Course on Human-Computer Interaction (HCI-16)

HCI 2015-2016

The Workpad Project

Lecturer: Andrea MARRELLA

Lecturer

Andrea Marrella

Dipartimento di Ingegneria Informatica, Automatica e Gestionale “A.Ruberti”

Sapienza - Università di Roma

marrella@dis.uniroma1.it

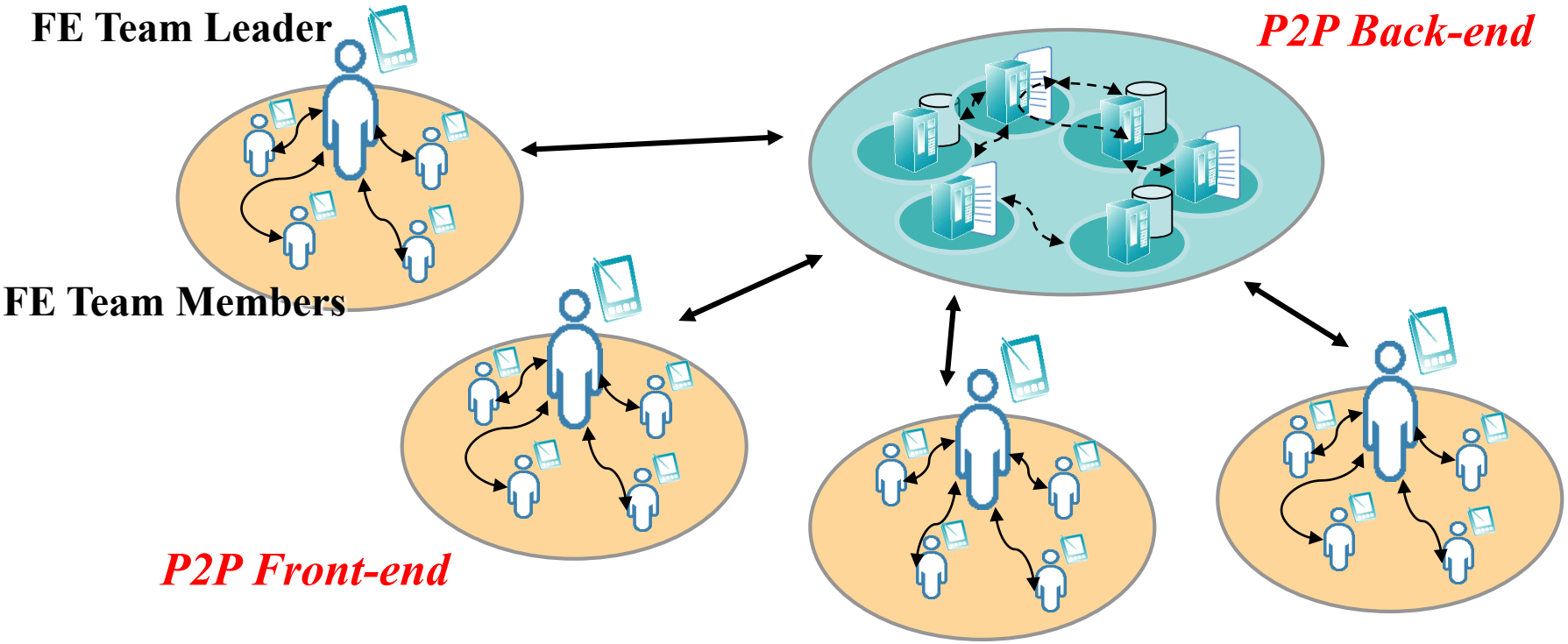
http://www.dis.uniroma1.it/~marrella/

The WORKPAD Project

- The **lack** of **information integration** in an emergency scenario **inhibit** government agencies and volunteer organizations to **successfully communicate** and act in a coordinated way.
- The FP6 European project **WORKPAD** (1 Sept 2006 - 31 August 2009) provides an architecture that intends to **improve the collaboration in emergency management**.
- The use of a **user-centered design methodology** during the entire development cycle has guaranteed that the resulting system meets the end-user requirements.
  - The feasibility of its use in real emergencies is also proven by a demonstration showcased with real operators.
  - **Main User** = Protezione Civile Calabria

Idea and High-level Architecture

- An adaptive peer-to-peer service-oriented software infrastructure for supporting collaborative work of human operators in emergency/disaster scenarios.



How to Collect User Requirements

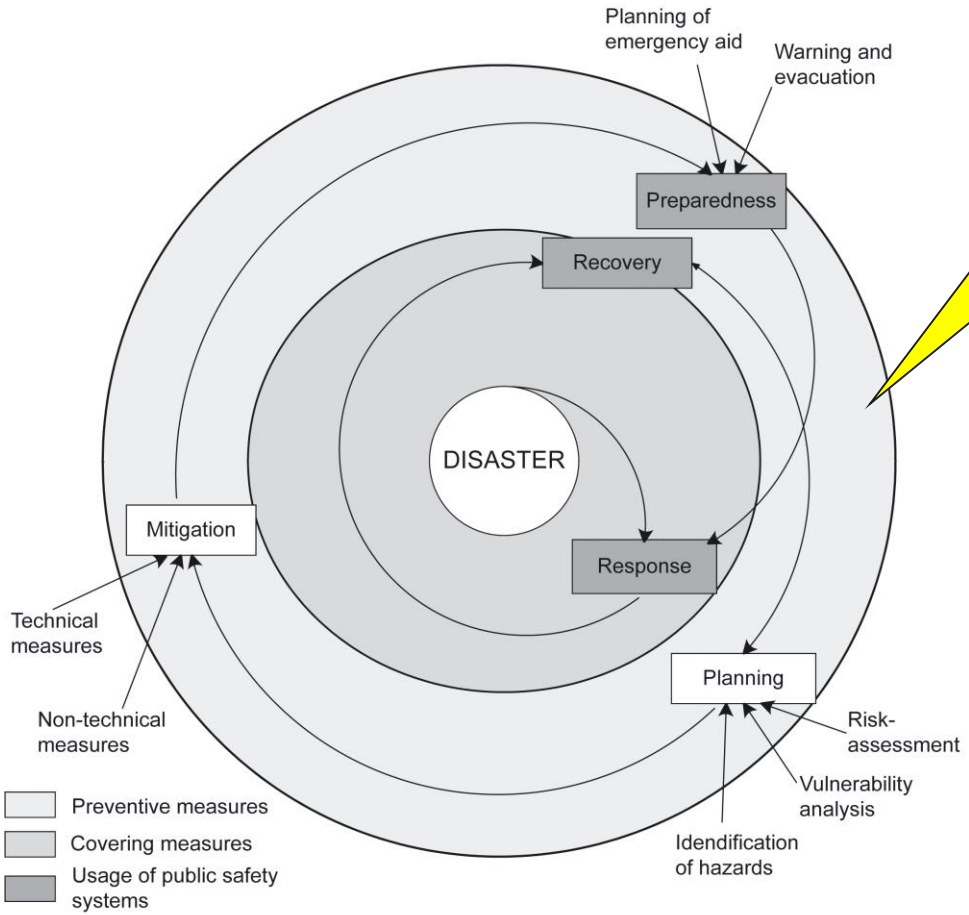
- Before starting learn about your product and involved users.
- Define methods, protocols and plan andprepare all the activities.
- Perform the activities.
- Analyse the data.
  - Document customer and user needs.
  - Describe individual requirements in a systematic and structured way.

Before Starting...

- **Learn** about **your product** and **involved users**.
  - Get a clear understanding and a description of the real world (**operational environment**) where the system has to operate.
    - *physical*, *organizational* and *technical* environment.
  - Collect and check the existing material (documents, prototypes, etc.).
    - analysis of published sources such as research reports, census data, demographic information, etc.
  - investigate information about the potential **users** and **stakeholders**, and the **processes** that currently take place in emergency management.
    - consider ALL the users and stakeholders who may influence or can be impacted by the system.

Dealing with Emergencies

Emergency management: total systematic coordination activities for the prevention and the coverage of natural and human-made disasters, as well as the organization and management of resources and responsibilities for dealing with all aspects of emergencies [from ISDR - International Strategy for Disaster Reduction]



The WORKPAD project addresses **response** and **short-term recovery**.

Types of Emergencies

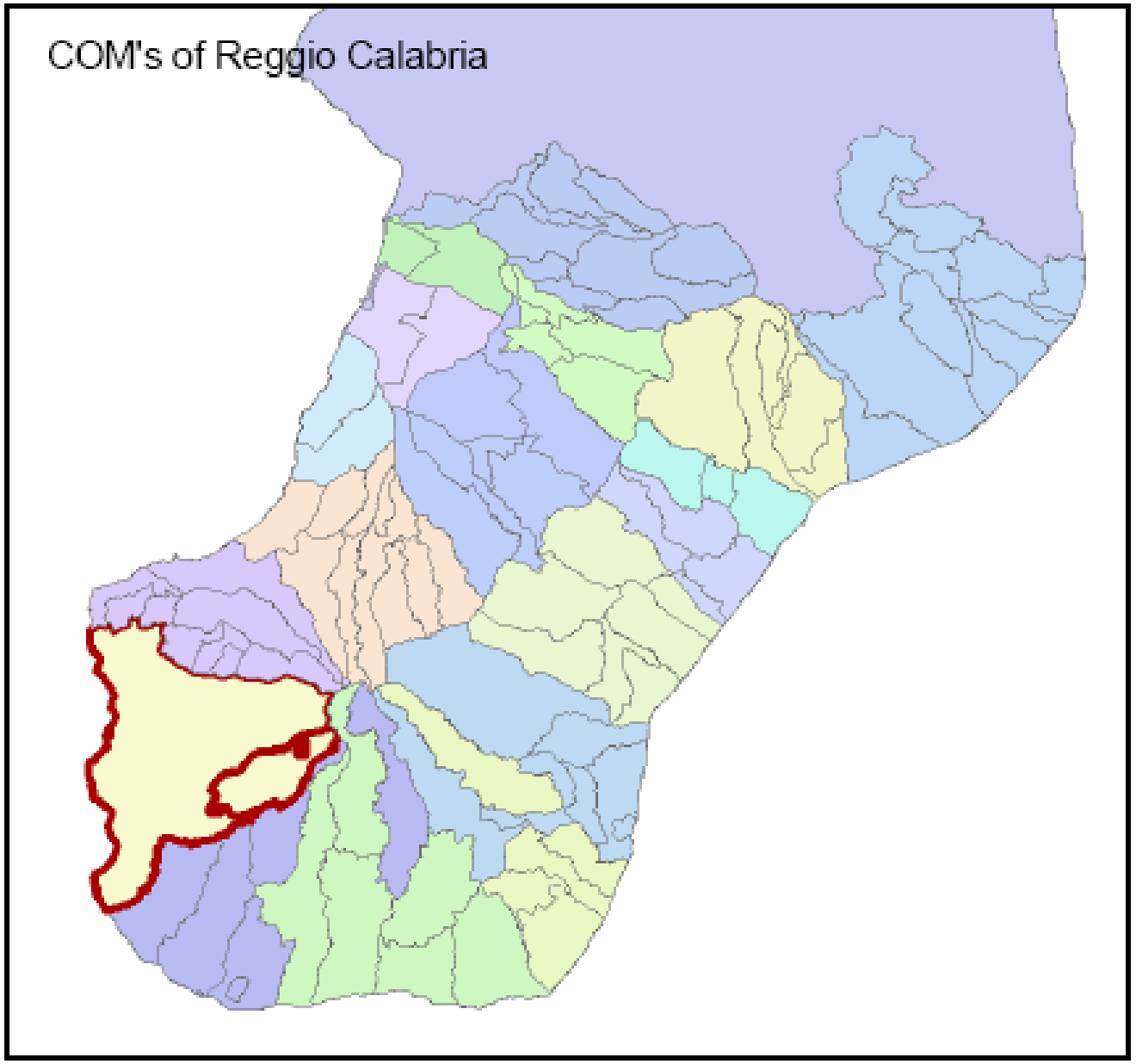
- The Italian law identifies **3 levels of emergencies** and define management responsibilities:
  - **Micro-Emergencies**
    - Mayors coordinate Micro-Emergencies involving their own territory by using **COCs** (Centro Operativo Comunale).
  - **Middle-Emergencies**
    - Middle-emergencies involve provinces or regions, are coordinated by Prefect(s) and are handled by the **CCS** (Centro Coordinamento Soccorsi).
      - Main focus of the WORKPAD project.
  - **Macro-Emergencies**
    - Macro-emergencies (at national level) are handled by National Homeland Security (Protezione Civile Nazionale).
      - Out of the scope of the WORKPAD project.

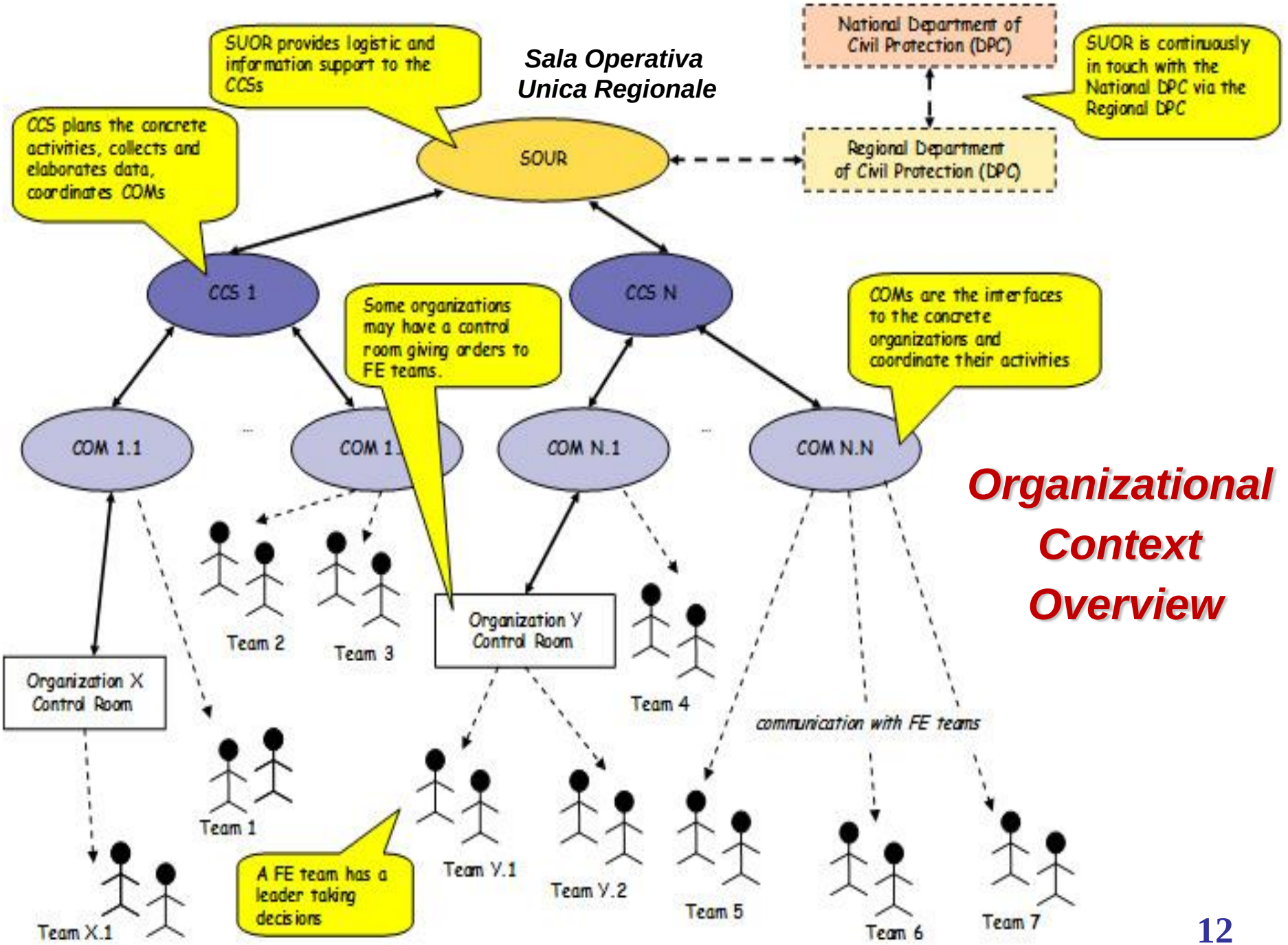
CCS – Centro Coordinamento Soccorsi

- Middle emergencies are handled by the **CCS** (Centro Coordinamento Soccorsi).
- CCS is composed by a fixed number of functionaries of the most relevant emergency organizations: Police, Fire Brigade, Red Cross…
  - In specific situations, further organizations can be involved around “the CCS table”, e.g.:
    - A.N.A.S. (the organization that manage roads) is involved in emergencies concerning nationals roads.
    - R.F.I. is involved in emergencies concerning railways.
- CCS is leaded by a Prefect
  - Prefect is the “entity” that authorizes and coordinates actions suggested by the emergency organizations spread on the field.

Main Tasks of the CCS

- Collection and elaboration of data and information about the evolution of the situation.
- Coordination of the whole activity performed in the **COM**s (Centro Operativo Misto).
  - COM is an operative decentralized structure that is coordinated by the CCS.
  - The constitution of a COM is intended to react quickly and locally to the emergency.
  - For instance, Reggio Calabria has 19 COMs.


COM's of Reggio Calabria



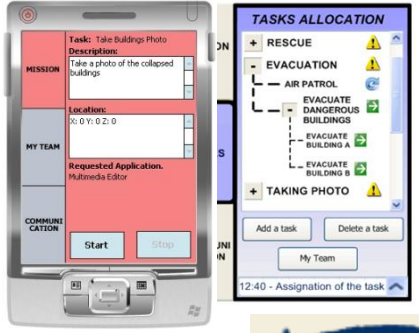
Organizational Context Overview

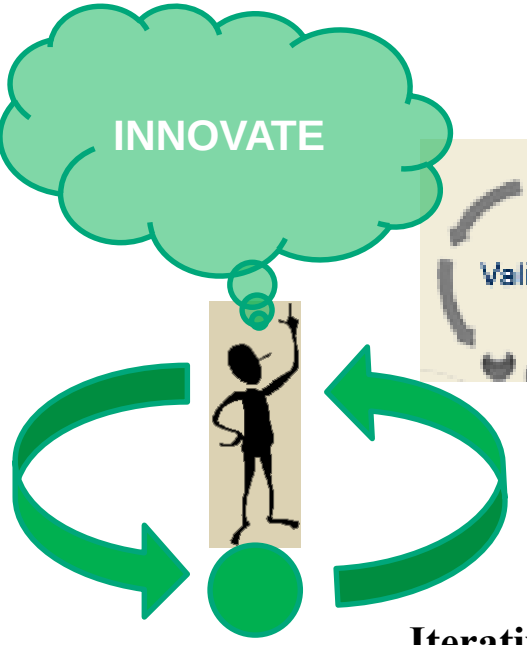
How to Collect User Requirements

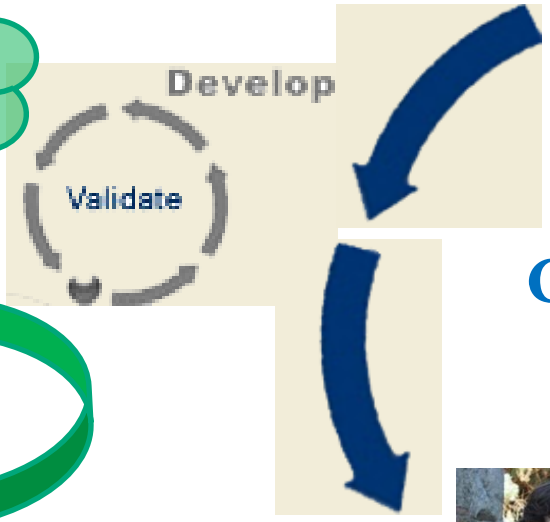
- Before starting learn about your product and involved users.
- Define methods, protocols and plan and prepare all the activities.
- Perform the activities.
- Analyse the data.

