methods used to verify that the requirements of the COP system are used and include the following definitions:

Demonstration: The operation of the system, or a part of the system, that relies on observable functional operation not requiring the use of instrumentation, special test equipment, or subsequent analysis.

Test: The operation of the system, or a part of the system, using instrumentation or other special test equipment to collect data for later analysis.

Analysis: A review of test data (from the test) and theoretical analysis required to verify the requirements. The processing of accumulated data obtained from other qualification methods. Examples are reduction, interpolation, or extrapolation of test results.

Inspection: Visual examination of system components, documentation, etc.

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| **Requirement** | **Qualification Method** |
| **SCOP-0001** | Demonstration |
| **SCOP-0002** | Demonstration |
| **SCOP-0003** | Demonstration |
| **SCOP-0004** | Demonstration |
| **SCOP-0005** | Demonstration |
| **SCOP-0006** | Demonstration |
| **SCOP-0007** | Test |
| **SCOP-0008** | Demonstration |
| **SCOP-0009** | Inspection |
| **SCOP-0010** | Inspection |
| **SCOP-0011** | Inspection |
| **SCOP-0012** | Test |
| **SCOP-0013** | Test |
| **SCOP-0014** | Test |
| **SCOP-0015** | Analysis |
| **SCOP-0016** | Analysis |
| **SCOP-0017** | Test |
| **SCOP-0018** | Inspection |
| **SCOP-0019** | Test |

Table 2 - Qualification matrix

# Requirements traceability

See *Requirements Traceability Matrix*[3][2] for description.

# Requirements specification, Sub-supplier

This chapter characterizes the requirements according to satisfy the system functionality and performance.

The purpose of this chapter is to specify the requirements and qualifications provisions to the system in order to obtain product acceptance.

All the requirements have the unique prefix identifier TPOD with a four-digit suffix.

## Functional requirements

1. TheCOP shall be able to interface with every existing communication systems within the involved domains.
2. The handheld device shall include a touch screen to interface the software
3. It shall be possible to locate the handheld device at any time
4. The handheld device shall include features, which enables verbal communication with a mobile head quarter.
5. The handheld device must be able to deploy firmware over-the-air (FOTA) technology.

## Non-functional requirements

1. The handheld device must cost less than 25000 Danish kroner.
2. The handheld device must not weighmore than 1000g
3. The screen on handheld device shall be between 10”-12”and shall in all cases comply with the 16:10 format.
4. The handheld device shall be fully functional after a drop of 1 meter on concrete floor. This includes both software and hardware features.
5. The handheld device shall perform according to IP-67 classification.
6. The battery in the handheld device shall be replaceable on sight and rechargeable by means of a 12V battery supply.
7. It shall be possible to interface all functionality of the handheld device by using your hands only and hands with gloves.
8. The handheld device shall be fully operational in the temperature range of: -25 – 80 oC.

## Performance requirements

1. The battery in the handheld device shall last for at least 12 hours of operation.
2. The display shall be readable in direct sunlight and the sub-supplier shall evaluate the best possible technology for a screen that performs a minimum of 1000 cd/m2.
3. The handheld device shall as minimum contain a general purpose 1GHz processor and 512MB Ram and 420MHz dedicated DSP processor.

# Verification strategy/Qualifications provisions

This chapter will describe how project unique requirements shall be verified.

## Qualification Methods

The qualification methods used to verify that the requirements of the COP system are used and include the following definitions:

Demonstration: The operation of the system, or a part of the system, that relies on observable functional operation not requiring the use of instrumentation, special test equipment, or subsequent analysis.

Test: The operation of the system, or a part of the system, using instrumentation or other special test equipment to collect data for later analysis.

Analysis: A review of test data (from the test) and theoretical analysis required to verify the requirements. The processing of accumulated data obtained from other qualification methods. Examples are reduction, interpolation, or extrapolation of test results.

Inspection: Visual examination of system components, documentation, etc.

|  |  |
| --- | --- |
| **Requirement** | **Qualification Method** |
| **TPOD-0001** | Demonstration |
| **TPOD-0002** | Test |
| **TPOD-0003** | Test |
| **TPOD-0004** | Demonstration |
| **TPOD-0005** | Test |
| **TPOD-0006** | Analysis |
| **TPOD-0007** | Test |
| **TPOD-0008** | Inspection |
| **TPOD-0009** | Test |
| **TPOD-0010** | Test |
| **TPOD-0011** | Test |
| **TPOD-0012** | Demonstration |
| **TPOD-0013** | Test |
| **TPOD-0014** | Test |
| **TPOD-0015** | Test |
| **TPOD-0016** | Test |

Table 3 - Qualification matrix

# Bibliography

1. **International Council on Systems Engineering**.*INCOSE Systems Engineering Handbook v. 3.2a*.INCOSE, 2010.
2. **Project plan**. Company E, 2010.
3. **Requirements Traceability Matrix**, Company E, 2010