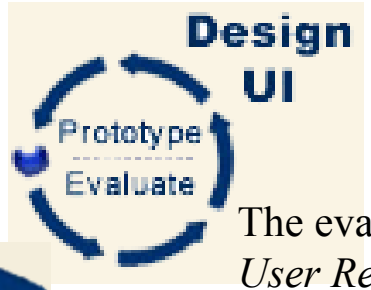
Incremental design of the components of the system, with a step-by-step realization of :

- Mock-Ups
- Working Prototypes





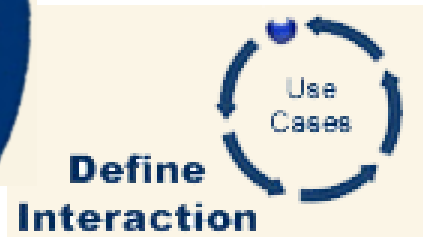




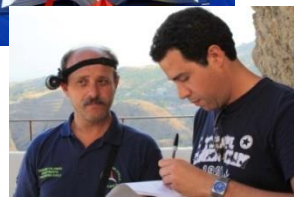
The evaluation of *User Requirements* allows to understand how the final user should interact with the system :

- Scenarios Analysis
- Task Analysis
- Use Case Analysis

USER CENTERED DESIGN



Iterative evaluation and **refinement** of the prototypes

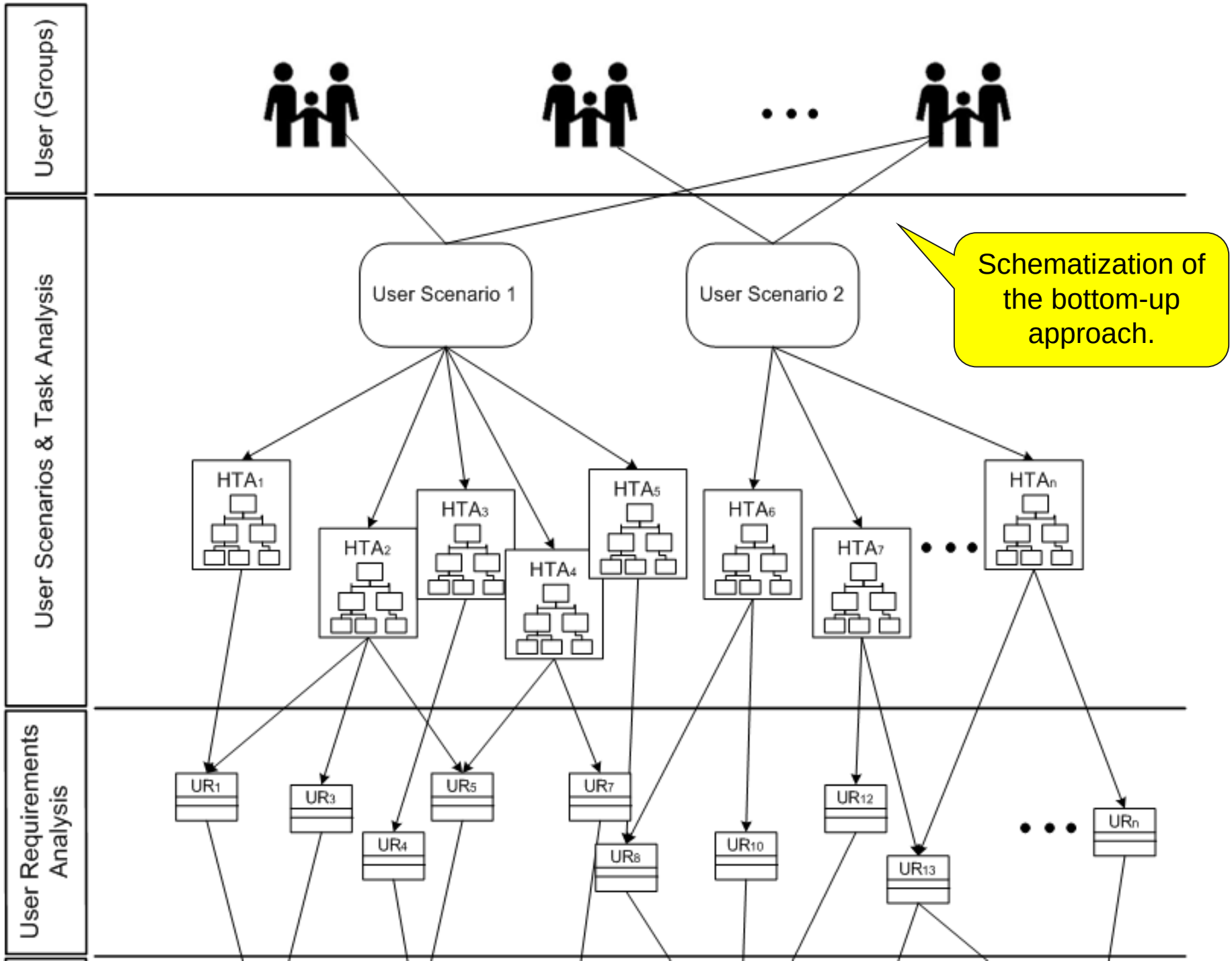


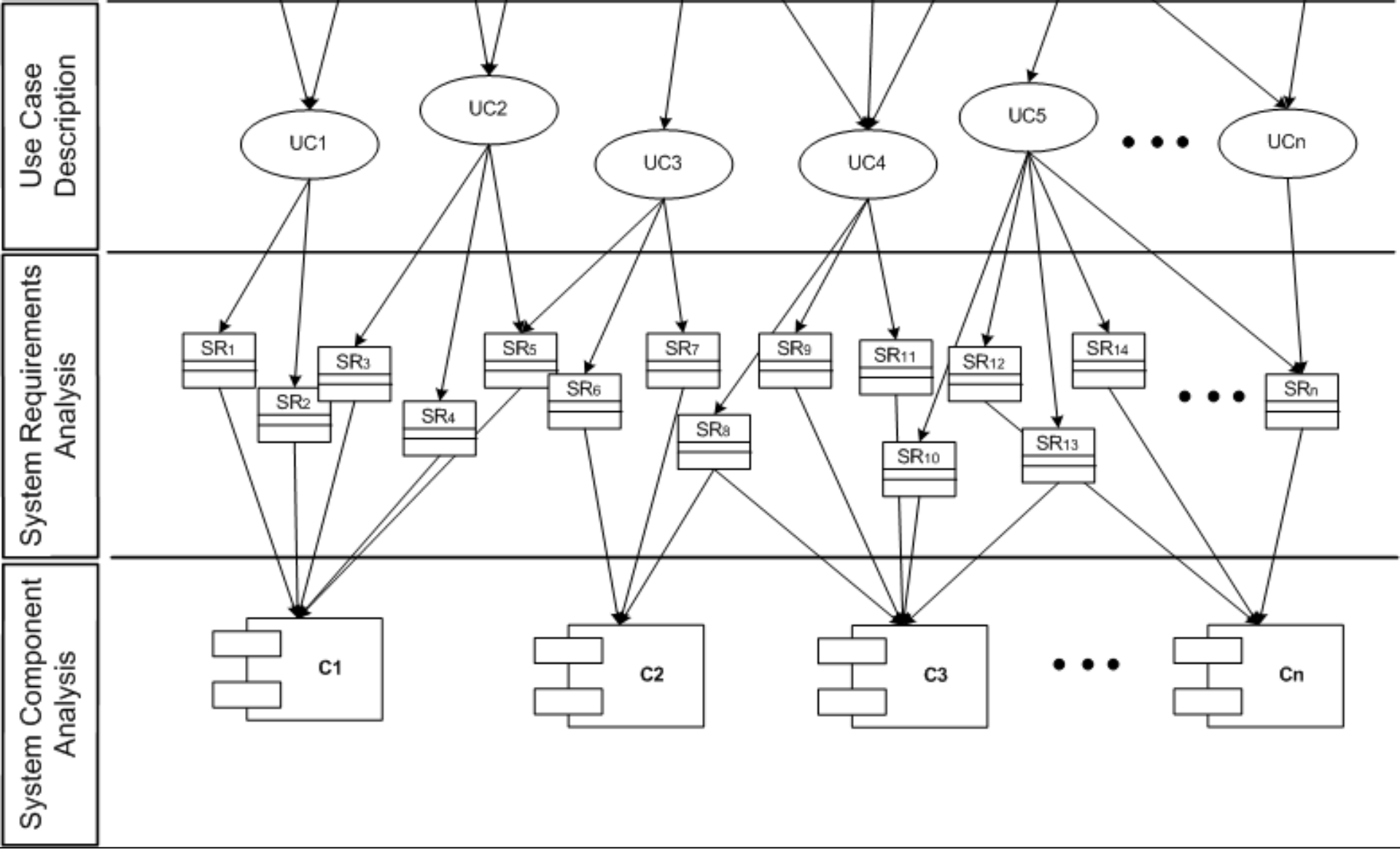
A twofold approach :

Top-Down = used to get information regarding the related works
Bottom-Up = used to get requirements from the practical work carried in the field.

Twofold Requirements Elicitation Approach

- Top down (based on “related work”)
  - Regulations, laws, initiatives and projects on a National and/or European basis
- Bottom up (based on the the actions carried in the field)
  - Case study: Emergency Management of Civil Protection
  - Experience of users and system engineers
  - Analysis of Emergency Management in other European countries (Austria, Czech Republic, Spain)
  - Analysis of EU regulations concerning Emergency Management (MIC, CECIS, Training Program)
  - Analysis of related European Projects (Amira, Oasis, Pompei, ...)


User (Groups)
User Scenarios & Task Analysis
User Requirements Analysis
User Scenario 1
User Scenario 2
Schematization of the bottom-up approach.
HTA1
HTA2
HTA3
HTA4
HTA5
HTA6
HTA7
HTAn
UR1
UR3
UR4
UR5
UR7
UR8
UR10
UR12
UR13
URn


Use Case Description
System Requirements Analysis
System Component Analysis
UC1
UC2
UC3
UC4
UC5
UCn
SR1
SR2
SR3
SR4
SR5
SR6
SR7
SR8
SR9
SR10
SR11
SR12
SR13
SR14
SRn
C1
C2
C3
Cn

Bottom-Up Approach

- HCI techniques have been used for:
  - User group categorisation
  - Semi-structured interviews
  - Focus groups
  - Scenario development
  - Storyboards
  - Hierarchical task analysis
  - Usability tests
    - Mock-ups and real prototypes

Identify user and stakeholder groups, their main roles, responsibilities and task goals in relation to the system

Interviews

- Interviewing is a technique that involves **structured** or **unstructured** discussion between requirement engineers and potential users of the application or system.
  - users, stakeholders and domain experts are *questioned* to collect information about their needs or requirements in relation to the new system to be developed.
- **Structured** interviews can be conducted if the requirements engineer already has a *fairly good knowledge* about the user's requirements.
- Interviews are usually **semi-structured** based on a series of fixed questions with scope for the user to expand on their responses.
- Advantages:
  - the questions can vary to adapt to the context;
  - the evaluator is free to start a discussion with the user to investigate interesting issues as they arise.

WORKPAD Interviews

- Semi-structured interviews with predefined set of fixed questions.
- Open-end discussion with the potential users dependning on the answer to the fixed questions.
- Questions are included in an **Interview Form** combined with ***Interview Guidelines***.
- ***Interview Guidelines*** provided instructions for the moderator to properly perform the interview.

Interview Guidelines - Example

- *The **moderator** is the leader of the interview and drives the potential user through the personal interview by asking questions that are specified in this document.*

- *The answers are **recorded** by another evaluator who also takes part to the interview. The interview is videotaped and tape-recorded by a third (technical) person, so that all statements are backed up.*

- *The moderator gives a **short summary** about the project to the users:*
  - *The WORKPAD project aims at building and developing an innovative software infrastructure (software, models, services, etc.) for supporting collaborative work of human operators in emergency/disaster scenarios....*

Interview Form - Example

Date:	
Name of the interviewed person:	
Organisation:	
Position in the organisation	
Moderator:	
Present Persons:	

List of questions

1) User Group Definition

- Question 1: What are your main responsibilities within this organisation?
- Question 2: In what kind of emergencies is your organisation involved?
- Question 3: What is your role during an emergency? In which phase of an emergency are you involved?
- Question 4: Do you know the statistical frequency according to which an emergency happens in your territory?

List of questions

- Depending on the user's answers, the interview is split in two branches:
  - the first one concerns front-end users;
  - the second one focuses on back-end users.
- The main purpose is to ask targeted questions to simulate a kind of "implicit scenario" in the mind of the user.
  - The target is to investigate which steps a user performs when preparing her/himself to face the emergency.

List of questions (Front-End)

2A) Front-End Users (Shortly after the emergency has happened)

- Question 5a: Which steps do you perform shortly after the emergency has happened?
- Question 6a: What kind of information (related to the emergency) do you get from the control centre?
- Question 7a: How long is the front-end team actively involved in this phase of the emergency (average)?
- Question 8a: What kind of information do you exchange with other members of the team during the transport to the place where the emergency has happened?

List of questions (Front-End)

2A) Front-End Users (During the emergency)

- Question 9a: Describe the composition of the team and the various roles of the team members allocated to them during the emergency.
- Question 10a: What kind of technical devices do you currently use in emergencies?
- Question 11a: How do you communicate with the other team members and with the back-end centre?
  - Does your team use a separate communication channel?

List of questions (Front-End)

2A) Front-End Users (During the emergency)

- Question 12a: What kind of technology do you currently use in/after emergency situations?
- Question 13a: What kind of information (and in which form) do you exchange with the team leader?
- Question 14a: Do you co-operate with members of other teams/organizations? (for example police, etc.)?
  - Do you exchange information and/or data?
  - Do you share a common technology?

List of questions (Back-End)

2B) Back-End Users (Shortly after the emergency has happened).

- Question 5b: Which steps do you perform shortly after the emergency has happened?
- Question 6b: How long are the back-end teams actively involved in this phase of the emergency (average)?
- Question 7b: What kind of information do you send to front-end operators, who have to prepare them to face the emergency?
- Question 8b: In which way do you obtain such information and in which format?

List of questions (Back-End)

2B) Back-End Users (During the emergency)

- Question 9b: What kind of technical devices do you use for the communication with the front-end operators?
- Question 10b: What kind of communication technology do you use?
  - Does your team use a separate communication channel?
- Question 11b: Does the communication take place with a particular team member(s) or can you communicate arbitrarily with everybody?
  - how strict are the hierarchical and the communication structures defined within your organisation?

List of questions (Back-End)

2B) Back-End Users (During the emergency)

- Question 12b: What kind of information do you send to the front-end users?
- Question 13b: What kind of information do you receive from the front-end users?
- Question 14b: Do you share technology and data with other organizations?
  - Which kind of data/technology?
  - In which way does this exchange of information take place?

List of questions

3) The last questions are the same for any kind of user

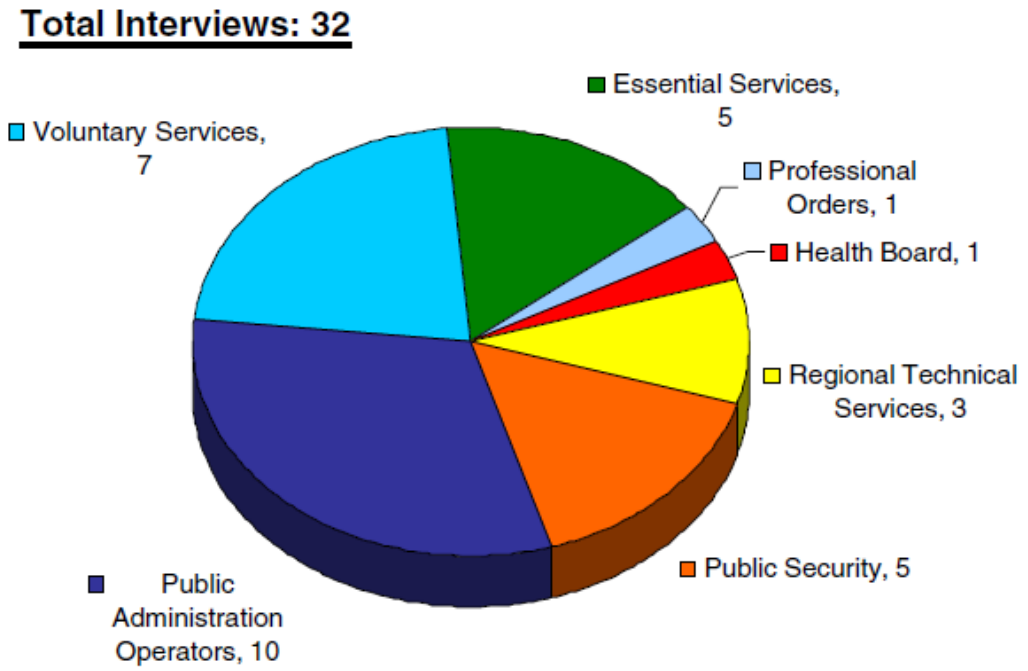
- Question 16: Do you currently use Geographic Information Systems (GIS)?
  - If yes, which software and data do you use?
- Question 17: Do you think that the devices and technologies used to face the emergency are conformant to the purpose for which they are used?
- Question 18: What do you think would be a big improvement concerning the technology part?
  - What kind of improvement would you propose?

Execution of Interviews

- Reggio Calabria, **November 22-24, 2006**
- 32 interviews
- 3 evaluators involved
- User groups
  - Public Security
  - Public Administation Operators
  - Voluntary Service
  - Essential Services
  - Professional Orders
  - Health Board
  - Regional Technical Services

Results of Interviews

- The results of interviews are a collection of (unstructured) information useful to:
  - gather user requirements;
  - understand how Civil Protection works;
  - get information about existing infrastructures.



User Groups Distribution

How to Collect User Requirements

- Before starting learn about your product and involved users.
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- Perform the activities.
- Analyse the data.
  - Document customer and user needs.
  - Describe individual requirements in a systematic and structured way.

Public Security Organizations

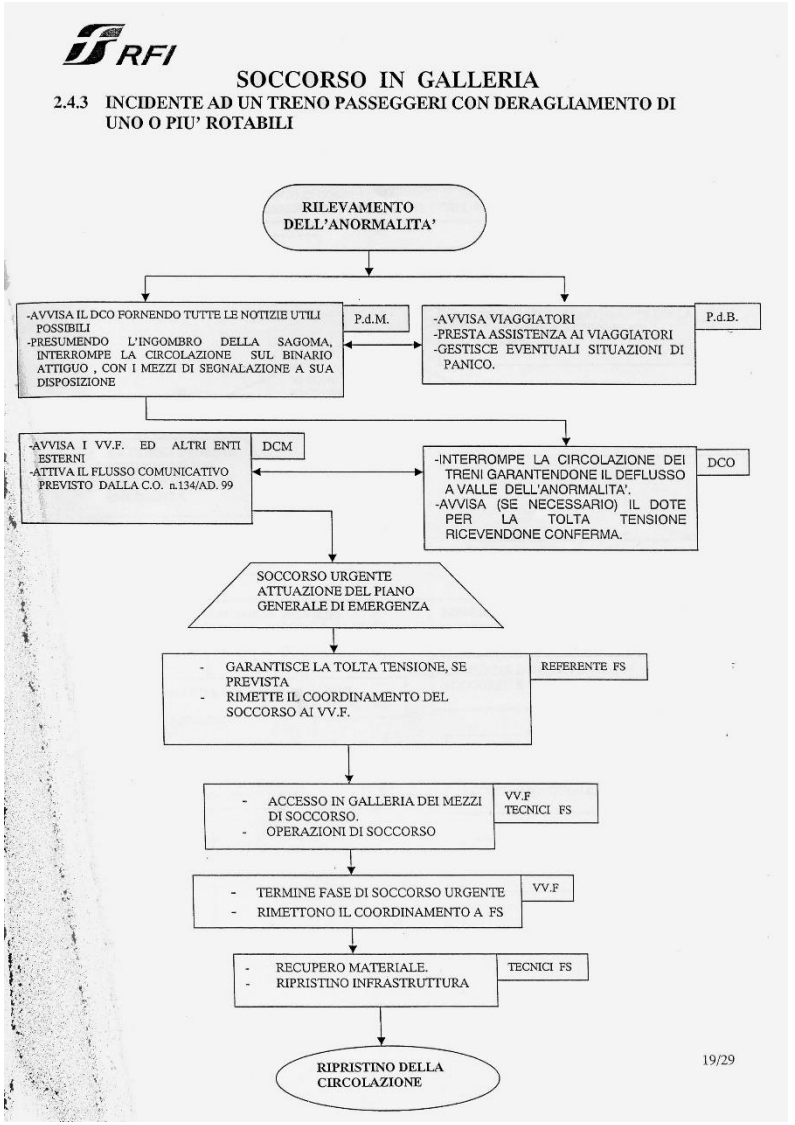
- Public Security organizations are in first line in the emergency management:
  - Usually they are in charge to collect warning signals sent by people.
  - They immediately reach the area to analyze the situation.
- Each Public Security organization perform its own specific tasks:
  - Policemen and Carabineers guarantee the maintenance of people security.
  - The urban police deals with traffic.
  - Fire Brigade coordinates actions on the field suggesting to Prefecture what actions should be done.
- Each Public Security organization provides a control room which communicate both with the CCS and COMs and with operators on the field.

Essential Services (1/2)

- They have expertise in specific sectors:
  - for example, A.N.A.S. for road management.
- Each Essential Service organization takes part to the management of an emergency whenever its skills are requested.
- They communicate through mobile phones.

Essential Services (2/2)

- Some organizations (e.g., R.F.I. – Italian Railway Networks) have precise action plans for emergencies.
  - For example this document defines the workflow to deal with emergencies that may happen in a tunnel.



RFI

SOCCORSO IN GALLERIA

2.4.3 INCIDENTE AD UN TRENO PASSEGGERI CON DERAGLIAMENTO DI UNO O PIU' ROTABILI

RILEVAMENTO DELL'ANORMALITA'

-AVVISA IL DCO FORNENDO TUTTE LE NOTIZIE UTILI POSSIBILI
-PRESUMENDO L'INGOMBRO DELLA SAGOMA, INTERROMPE LA CIRCOLAZIONE SUL BINARIO ATTIGUO , CON I MEZZI DI SEGNALAZIONE A SUA DISPOSIZIONE — P.d.M.

-AVVISA VIAGGIATORI
-PRESTA ASSISTENZA AI VIAGGIATORI
-GESTISCE EVENTUALI SITUAZIONI DI PANICO. — P.d.B.

-AVVISA I VV.F. ED ALTRI ENTI ESTERNI
-ATTIVA IL FLUSSO COMUNICATIVO PREVISTO DALLA C.O. n.134/AD. 99 — DCM

-INTERROMPE LA CIRCOLAZIONE DEI TRENI GARANTENDONE IL DEFLUSSO A VALLE DELL'ANORMALITA'.
-AVVISA (SE NECESSARIO) IL DOTE PER LA TOLTA TENSIONE RICEVENDONE CONFERMA. — DCO

SOCCORSO URGENTE ATTUAZIONE DEL PIANO GENERALE DI EMERGENZA

- GARANTISCE LA TOLTA TENSIONE, SE PREVISTA
- RIMETTE IL COORDINAMENTO DEL SOCCORSO AI VV.F. — REFERENTE FS

- ACCESSO IN GALLERIA DEI MEZZI DI SOCCORSO.
- OPERAZIONI DI SOCCORSO — VV.F TECNICI FS

- TERMINE FASE DI SOCCORSO URGENTE
- RIMETTONO IL COORDINAMENTO A FS — VV.F

- RECUPERO MATERIALE.
- RIPRISTINO INFRASTRUTTURA — TECNICI FS

RIPRISTINO DELLA CIRCOLAZIONE

19/29

Voluntary Services

- The Voluntary organizations are involved in the first aid response.
- Some organizations are characterized by high specializations: dog units, free divers, radio amateurs, etc…
- They communicate mainly using transceivers and mobile phones.

Health Board

- It takes part to all emergencies where public health is involved.
  - Often Public Health and volunteers overlap in interventions.
- The communication always happens through phones.

Professional Orders

- Professional orders are composed by qualified persons (Geologists, Architects, Engineers, Druggists, etc.).

- Usually, they aren't directly involved by Prefecture in most of the emergencies.
  - Each freelancer act by himself without coordination when he/she realizes he/she can be useful.

Bottom-Up Approach

- HCI techniques have been used for:
  - User group categorisation
  - Semi-structured interviews
  - Focus groups
  - Scenario development
  - Storyboards
  - Hierarchical task analysis
  - Usability tests
    - Mock-ups and real prototypes

Focus Groups

- Six/ten individuals are brought together to discuss their experiences or opinions around topics introduced by a moderator.
  - bring together a cross-section of stakeholders in a discussion group format.
  - each participant can act to stimulate ideas in the other people present, and by a process of discussion, the collective view becomes established which is greater than the individual parts.
- Used for having a quick understanding of user's perception about a topic.
- Very useful:
  - to precisely identify problems and possible solutions still unclear.
  - to build user scenarios and to perform task analysis.

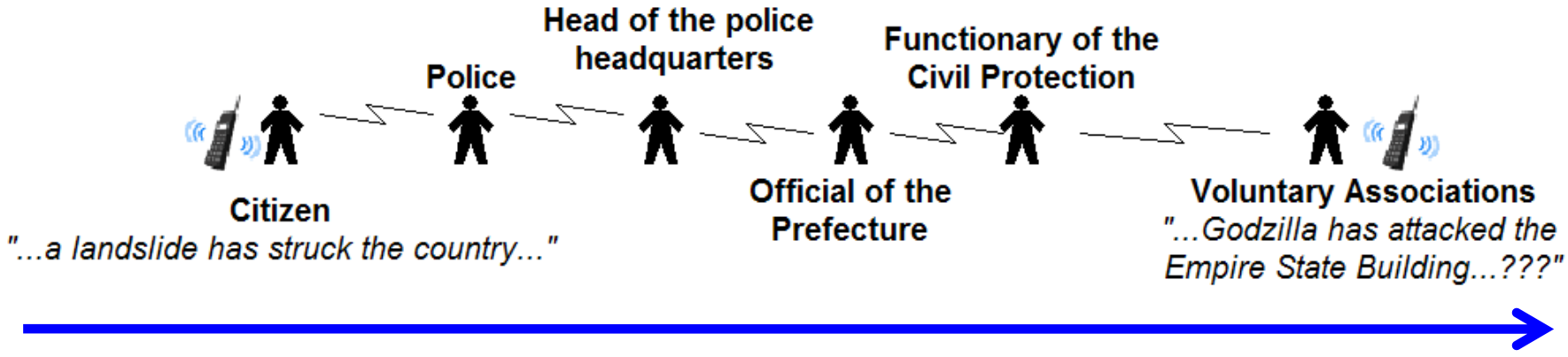
Results of the Focus Group in WORKPAD

- At the Back-end
  - Usually, control rooms have an information system where data collected about emergency are stored.
  - This information is not directly shared among organizations.

- At the Front-end
  - Currently, inside a team the communication takes place by transceivers and mobile phones.

How and when is each organization alerted?

- Involved organizations are alerted with a ‘chain of phone calls’...
- ... often a ‘chain of phone calls’ can distort the information...

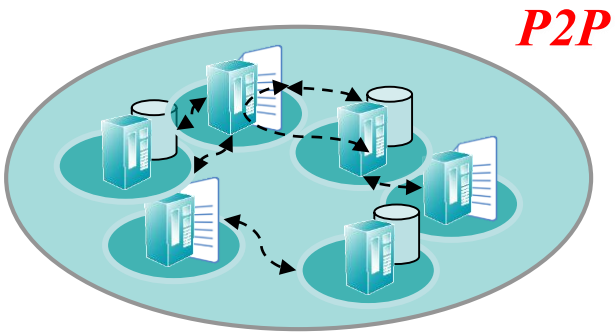


How can information and data be obtained?

- When an emergency happens, currently the only way to exchange information is through mobile phones.
- This happens because collected data are considered as “strictly reserved”...
- Towards the requirements
  - what about sharing this information?

The WORKPAD proposal for the Back-End side

- WORKPAD proposes to “build” an interconnected set of systems where each operator can put or retrieve relevant information about the emergency scenario.
  - …this information will be potentially spread and shared over the network…
  - …so, this could guarantee a consistent gain of time in the managment of the emergency…



How do the members of a team communicate? (1/3)

- On the front-end side, users have underlined some problems…
  - The radio communication is often not working…so they are forced to use mobile phones…
  - …unfortunately in many areas there is no signal...

- Towards the requirements
  - a significant improvement concerning the way to communicate would be very useful...

How do the members of a team communicate? (2/3)

- Moreover, the communication with members of other organizations is often difficult…

- …this happens because each team uses a dedicated frequency for intra-team communication.
  - Currently there is no way to allow communication between two Teams Leaders (except via mobile phones...provided that the phone number is known...).

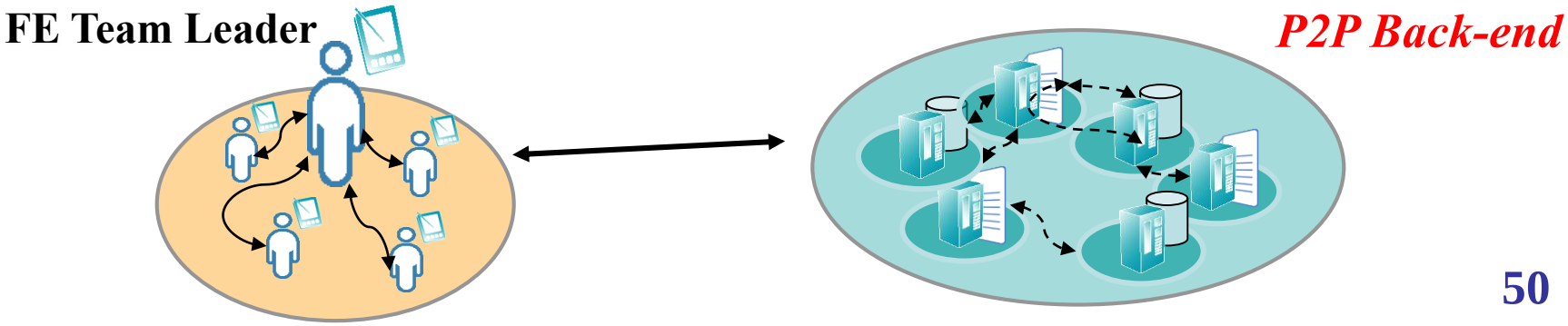
How do the members of a team communicate? (3)

- It is important to notice that, for all the teams belonging to the same organization, the communication channel **MUST BE** dedicated (this is an explicit USER REQUEST).

- Some organizations (as the “Corpo Forestale dello Stato”) are looking for a tool that not only allows to communicate, but also to have visual information:
  - exactly a PDA/smartphone.

The WORKPAD proposal for the front-end side

- WORKPAD proposes to equip each team member with handheld devices (PDAs, smartphones).
  - Team Leader's device could be connected using a satellite channel…the team's members could set up a mobile ad-hoc network…in this way all issues concerning the radio communication would be overcome.
  - Team Leader's device could be connected with the back-end infrastructure, in order to obtain the information to manage the emergency.
  - Team Leader's device coordinates other team member's devices by providing appropriate information (for example, cartography data).



Bottom-Up Approach

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  - Scenario development
  - Storyboards
  - Hierarchical task analysis
  - Usability tests
    - Mock-ups and real prototypes

Scenarios

- Scenarios are used to provide detailed examples on how users may carry out their tasks in a real-world context.
  - They can help to identify user characteristics that may impact the design and the tasks that the system needs to support.
  - They help to validate initial design choices with the user.
  - They help to identify potential design issues at an early stage.

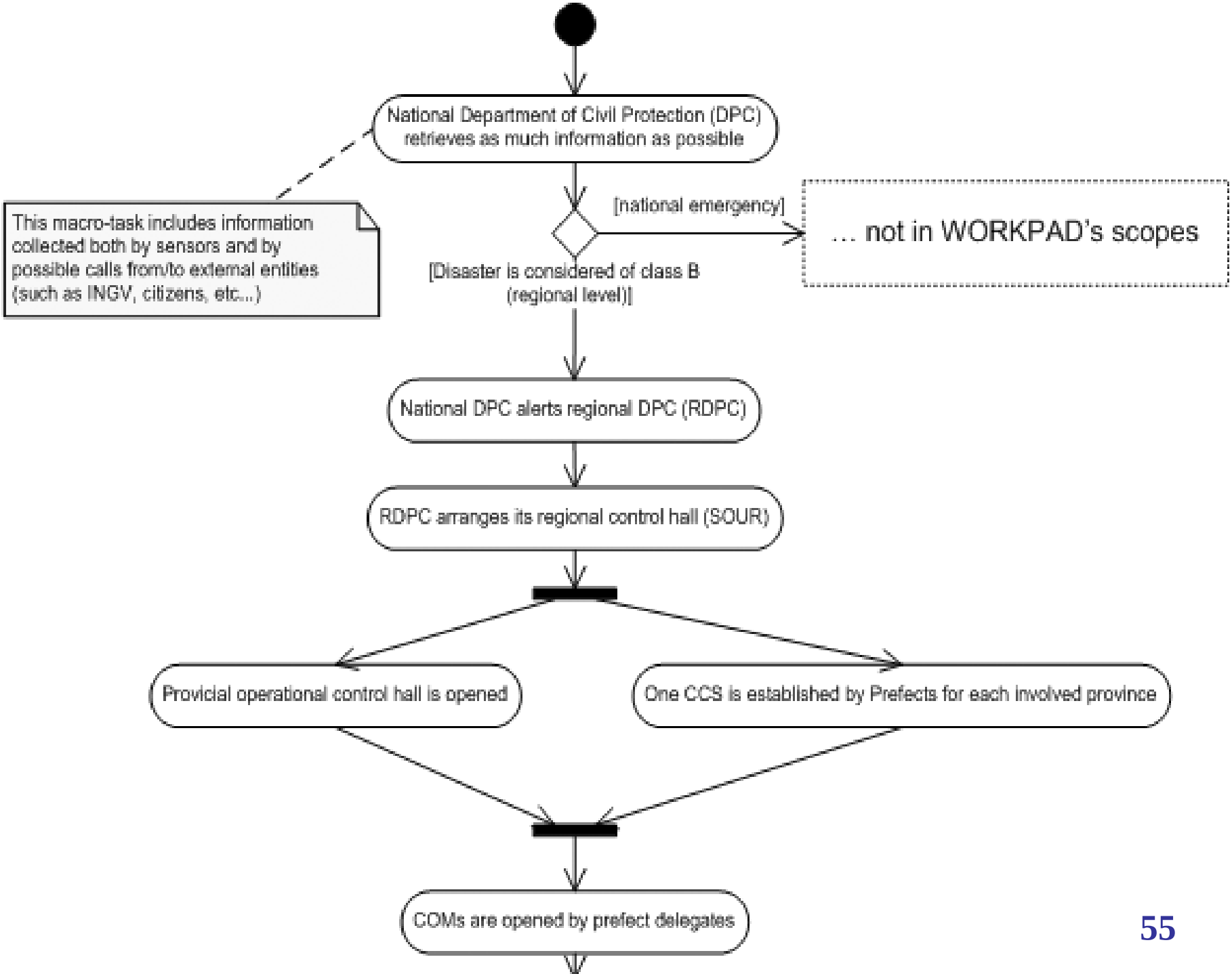
- Scenarios can also be used to:
  - communicate with others (e.g. designers, clients, users)
  - validate other models:
    - a detailed scenario can be ’re-played' against other models, e.g., task and dialog models
  - reproduce system dynamics:
    - while screenshots and pictures primarily give an idea of system appearance, a scenario can give an idea of system behavior.

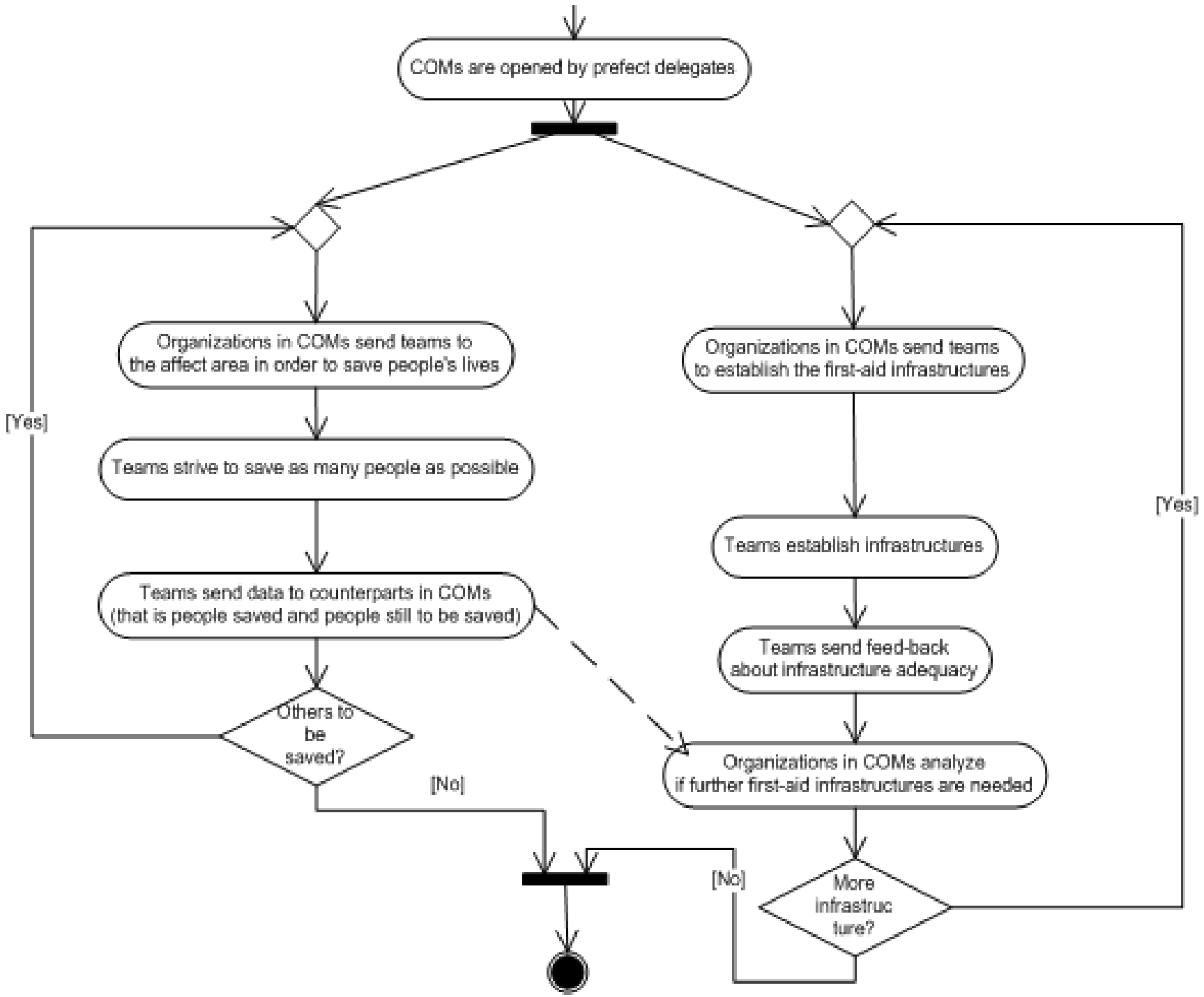
User Scenarios in WORKPAD

- Structured scenarios: written, textual descriptions organized in a scenario description form.
  - Two main scenarios : Earthquake and Flood
- Their objective is to serve as the basis for:
  - a better definition of users and user groups.
  - Task Analysis, Use Cases and UML modelling.
  - Show cases: validation and test.
- Scenarios were structured in:
  - scenario title, relevant emergency phase, main goal, duration, actors, initial state, final state, and dependencies.
  - UML activity diagrams depicting the sequencing of involved high-level activities.

Earthquake Scenario

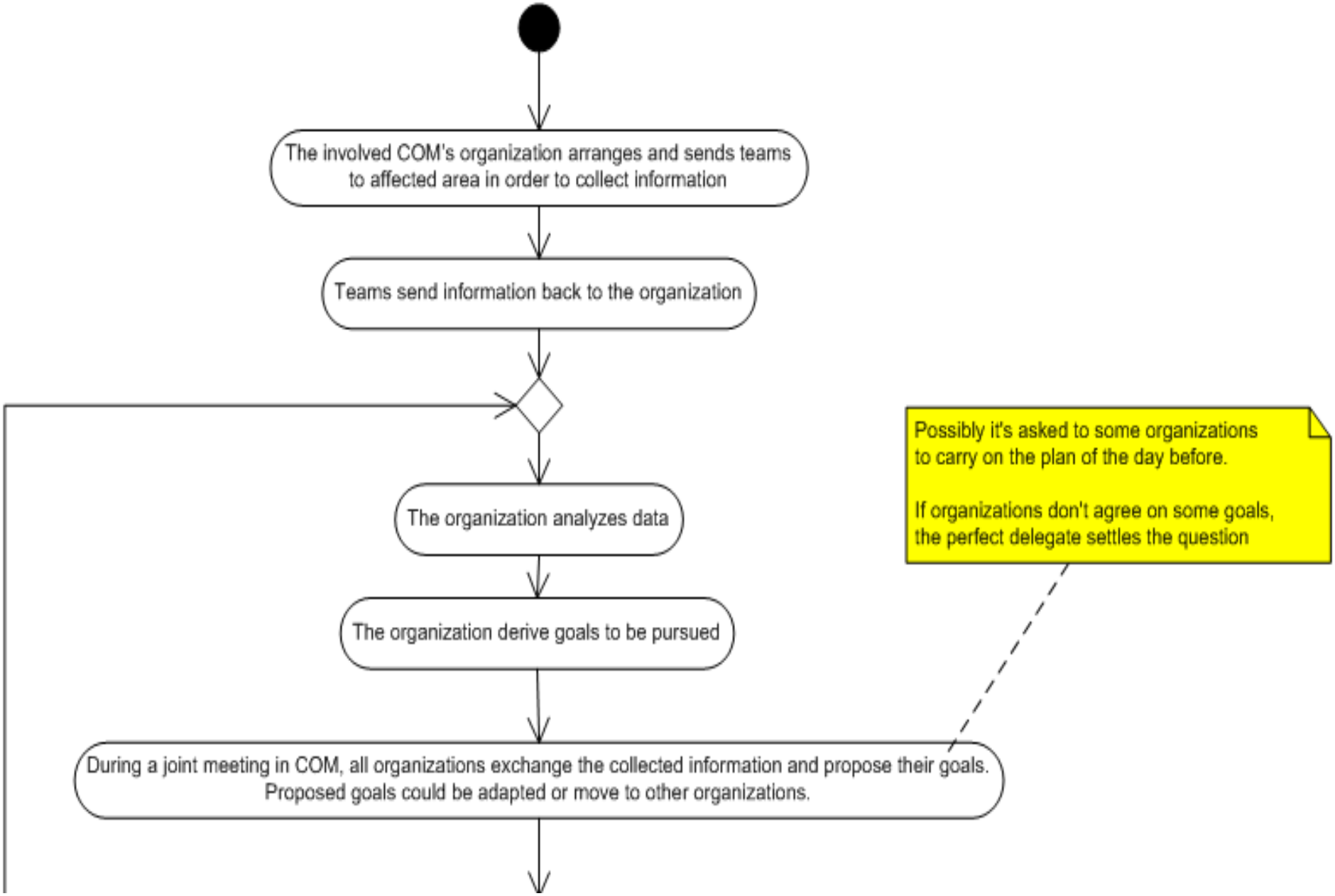
Scenario	Earthquake
Phase	Response Phase
Main goal	First aid to population
Duration	2-3 days
Actors	National and regional Civil Protection Departments, Police (State Police, Carabinieri, etc.), Hygenic Public Health department, Voluntary Services, Transportation & Infrastructure (e.g., Railway) Providers, Fire Brigades, State Forest Corp
Initial State	Emergency incident → notification about seismic activities
Final State	Teams are present in the field and received appropriate commands
Dependencies	Predecessor to second phase (Short-term Recovery Phase)
Task overview	See Figure : Macro Description of the Response phase process

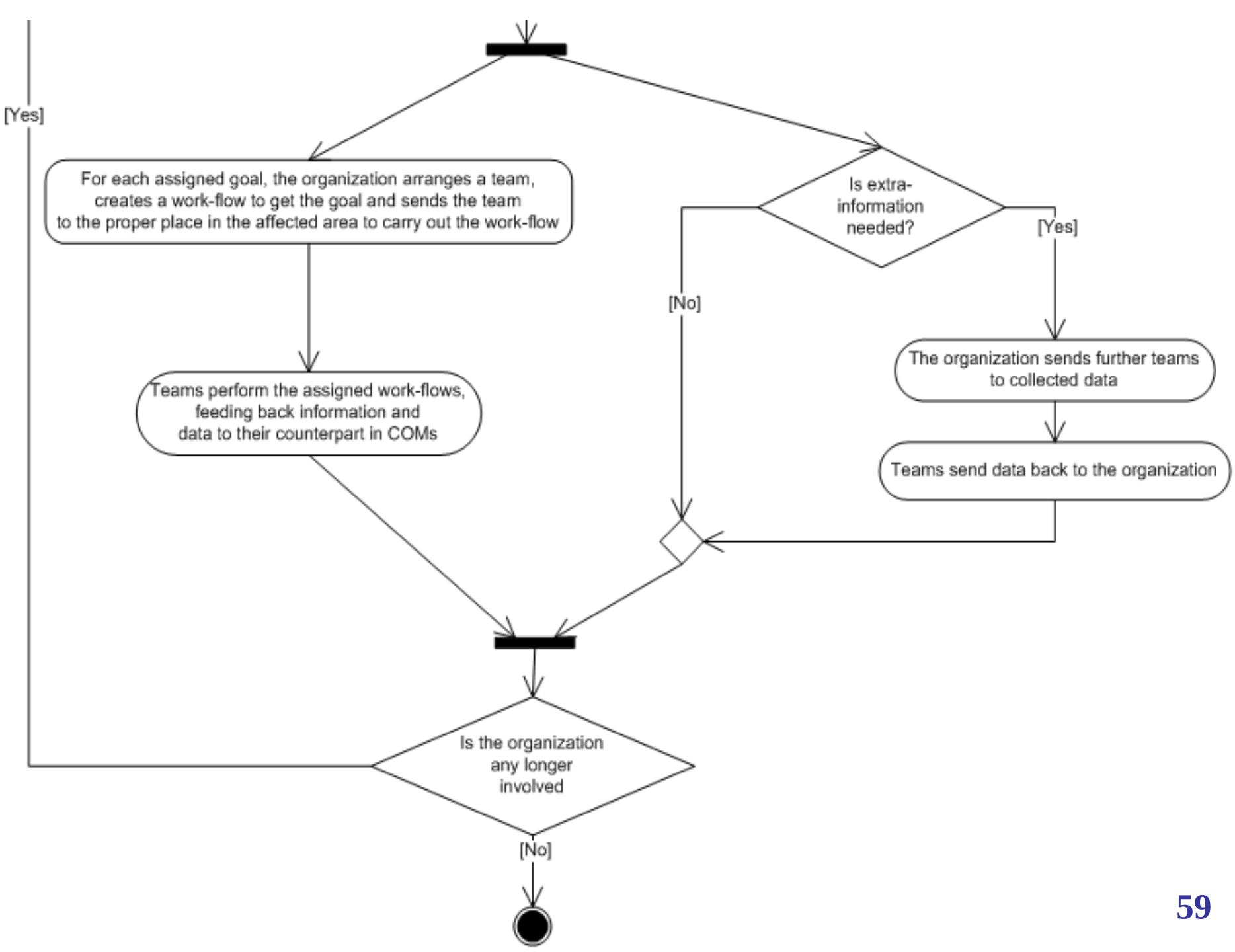

National Department of Civil Protection (DPC) retrieves as much information as possible
This macro-task includes information collected both by sensors and by possible calls from/to external entities (such as INGV, citizens, etc...)
[national emergency]
… not in WORKPAD's scopes
[Disaster is considered of class B (regional level)]
National DPC alerts regional DPC (RDPC)
RDPC arranges its regional control hall (SOUR)
Provicial operational control hall is opened
One CCS is established by Prefects for each involved province
COMs are opened by prefect delegates


COMs are opened by prefect delegates
Organizations in COMs send teams to the affect area in order to save people's lives
Teams strive to save as many people as possible
Teams send data to counterparts in COMs (that is people saved and people still to be saved)
Others to be saved?
[Yes]
[No]
Organizations in COMs send teams to establish the first-aid infrastructures
Teams establish infrastructures
Teams send feed-back about infrastructure adequacy
Organizations in COMs analyze if further first-aid infrastructures are needed
More infrastructure?
[Yes]
[No]

Flood Scenario

Scenario	Flood
Phase	Short-term Recovery Phase
Main goal	Recovery of the affected area, restoring infrastructure/essential service
Duration	14 days
Actors	DPC (national and regional), Fire Brigades, Army, Police (State Police and Carabinieri), Hygienic Public Health department, Voluntary Services, Transportation & Infrastructure Providers, State Forest Corp
Initial State	Initial assistance is provided, situation is stabilised → living conditions can not yet be sufficiently provided
Final State	Basic living conditions can be provided up to a certain degree → CCS are closed
Dependencies	Ancestor to response phase and predecessor to further long-term recovery phases
Task overview	See Figure : Macro description of the Short-Term Recovery phase process


The involved COM's organization arranges and sends teams to affected area in order to collect information
Teams send information back to the organization
The organization analyzes data
The organization derive goals to be pursued
During a joint meeting in COM, all organizations exchange the collected information and propose their goals. Proposed goals could be adapted or move to other organizations.
Possibly it's asked to some organizations to carry on the plan of the day before.
If organizations don't agree on some goals, the perfect delegate settles the question


[Yes]
For each assigned goal, the organization arranges a team, creates a work-flow to get the goal and sends the team to the proper place in the affected area to carry out the work-flow
Is extra-information needed?
[Yes]
[No]
The organization sends further teams to collected data
Teams perform the assigned work-flows, feeding back information and data to their counterpart in COMs
Teams send data back to the organization
Is the organization any longer involved
[No]

Storyboards and HTA for the Earthquake Scenario

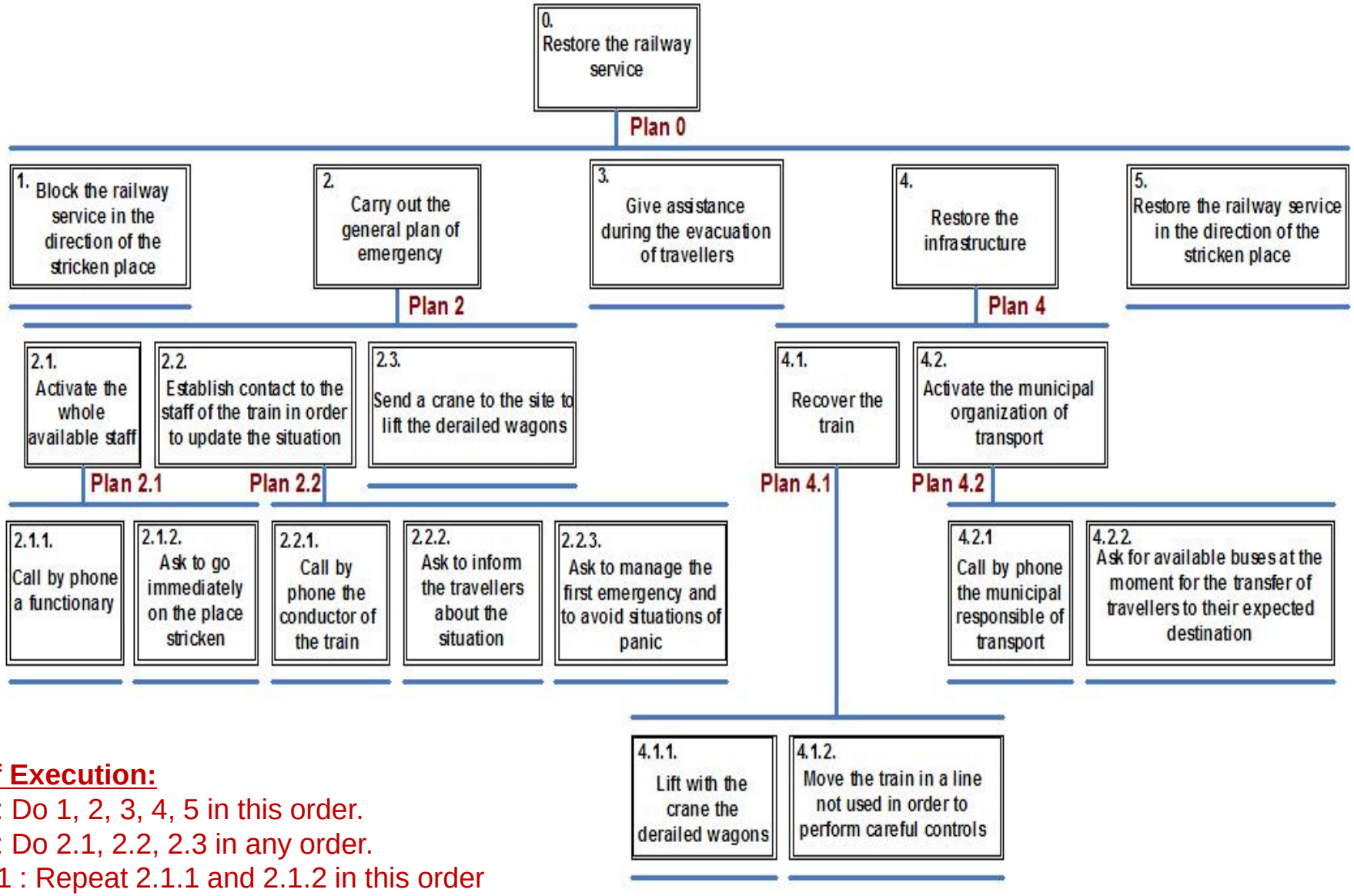
- Some storyboards have been derived from the earthquake scenario.
- Each storyboard is analyzed through **HTA**, that describes the low-level tasks performed by the actors involved to reach the intended goal.
- In order to better understand the carried out analysis , a summary of the earthquake scenario used for obtaining the storyboards is proposed:
  - *"At 10:30 A.M. a violent sixth-grade earthquake hit the south of Italy, with severe damages in a Calabrian town of 34.000 inhabitants. Furthermore, it is reported that the earthquake has caused damage to property and people in many other Calabrian cities."*

Storyboard "Restore Railway Service"

- **Actor:** Ferrovie dello Stato
- **Phase:** Response and Short-Term Recovery Phase
- **Initial State:** The COM activated in the catastrophe zone alerts the State Railways of the city. The earthquake has caused an electricity interruption in some areas of the city, and caused problems to the railway practicability. A short-circuit caused fire on a passenger train standing in a gallery.
- **Relevant Conditions:** Fire Brigade, Police and Red Cross have already been alerted to intervene and lead the operations of first help in the operational area. Volunteers of Civil Protection also join them.
- **Final State:** The railway service can again be activated.

Storyboard "Restore Railway Service"

- **Main Goal:** Restore the railway service
- **Duration:** 2-3 hours
- **Dependencies:**
  - **Fire Brigade:** firemen move with functionaries of State Railways into the gallery. Their task is to extinguish the fire and to evacuate all people out of the train.
  - **Voluntary Associations:** the people who have been evacuated are transported out of the gallery by volunteers who afterwards give them assistance.
  - **Police:** policemen secure the area in order to guarantee maintenance of the public security.
  - **Red Cross:** Red Cross operators move with functionaries of State Railways into the gallery in order to conduct the operations of first aid. The ambulances stay outside the gallery.



Plan of Execution:

Plan 0 : Do 1, 2, 3, 4, 5 in this order.
Plan 2 : Do 2.1, 2.2, 2.3 in any order.
Plan 2.1 : Repeat 2.1.1 and 2.1.2 in this order
while all available functionaries haven't been alerted to go on the place stricken.
Plan 2.2 : Do 2.2.1; then do 2.2.2 and 2.2.3 in any order
Plan 3 : Do 3.1 and 3.2 in any order. Then do 3.3 and 3.4 in this order.
Plan 4 : Do 4.1, 4.2 in this order. Then, if 4.2 has been successful, do 4.3; else do 4.4.
Plan 4.1 : Do 4.1.1, 4.1.2 in this order.
Plan 4.4 : Do 4.4.1, 4.4.2 in this order.

Storyboards and HTA for the Flood Scenario

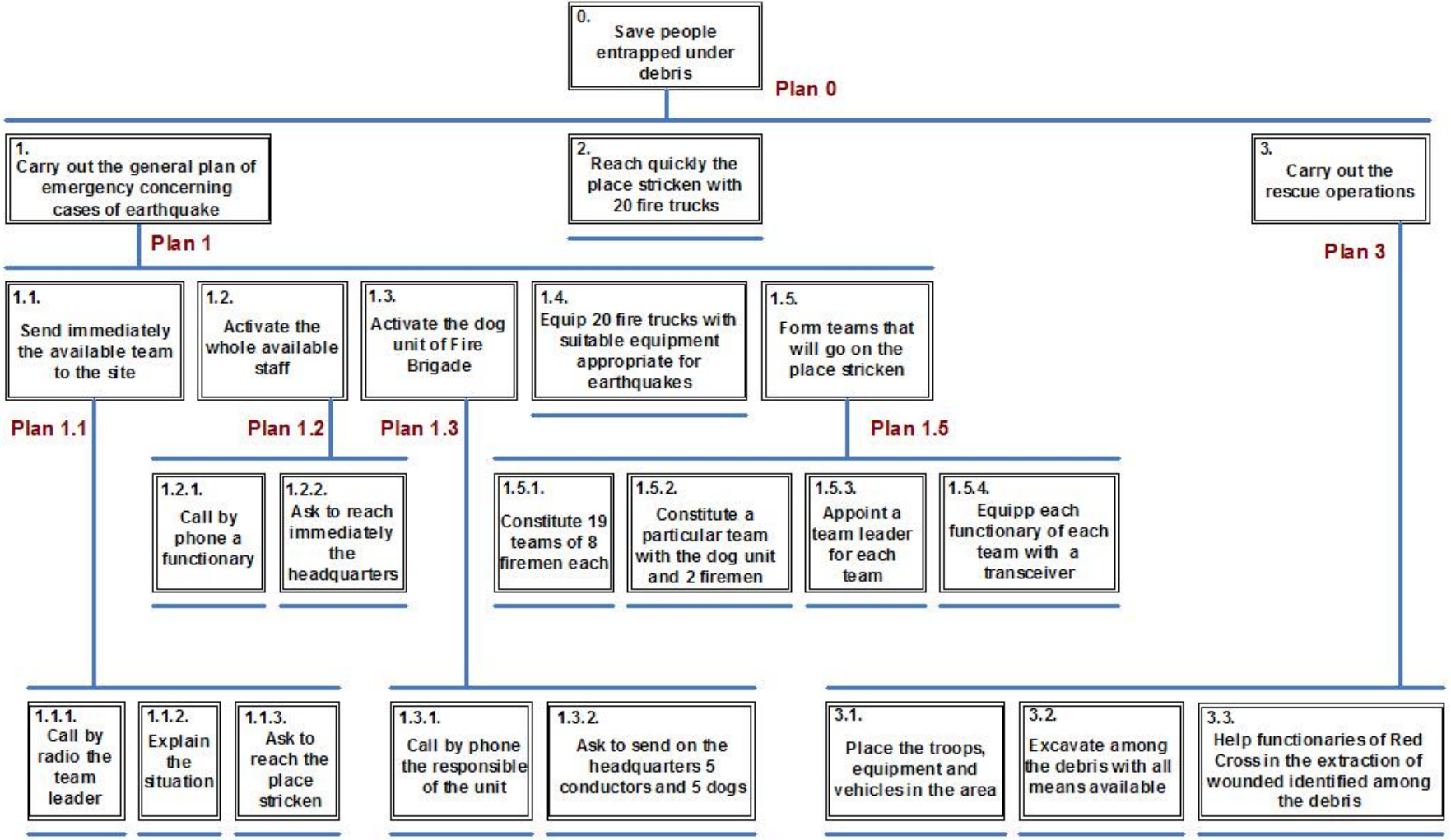
- Some storyboards have been derived from the flood scenario
- Each storyboard is analyzed through HTA, that describes the low-level tasks performed by the actor involved to reach the goal proposed.
- In order to better understand the carried out analysis, we propose a summary of the earthquake scenario used for obtaining storyboards:
  - *"During the night a violent and unexpected downpour hit a Calabrian town of 34.000 inhabitants. The town is flooded, which makes the lifesaving operations difficult."*

Storyboard “Evacuation of People"

- **Actor:** Vigili del Fuoco (Fire Brigade)
- **Phase:** Response Phase
- **Initial State:** The Fire Brigade headquarter of the area is alerted by the Regional Civil Protection Department. In a building of 6 floors, 7 kilometers out of the city centre, water has partially flooded the ground floor (not inhabited). 40 people are trapped - women, elderly people and children. The number injured people is unknown.
- **Relevant Conditions:** Two ambulances move to the operational area. Some functionaries of Civil Protection are already on site to manage the situation. Two police teams have already marked off the area.

Storyboard “Evacuation of People"

- **Final State:** The building must be evacuated in the shortest possible time in order to rescue all inhabitants.
- **Main Goal:** Rescue all people trapped into the building
- **Duration:** 4-5 hours
- **Dependencies:**
  - **Civil Protection:** Initially, functionaries of Civil Protection take a census of inhabitants. After the arrival of the Fire Brigade on site, their duty is to give assistance to the already evacuated people.
  - **Police:** The policemen have a focus on maintenance of public security.
  - **Red Cross:** Functionaries of Red Cross intervene in case of injured people.



Plan of Execution :

Plan 0: Do 1, 2 in this order. When the fire trucks arrive on the place stricken, do 3.

Plan 1: Do 1.1, 1.2, 1.3 in the same time. Then do 1.4.

Plan 1.1: Repeat 1.1.1, 1.1.2 in this order while all available functionaries haven't been alerted to reach the headquarters.

Plan 1.2: Do 1.2.1, 1.2.2 in this order.

Plan 1.4: Do 1.4.1, 1.4.2 in any order. Then do 1.4.3, 1.4.4 in any order.

Plan 3: Do 3.1, 3.2, 3.3 in this order.

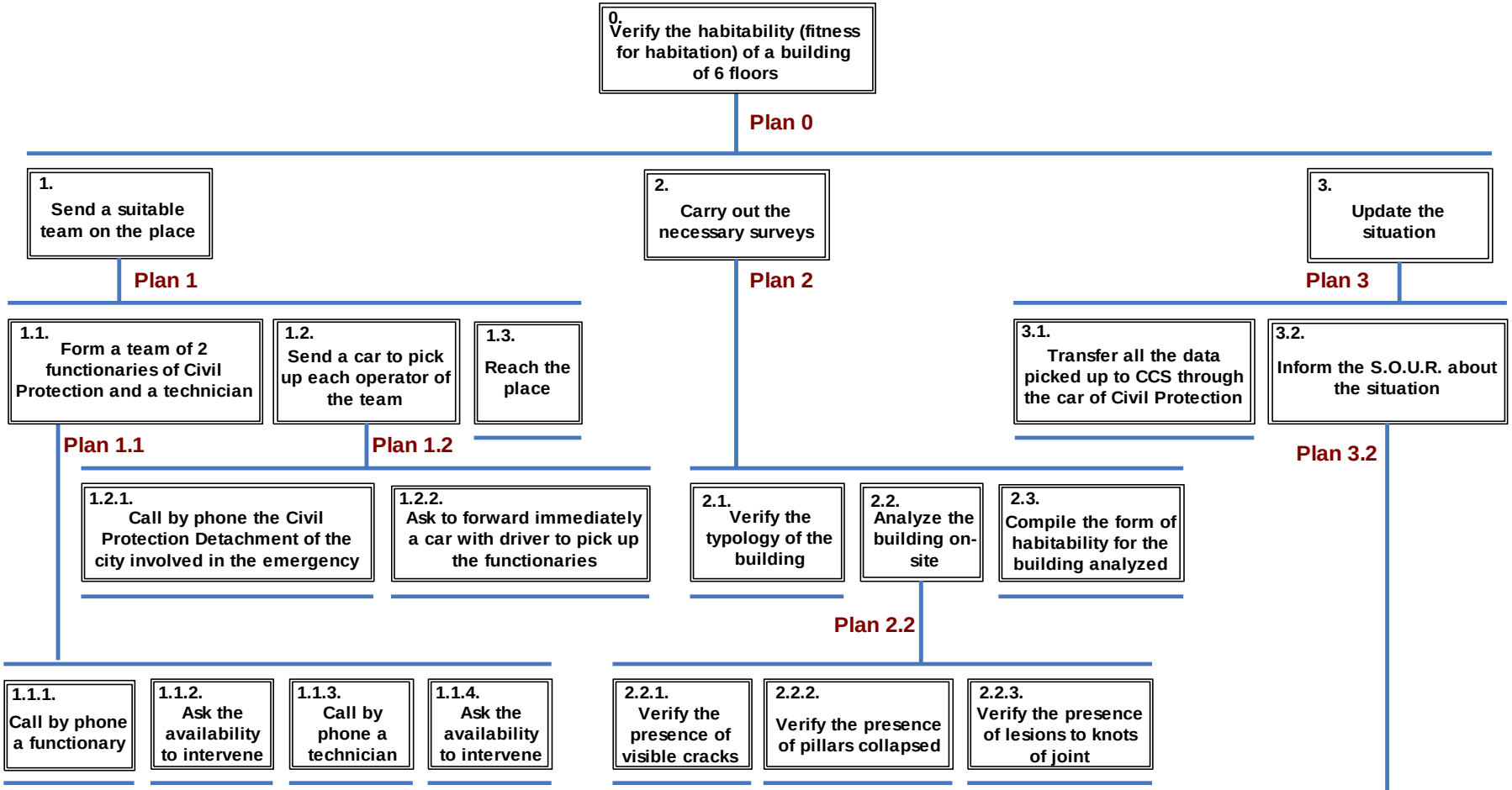
Plan 3.2: Do 3.2.1, 3.2.2, 3.2.3 in this order

Storyboard “Verifying the habitability"

- **Actor:** Civil Protection
- **Phase:** Response Phase
- **Initial State:** S.O.U.R. is alerted by the CCS activated in prefecture. According to some notifications of citizens, the violent downpour that hit the city in the night has caused the collapse of some pillars in a building of 6 floors situated in the city centre. It is necessary to go on site to verify the habitability (fitness for habitation) of the building.
- **Relevant Conditions:** Due to the great distance of the S.O.U.R. from the city affected by the emergency, it would be desirable to involve the Civil Protection Detachment of the city.

Storyboard “Verifying the habitability"

- **Final State:** The habitability of the building must be verified in the shortest possible time and the CCS must be informed about the results of the verification.
- **Main Goal:** Verify the habitability of a building
- **Duration:** 2-3 hours
- **Dependencies:**
  - **Civil Protection:** It acts directly in the city involved in the emergency. It is coordinated by S.O.U.R.



Plan of Execution :

Plan 0 : Do 1. When the Civil Protection staff arrives on the place stricken do 2, 3 in this order.
Plan 1 : Do 1.1, 1.2, 1.3 in this order.
Plan 1.1 : Repeat 1.1.1, 1.1.2 in this order while at least 2 functionaries haven't been alerted to intervene. Then repeat 1.1.3, 1.1.4 in this order while at least a technician hasn't been alerted to intervene.
Plan 2 : Do 2.1, 2.2, 2.3 in this order for the villa in which the collapse has happened. Then repeat these tasks while all the buildings in the immediate proximities have not been verified.
Plan 2.2 : Do 2.2.1, 2.2.2, 2.2.3 in any order.
Plan 3 : Do 3.1, 3.2 in any order.
Plan 3.2 : Do 3.2.1, 3.2.2 in this order.

From Task Analysis to Use Cases

- The design of:
  - scenarios (the macro level)
  - storyboards (the medium level)
  - task analysis (the micro level)

has allowed defining detailed User Requirements and Use Cases

- In WORKPAD User Requirements have been categorized in:
  - General, Communication, Back-End and Front-End.

ID	A unique identifier, composed of a classifier and a sequential number (eg "G-2"): G … General requirement C … Communication requirement B … Back-End requirement F … Front-End requirement
Title	A short title of the requirement giving an overview.
Description (optional)	A more detailed description of the requirement.
Classification	A classification according to: G … General requirement C … Communication requirement B … Back-End requirement F … Front-End requirement
Significance	Depicts the importance of the requirement for an emergency management system in general: Must … This requirement *must* be provided. Shall … This requirement *shall* be provided. Should … This requirement *should* be provided.
Priority	Indicates the priority in terms of an implementation of this requirement within the WORKPAD project: 1 … Mandatory 2 … Desirable 3 … Optional
Relevancy	The requirement is relevant for either scenario 1 or 2 (implying also the storyboards), and the showcase (true/false) (eg "1/false", 'X' would denote "relevant for both")
Source	The requirement was acquired through: U … User analysis (such as Interviews, user workshops, HTAs) I … Investigations of related work and/or EU regulations
Dependency (optional)	Indicates a relation between requirements.
Evaluation	The evaluation of this requirement is done via: Ver … Verification: testing (such as software, performance etc.) or review Val … Validation: user/field test, user feedback

User Requirements Form

Example of a User Requirement

ID	**B-4**
Title	The BE must integrate various data sources and make them available through a well-defined interface.
Description	To alleviate information access and to address interoperability, well-defined interfaces – ideally based on standards – must be provided at the WORKPAD BE. In this way, the BE abstracts from logical and physical data models and implementations of data providers such that they are not visible to knowledge consumers.
Classification	**B**
Significance	Must
Priority	1
Relevancy	X/true
Source	I
Dependency	**G-3, G-12**
Evaluation	Ver

Example of a User Requirement

ID	**F-10**
Title	FE applications must include some basic GIS functionality.
Description	It must be possible to deliver geographic data to the FE entities and to present it accordingly.
Classification	**F**
Significance	Must
Priority	1
Relevancy	X/true
Source	**U**
Dependency	G-3, B-14
Evaluation	**Val**

A Summary of final User Requirements listing

General (G)

- **G-3** The user must be able to access spatial as well as non-spatial information through one platform.
- **G-11** The user must be able to exploit the WORKPAD system in all kinds of disasters (natural, technical and man-made).
- **G-12** The user must be able to access relevant data-sources of different organizations involved in the emergency management process through WORKPAD.
- **G-17** The user must be supported in her relevant work-flows in emergency situations by appropriate and adaptive process management techniques within WORKPAD.
- **G-29** Usability issues shall be taken into account.
- **G-31** The user shall be able to get (quasi) real-time and comprehensive information about the current status of the situation.
- **G-37** The user shall be supported in her coordination activities by geographic data.

A Summary of final User Requirements listing

Communication (C)

- **C-1** By using WORKPAD, the user must be able to be connected between different organizations involved in an emergency.
- **C-4** The user's communication must be guaranteed via fault-tolerant network services.
- **C-6** The user must not notice dynamic joins or leaves of network nodes; instead the network must be able to (re-)configure itself.

Back-End (B)

- **B-4** The user must be able to access various data sources integrated in the BE through a well-known interface.
- **B-11** Users must be able to get notifications about (generic) information updates at the inter-organizational level related to subscriptions.
- **B-14** The user must be able to query geographic data from the BE.

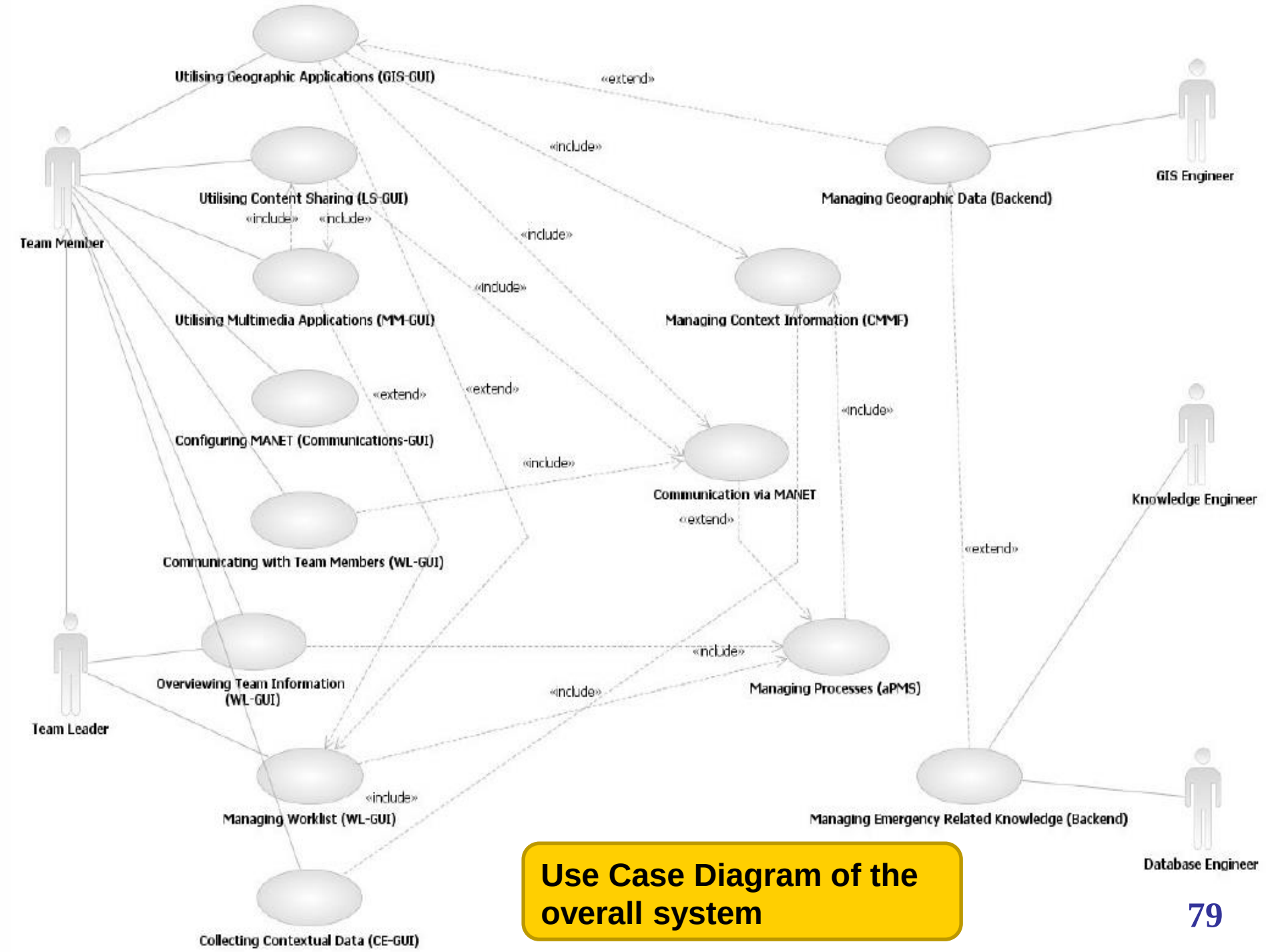
A Summary of final User Requirements listing

Front-End (F)

- **F-1** The users in FE teams must be able to electronically communicate with the BE and request data.
- **F-2** The users in FE teams must be able to deliver information to the BE.
- **F-7** The user must be supported by notification mechanisms.
- **F-9** Information must be presented to the user in an appropriate, user-friendly (i.e. usable) way.
- **F-20** The users of FE teams should be supported by the WORKPAD system in collaboration, data exchange, and the exploitation of distributed services and information when operating in the field.
- **F-21** The user must be able to communicate with other team members via text\audio messages.
- **F-24** The user must be provided with current positions of objects (e.g., vehicles,buildings) or persons (other team members) of interest.
- **F-25** The user must be able to create, modify, or annotate points of interests on a digital map.

User Requirements are used as input for the use cases…

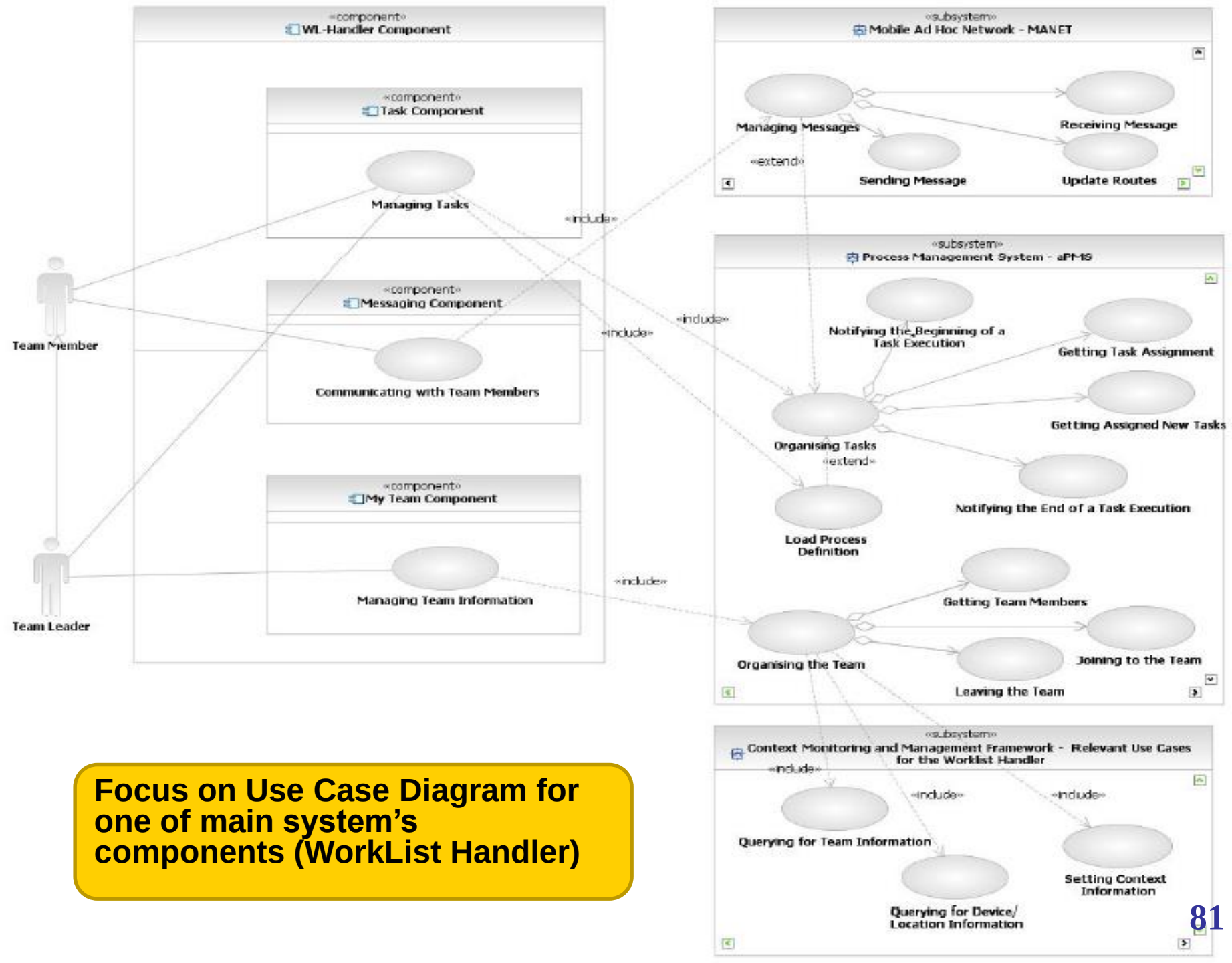
…and System Requirements are the outputs.



Use Case Diagram of the overall system

An Example of a Use Case

ID	UC-WLH-2
Use Case Name	Communicating with Team Members
Brief Description	Interact with each other by an audio or textual communication.
Actors	Team Member, Team Leader
Preconditions	Communication devices
Final State(s)	Sended audio or textual messages.
Main Flow	1. The actor receives an incoming message. 2. The system displays it. 3. The system broadcasts new message to all team members and also to the team leader. 4. The system displays overview of the received messages.
Alternatives	None.
Related System Requirements	WH-F-2
Related User Requirements	G-28, F-21, F-22
Included Use Cases	UC-Abstract-MANET-1
Extended Use Cases	None.
Frequency of Execution	Very often.
Created by	Andrea Marrella
Date created	13/12/2008
Last Updated By	Andrea Marrella
Date Last Updated	22/02/2008



Focus on Use Case Diagram for one of main system's components (WorkList Handler)

A First Mock-Up of the Worklist Handler

Three categories easily accessible through the use of tabs on the left side of the screen.

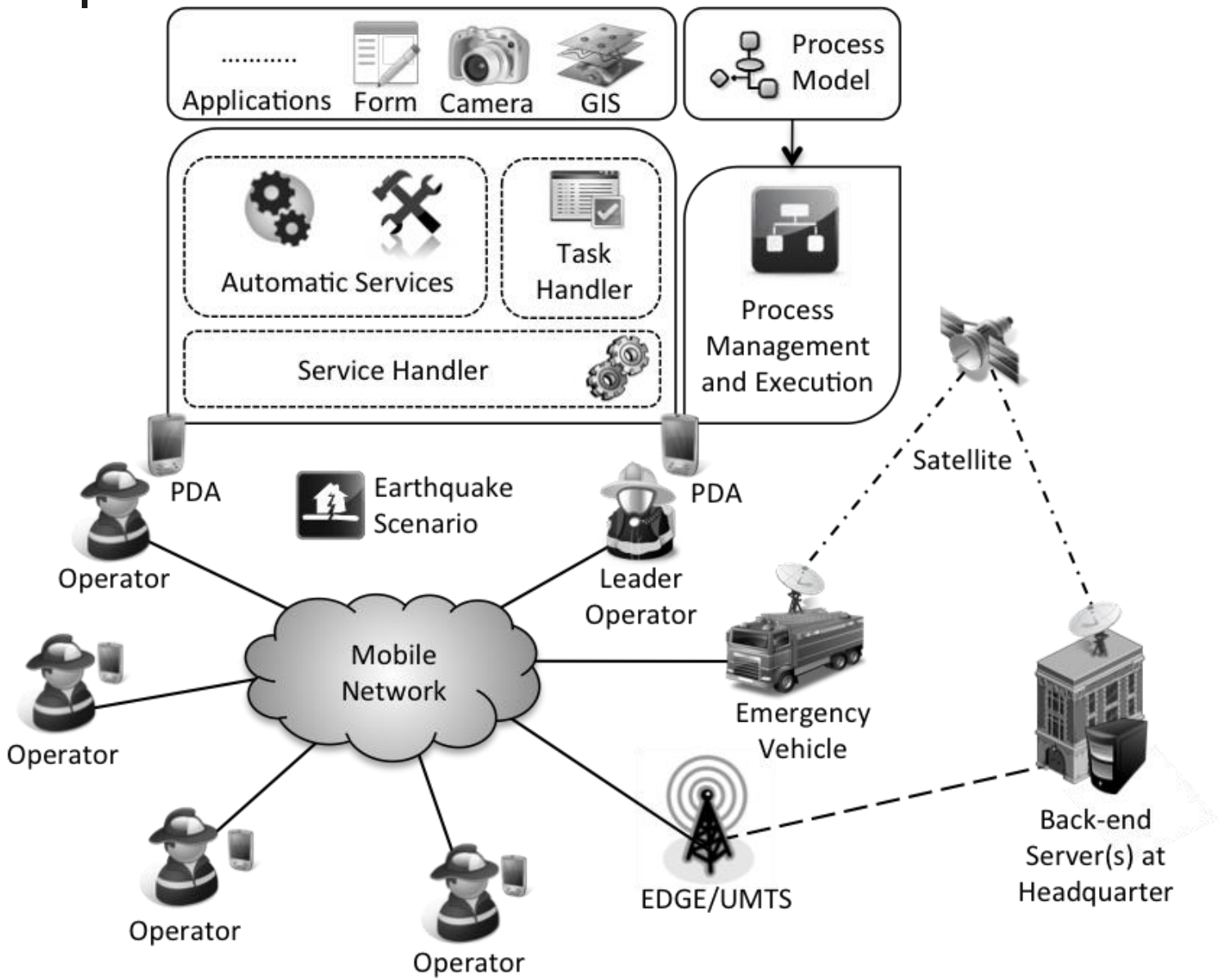
Every macro-category is characterized by a different color, so that the user can memorize and locate the context of the interaction.

Low probability to push the wrong button.

Tasks organized on the screen in a hierarchical way.

Each category contains only the essential information.

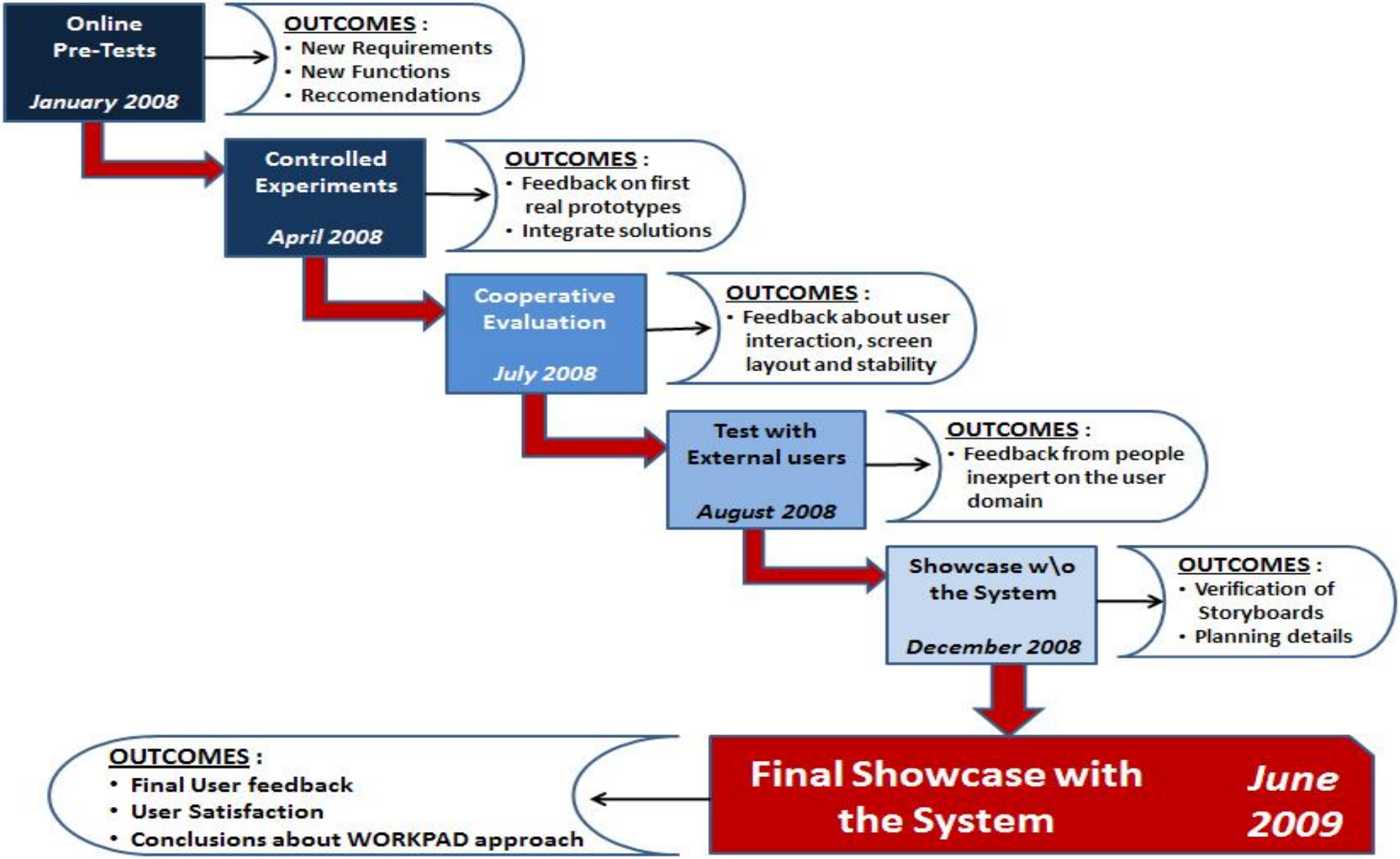
Final Architecture for the Front-End



Evaluation Techniques in WORKPAD

- User Test Methodology
  - Online Pre-Tests
  - Controlled Experiments
  - Cooperative Evaluation
  - Test with External Users
- The WORKPAD Showcases
  - Without and with WORKPAD

User Test Methodology



Gradual improvement of the User Interface

On-line Pre Tests

Controlled Experiments

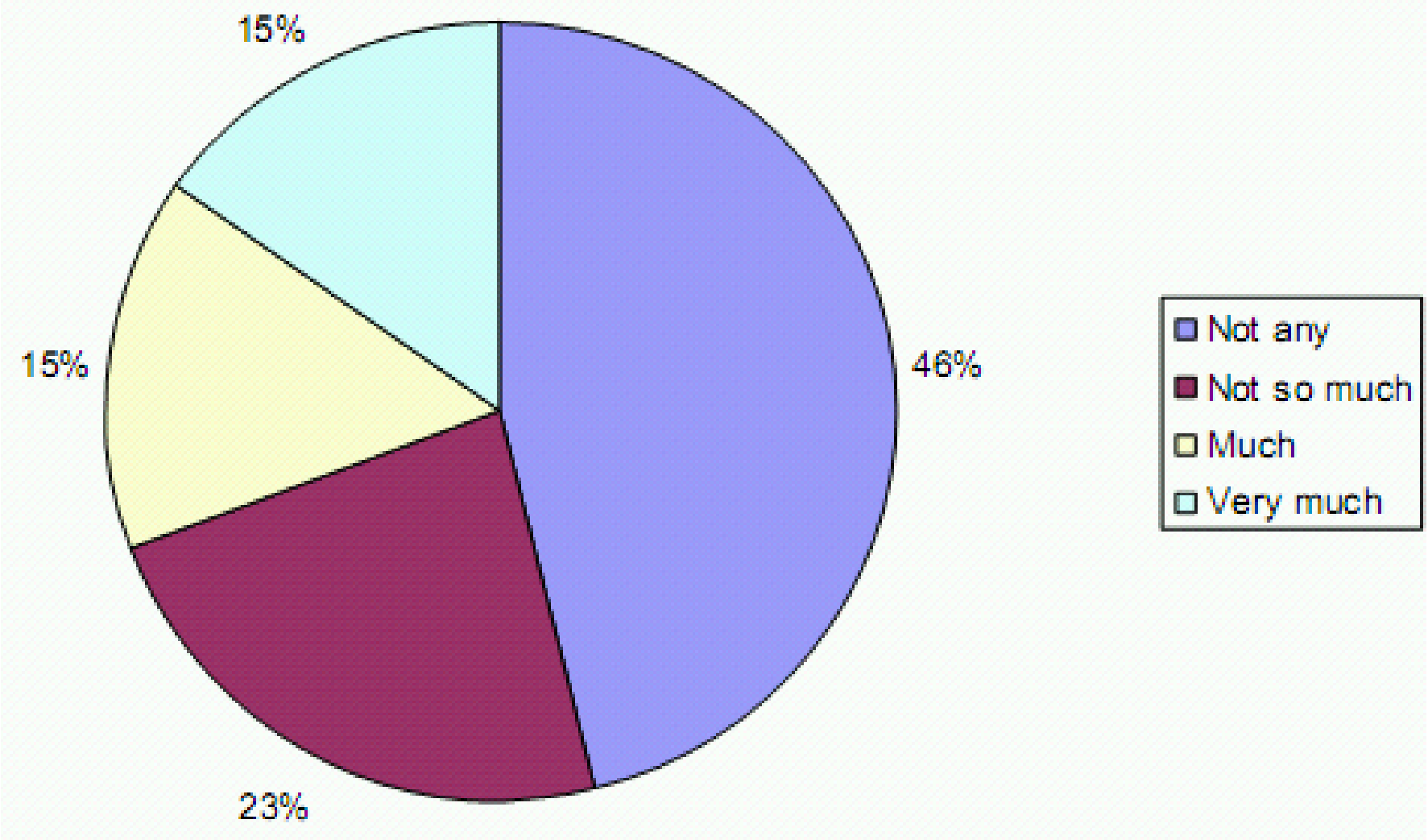
Cooperative Evaluation

Tests with External Users

On-line pre-tests

- We used **mock-ups** (Web and Powerpoint) to get feedbacks from the potential users.
  - The main goal was to gain a **first insight** into the **level of usability** and **understandability**.
  - Important to get feedback from the users, if the **requirements** were **understood correctly** and are **adequately met** by the **system features**.
- **Questionnaire** (Web) : questions about task management, map overview, connection establishment, multimedia and context editor, file sharing.
- **Users Involved**:
  - 13 users (8 male and 6 female) from Calabria region, 3 of age 46-60 and 10 of age 31-45, with different experience with PDA's participated in the test.

Example Results: Experiences with PDA‘s



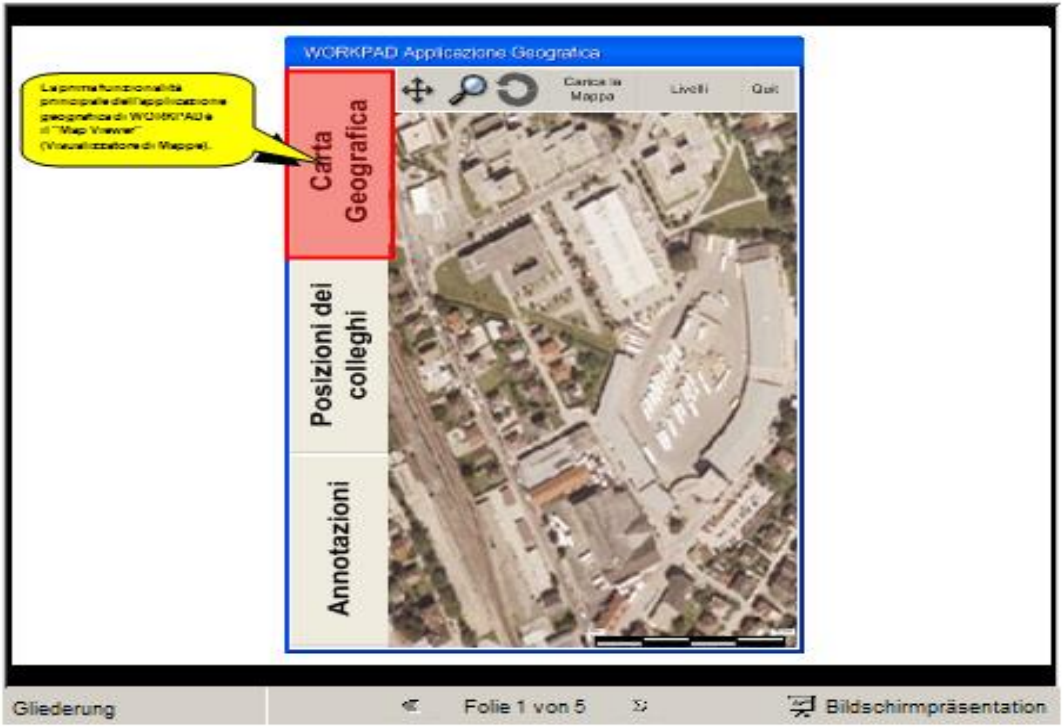
MAP OVERVIEW

Imagine you work for the fire brigades and are currently at the emergency area where your task is to first of all rescue people out of the debris. A young women needs your help! You are not able to help her on your own and therefore want to know where the other team members currently are. With the help of the map overview you can locate them in the area and call them for help.

The **map overview** provides:

- geographic information of the affected area
- position information about team members that are present in the emergency area
- map interaction functionalities
- functionalities for transferring geographic information to other team members

Please go carefully through the following graphics and descriptions of the map overview and answer the questions then!
Start the presentation with a mouse click at the link "presentation" (see: down to the right)



If the presentation does not work well, please use the following link:

http://www.salzburgresearch.at/~rstein/srfg/mockup.ppt

11. Would a digital map be helpful for your daily work?

For your information:
If your answer is "no", you will move automatically to the next section of the questionnaire!

- ○ yes
- ○ No

12. Is the map view interface understandable and intuitive for you?

- ○ Yes
- ○ No
- ○ If no, please mention why:

13. How attractive is the map screen design for you?

Very attractive	attractive	less attractive	Not attractive
○	○	○	○

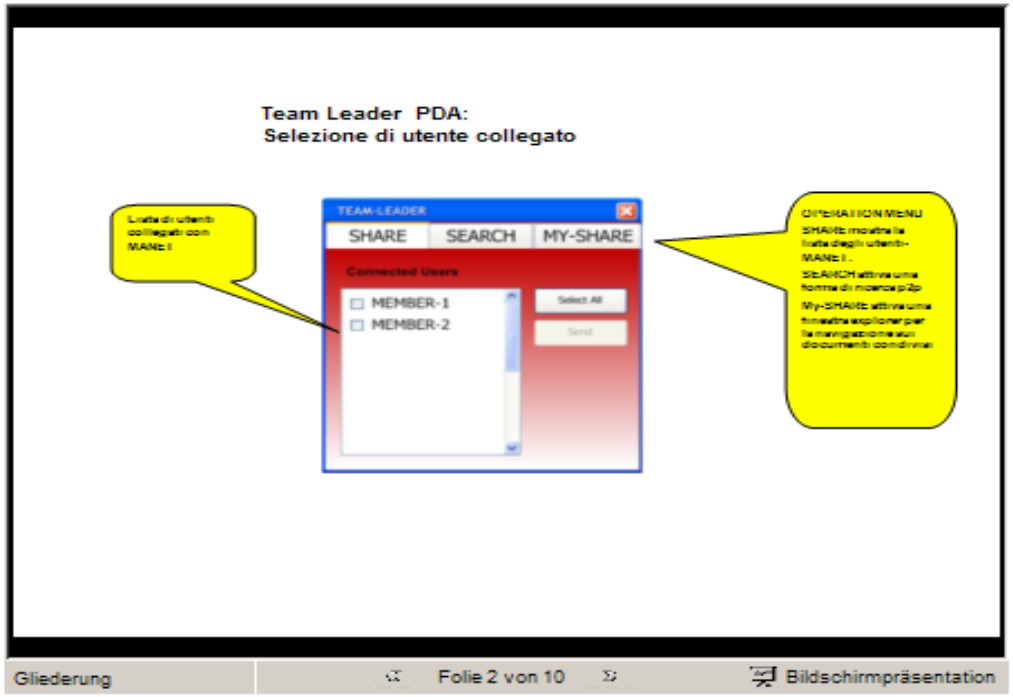
14. Do you consider the "Team Member's Position" functionality as useful?

○ very useful ○ Useful ○ Not so useful ○ useless

FILE SHARE

Think of a situation out in the emergency area where you want to share actual damage documentation of a bridge with your team partner over your handheld device. The **file share** component makes this possible! You can send files from one device to another device.

Please go carefully through the file share presentation and then answer the questions!
Start the presentation with a mouse click at the link "presentation" (see: down to the right)!



If the presentation does not work well, please use the following link:

http://www.salzburgresearch.at/~rstein/tor/mockup.ppt

33. Did you understand the presentation about the file share component?

- ○ Yes
- ○ No

Controlled Experiments

- We performed tests in **lab environments** under **controlled conditions**.
- We **observed users** during the use of the system to discover **open issues** and **areas of improvement**.

- Special focus was given to the **communication** and the **integration** of the different components:
  - *Users should feel the impression to work with a single system rather than with different components*.

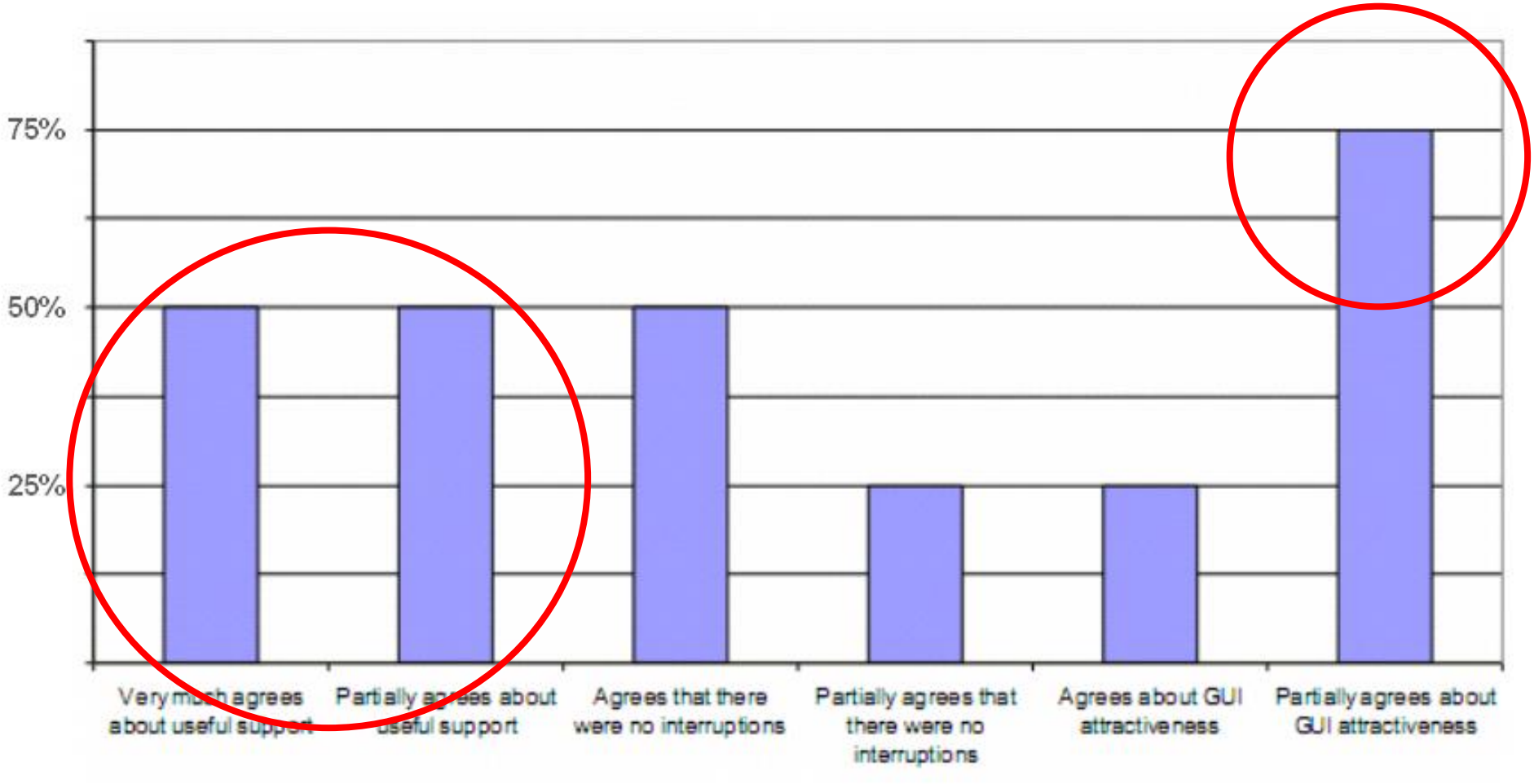
Results of Controlled Experiments

- After this phase, we performed **two main improvements** to the user interface of the Worklist Handler.
  - We **reduced the interactive elements** of the user interface, to minimize the possibility to press wrong elements.
  - We **improved the integration** of the different components of the system, to give the feeling of working with one system.

Cooperative Evaluation

- **Users** were asked to **interact with the system** in order to ***complete a specific task***.
- **Evaluators drove the users** through the test by interacting with them to ***collect feedbacks on user satisfaction***.
- These tests were recorded by cameras in order to analyze the level of the usability of the system off-line and **search for recurrent usage of patterns** that possibly could be speeded up the interaction.

Cooperative Evaluation: Summary of Results



Test with External Users

- External users are those who are inexpert of emergency management but have some technological skill.
- Tests executed by a subset of members of each technical partner of the project.
  - 4-6 users per Project partner

The WORKPAD Showcases

Pentidattilo, Calabria, Italy

First Showcase without WORKPAD

- Purpose of the WORKPAD team:
  - A better understanding of real world activities.
  - Verify if storyboards are feasible and realistic.
  - Become familiar with the showcase location (Pentidattilo).

Where is Pentidattilo?

Some Pictures

Some Pictures

Interviews

- After the execution of the storyboards we interviewed three people involved to get feedback for the final (small) improvements before the showcase with the WORKPAD system.
- We interviewed the following people:
  - 1 volunteer of civil protection
  - 1 member of the dog unit
  - 1 person supporting the dog unit

End-user comments after the interviews

- Currently the different emergency organisations mostly use radio communication in order to talk with their colleagues.
- Emergency operators would appreciate to have a GIS system on PDAs to have a quick glance on the status of the emergency.
  - Nowadays, they receive additional information (e.g., about weather) by voice communication, but it would be helpful to have this information constantly updated.

Second Showcase with WORKPAD

- Goal:
  - Show and evaluate the prototypical implementation of the reference architecture proposed in the project WORKPAD.
- Taken place in Mid of June 2009.
- One week of showcase.
- Six end-user organisations.
- Four storyboards.

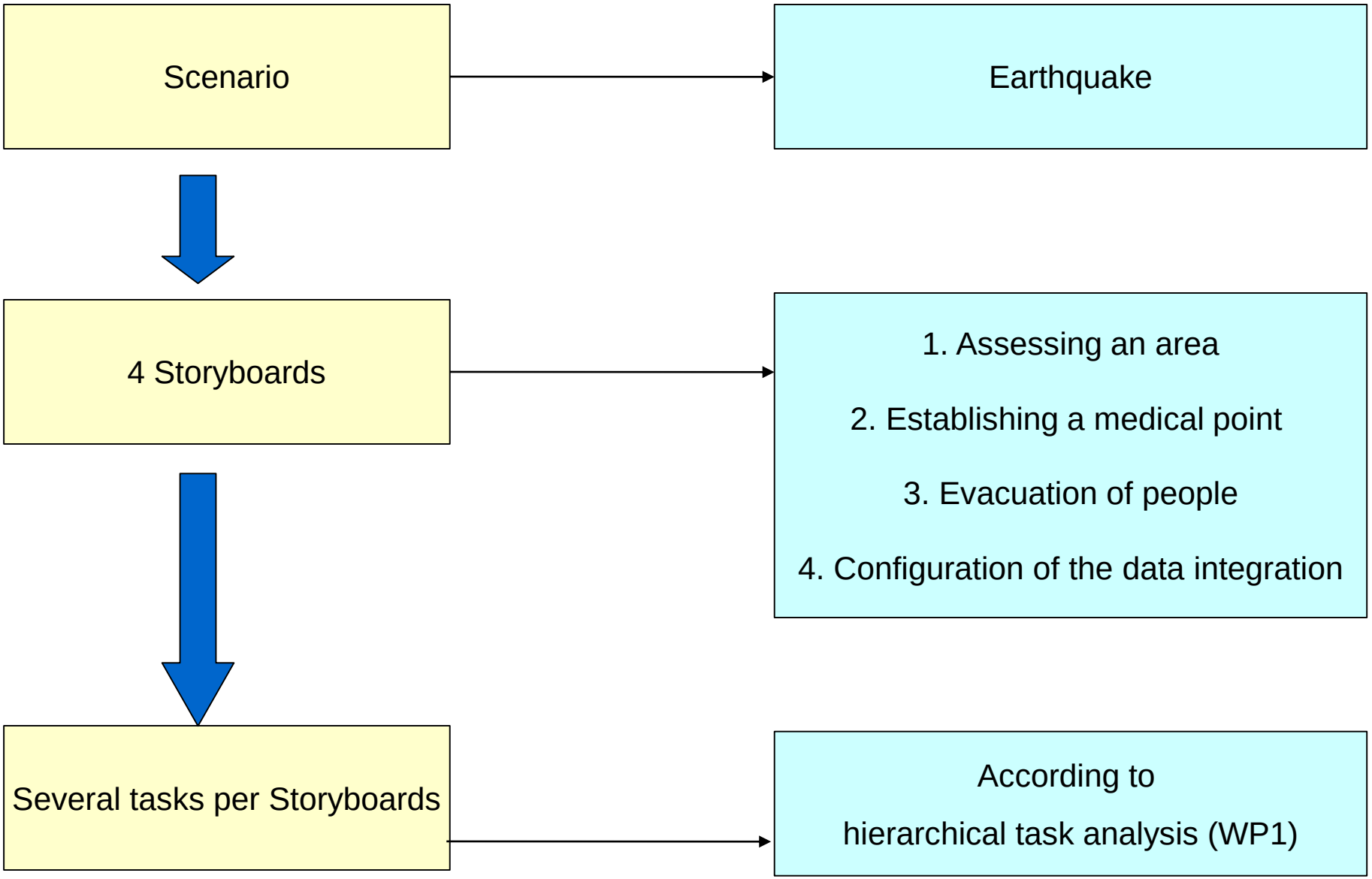
The Showcase Week

- Day 1:
  - Arrival and first test runs
- Day 2:
  - On-site tests in Pentidattilo
- Day 3:
  - User training
- Day 4:
  - Execution of SB1, SB2, SB4, and SB3 (in this order)
- Day 5:
  - Dissemination event and final brainstorming meeting

Involved user organisations

- Carpo Nazionale dei Vigili del Fuoco (VVF)
  - The Fire Brigade Provincial Headquarters
- Corpo Nazionale Soccorso Alpino e Speleologico (CNSAS)
  - Alpine Aid and Speleologic National Body
- Servizio di Urgenza ed Emergenza Medica (SUEM)
  - Service of Urgency and Medical Emergency
- Croce Rossa Italiana (CRI)
  - Italian Red Cross
- Europa Unita (EU)
  - Voluntary organisation
- Confraternita Misericordia (CM)
  - Voluntary organisation

Second Showcase of WORKPAD



Components Invoked per User

- Example Storyboard 1

	Process Management	Task-list Handler	Context Monitoring	Context Editor	Multimedia Editor	GIS Client	Lightweight Storage	BE Access
Member 1 /Leader	X	X				X		X
Member 2	X	X	X	X	X		X	X
Member 3	X	X	X	X	X		X	X
Member 4	X	X	X	X	X		X	X
Member 5	X	X	X	X				X
Member 6	X	X						X
Member 7	X	X						X
Member 8	X	X						X

Documentation

- Task execution forms
- Interview questionnaires
- Video recording, e.g.: Action Cam

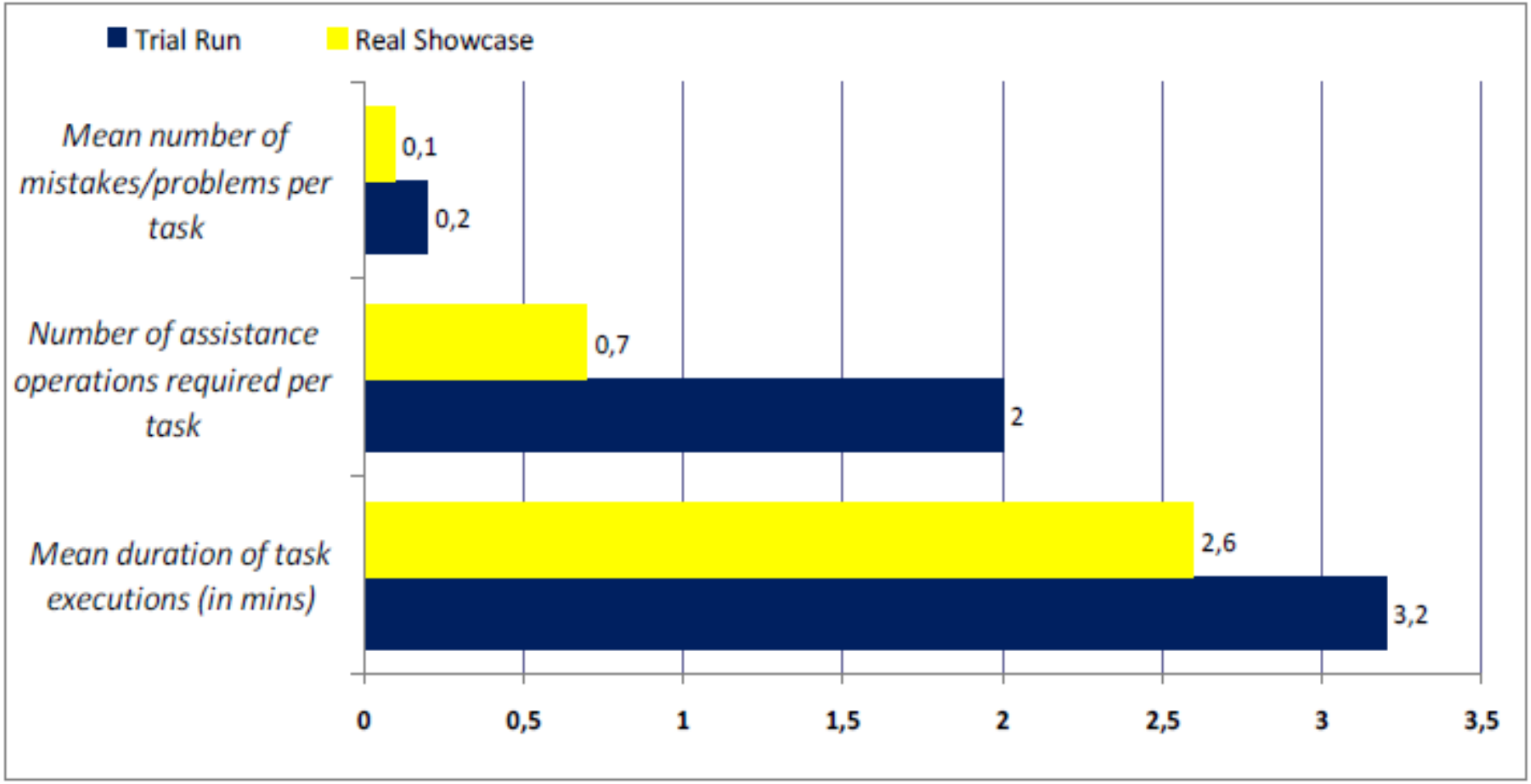
Movie of the Showcase

- Available on YouTube at
  - http://www.youtube.com/watch?v=idou2NkhPTg

Selected Analysis Results

- Metrics
  - Time span, number of required assists, correct task outcome, number of errors.
- Evaluation was based on questionaries and interviews.
- Trial and “real“ execution were measured.

Example Results



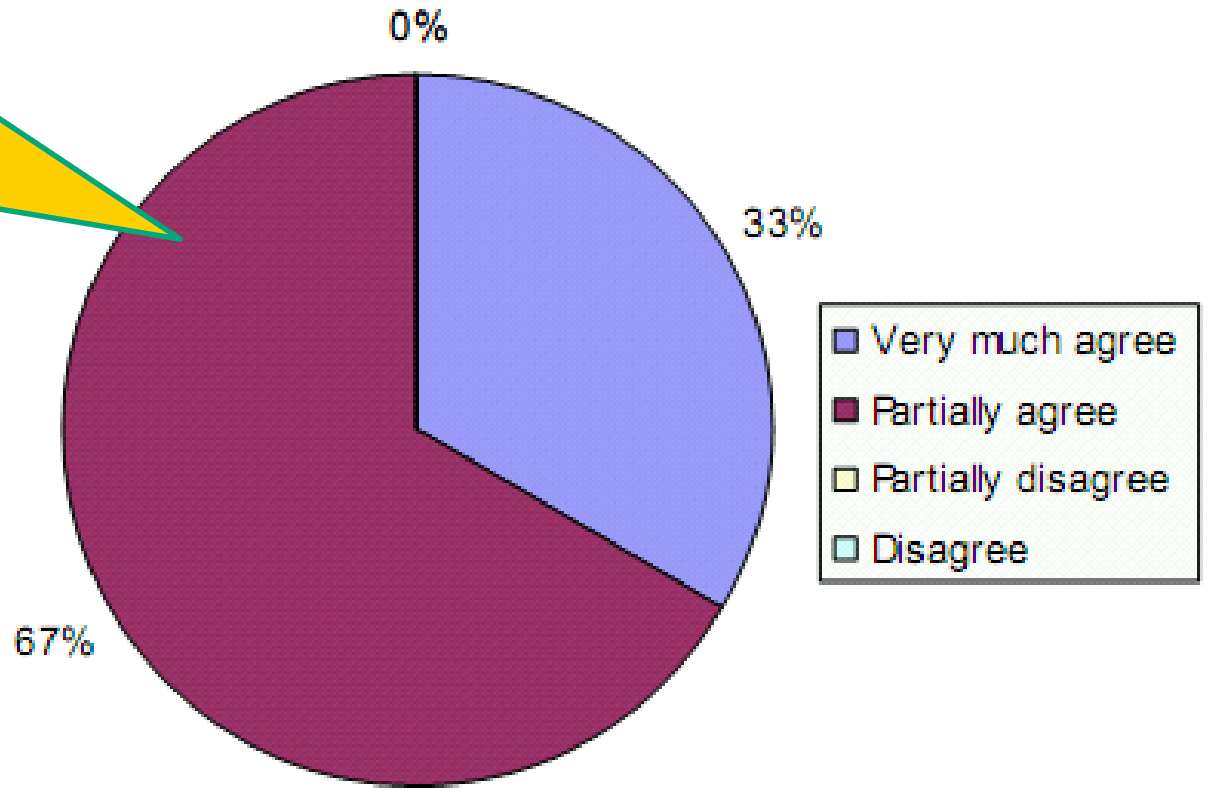
Interviewees

After each storyboard execution, 12 users were interviewed to get information on user satisfaction and to collect proposals for future improvement of WORKPAD.

	First Name	Last Name	Organistion name	Role in the organisation	Tasks in the organisation	Age	gender	Interviewer name
1			Soccorso Alpino	2nd chief in the station Aspromonte	preparing in peace time, instructor, trainer, all rescue tasks	42	M	Matteo
2			Regione Calabria - Unita Operativa Protezione Civile	worker in the department	Management and coordination of associations of volunteers	52	M	Angela
3			Le Pantere Verdi	Volunteer	logistic support in emergency situations, natural hazards, breakdown service	18	M	Matteo
4			Le Pantere Verdi	Volunteer	logistic support in emergency situations, breakdown service	21	F	Angela
5			Soccorso Alpino	Volunteer	Find and rescue lost people in the mountain	24	M	Renate, Angela
6			Civil Protection Calabria	Technical administration	Technician, Administrator	45	M	Allessandro
7			Civil Protection Calabria	Volunteer	Coordinator	25	M	Michele
8			PCRC	Technician		56	M	Massimo
9			Le Pantere Verdi	Administration	Treasurer, Administration, coordination of the logisitics group	43	F	Daniele
10			Soccorso Alpino	Volunteer		35	M	Michele
11			Soccorso Alpino	generic worker	technical assistant of the CNSAS	39	M	Allessandro
12			Le Pantere Verdi	President, coordinator of the organisation at national level	coordination of emergency teams	28	M	Allessandro

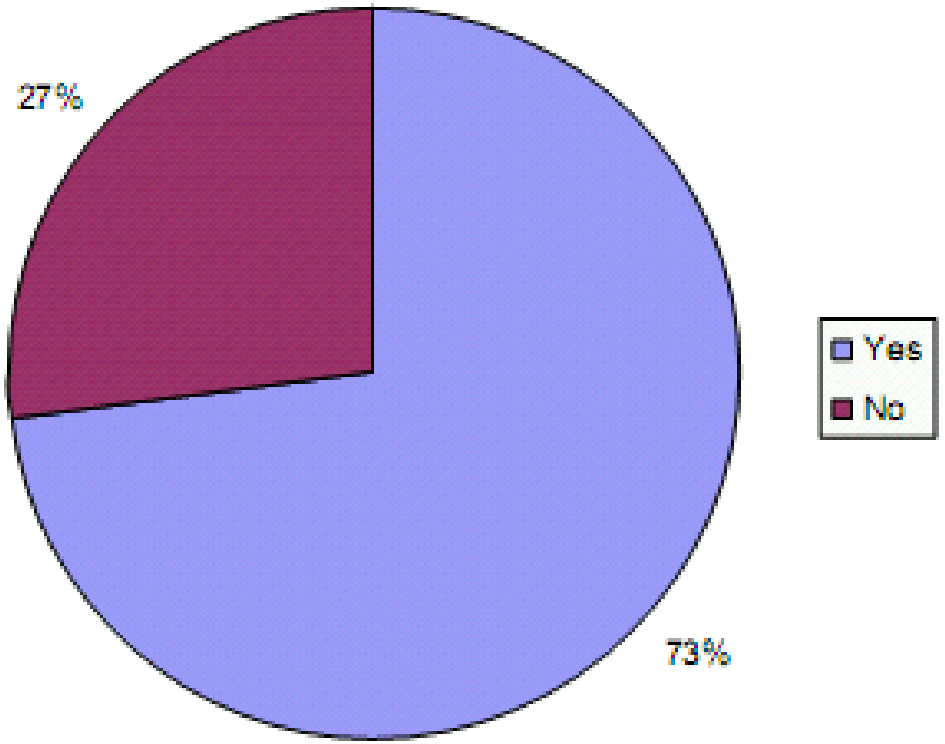
Results

Some users had problems with visibility on the screen in the blazing sun



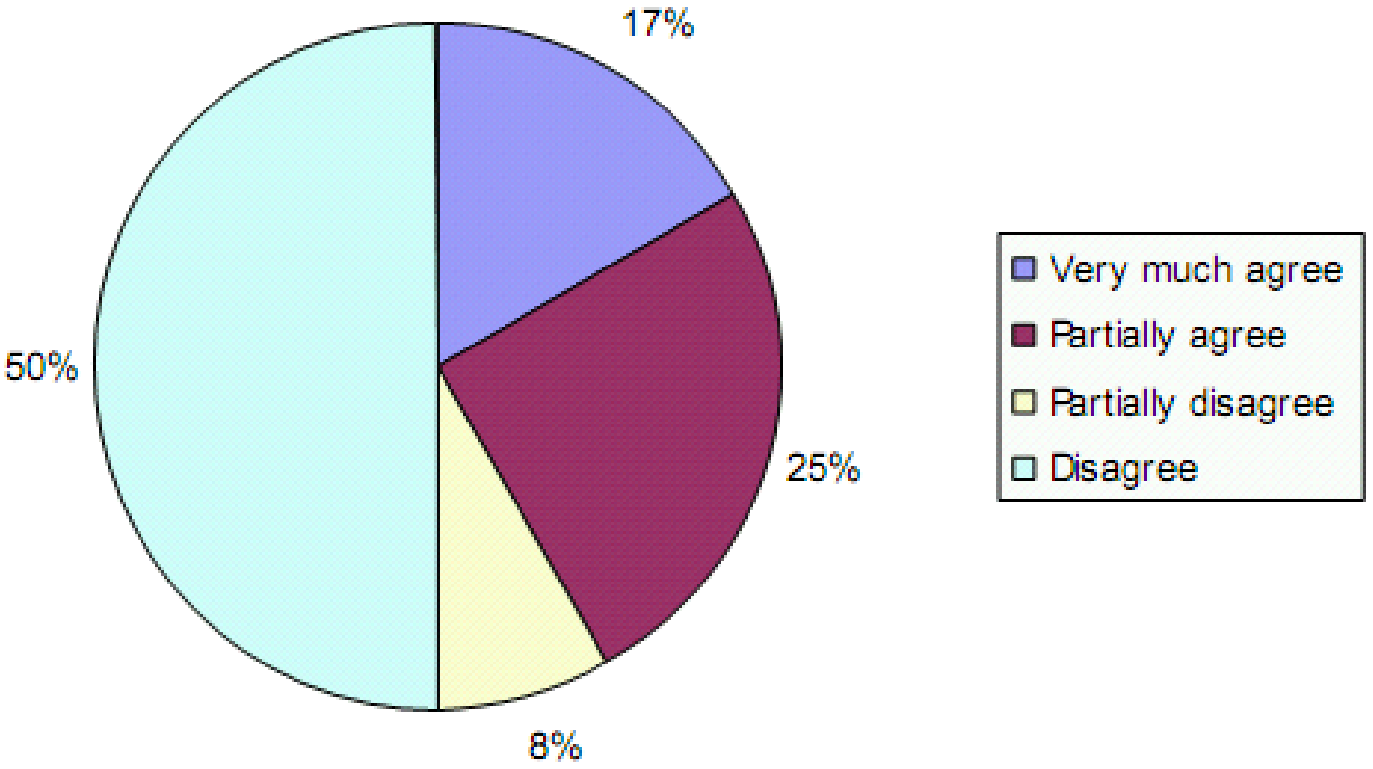
WORKPAD is easy and intuitive to use.

Results



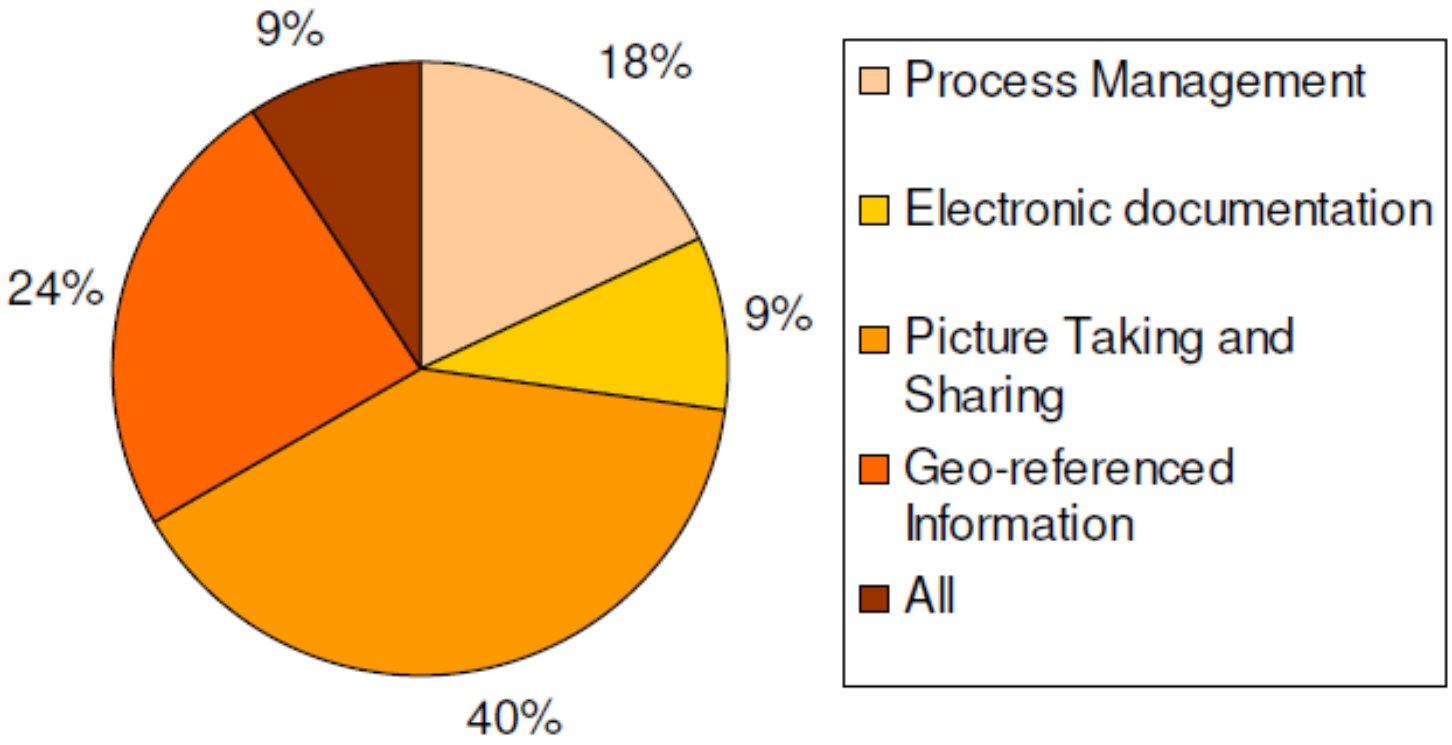
Does the WORKPAD system improve emergency management?

Results



It is difficult for me to navigate in WORKPAD.

Example Results



Which aspects do you consider as very useful?

Lesson Learned

- Advantages and Disadvantages of User Centered Design Techniques in a real project

Advantages	Disadvantages
Products are more efficient, effective, and safe	It is more costly
Assists in managing users' expectations and levels of satisfaction with the product	It takes more time
Users develop a sense of ownership for the product	May require the involvement of additional design team members (i. e. ethnographers, usability experts) and wide range of stakeholders
Products require less redesign and integrate into the environment more quickly	May be difficult to translate some types of data into design
The collaborative process generated more creative design solutions to problems.	The product may be too specific for more general use, thus not readily transferable to other clients; thus more costly

Lessons Learned / 1

- Active and continuous involvement of Protezione Civile both as institution and as individuals
  - Users have always been at the heart of the development through several iterations of the user requirement analysis
  - Users have been always confronting with the intermediate development milestones (ranging from initial paper mockups and intermediate demonstrators to the final prototype)
- Being users always at the center, the final results have been extremely satisfactory, and the system has fully met the user requirements from every perspective

Lessons Learned / 2

- The Human-Machine Approach to the analysis user requirements have been very useful for the end users themselves
- During the initial phases of user-requirement collection, we learned that civil-protection operators did not have clearly in mind the actual procedures and activities that they followed to face against emergencies.
  - That is also typical in many other domains.
- They have been forced to analyze carefully the current-day procedure and, hence, could find any pitfalls.
- Systemizing the procedures followed to manage emergencies guarantee a more systematic emergency management
  - Overall improvement of the response time that is not only motivated by the mere use of the system.