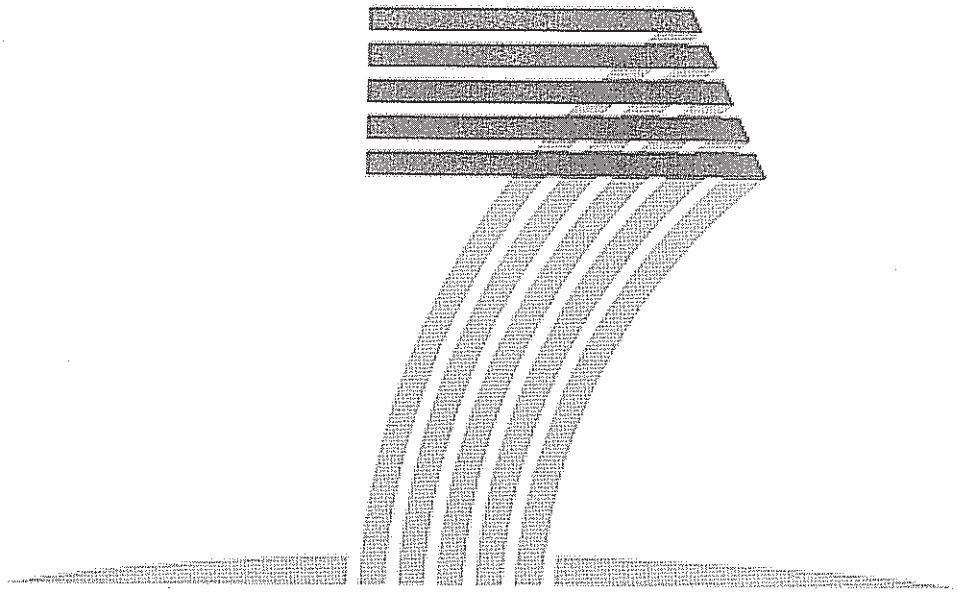


SEVENTH FRAMEWORK PROGRAMME

THEME [SEC-2011.1.5-1]
[Development of detection capabilities of difficult to detect radioactive sources and nuclear materials - Capability Project]

Grant agreement for: Collaborative project

Annex I - "Description of Work"

Project acronym: REWARD

Project full title: " Real Time Wide Area Radiation Surveillance System "

Grant agreement no: 284845

Version date: 2011-10-19

Table of Contents

Part A

Workplan Tables

A1: Project summary

Project Number [1]	284845	Project Acronym [2]	REWARD

One form per project

General Information			
Project title [3]	Real Time Wide Area Radiation Surveillance System		
Starting date [4]	The first day of the month after the signature by the Commission		
Duration in months [5]	36		
Call (part) identifier [6]	FP7-SEC-2011-1		
Activity code(s) most relevant to your topic [7]	SEC-2011.1.5-1: Development of detection capabilities of difficult to detect radioactive sources and nuclear materials - Capability Project		
Free keywords [8]	radiation surveillance, wireless sensor network, neutron detector, CZT		

Abstract [9]

We propose a novel mobile system for real time, wide area radiation surveillance. The system is based on the integration of new miniaturized solid-state radiation sensors: a CdZnTe detector for gamma radiation and a high efficiency neutron detector based on novel silicon technologies. The sensing unit will include a wireless communication interface to send the data remotely to a monitoring base station which also uses a GPS system to calculate the position of the tag.

The system will also incorporate middleware and high level software to provide web-service interfaces for the exchange of information, and that will offer top level functionalities as management of users, mobile tags and environment data and alarms, database storage and management and a web-based graphical user interface. Effort will be spent to ensure that the software is modular and re-usable across as many architectural levels as possible. Finally, an expert system will continuously analyze the information from the radiation sensor and correlate it with historical data from the tag location in order to generate an alarm when an abnormal situation is detected.

The system will be useful for many different scenarios such as nuclear terrorism, lost radioactive sources, radioactive contamination or nuclear accidents. It will be possible to deploy in emergency units and in general in any type of mobile or static equipment, but also inside public/private buildings or infrastructures. The sensing units will be highly portable thanks to their low size and low energy consumption. The complete system will be scalable in terms of complexity and cost and will offer very high precision on both the measurement and the location of the radiation.

The modularity and flexibility of the system will allow for a realistic introduction to the market. Authorities may start with a basic, low cost system and increase the complexity of it based on the latest needs and also on the budget.

A2: List of Beneficiaries

Project Number [1]	284845	Project Acronym [2]	REWARD

List of Beneficiaries

No	Name	Short name	Country	Project entry month [10]	Project exit month
1	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	CSIC	Spain	1	36
2	SENSING & CONTROL SYSTEMS SL	S&C	Spain	1	36
3	INSTITUTO TECNOLOGICO E NUCLEAR	ITN	Portugal	1	36
4	ALBERT-LUDWIGS-UNIVERSITAET FREIBURG	ALU-FR	Germany	1	36
5	Vitrociset spa	VCT	Italy	1	36
6	X-RAY IMAGING EUROPE GMBH	XIE	Germany	1	36
7	EDISOFT-EMPRESA DE SERVICOS E DESENVOLVIMENTO DE SOFTWARE SA	EDI	Portugal	1	36
8	REGIONE CAMPANIA	DIP	Italy	1	36

A3: Budget Breakdown

Project Number [1]	284845	Project Acronym [2]	REWARD

One Form per Project

Participant number in this project [11]	Participant short name	Fund. % [12]	Ind. costs [13]	Estimated eligible costs (whole duration of the project)					Total receipts	Requested EU contribution
				RTD / Innovation (A)	Demonstration (B)	Management (C)	Other (D)	Total A+B+C+D		
1	CSIC	75.0	A	647,003.00	54,308.00	130,519.00	18,088.00	849,918.00	0.00	661,013.00
2	S&C	75.0	T	640,400.00	47,840.00	111,200.00	174,000.00	973,440.00	0.00	789,420.00
3	ITN	75.0	T	257,600.00	38,400.00	0.00	30,800.00	326,800.00	0.00	243,200.00
4	ALU-FR	75.0	T	425,600.00	0.00	0.00	11,600.00	437,200.00	0.00	330,800.00
5	VCT	50.0	A	502,400.00	368,160.00	2,000.00	62,400.00	934,960.00	0.00	499,680.00
6	XIE	75.0	T	299,200.00	0.00	0.00	21,200.00	320,400.00	0.00	245,600.00
7	EDI	50.0	A	262,165.00	0.00	0.00	36,000.00	298,165.00	0.00	167,082.00
8	DIP	75.0	T	24,000.00	80,000.00	0.00	26,000.00	130,000.00	0.00	84,000.00
Total				3,058,368.00	588,708.00	243,719.00	380,088.00	4,270,883.00	0.00	3,020,795.00

Note that the budget mentioned in this table is the total budget requested by the Beneficiary and associated Third Parties.

*** The following funding schemes are distinguished**

Collaborative Project (if a distinction is made in the call please state which type of Collaborative project is referred to: (i) Small of medium-scale focused research project, (ii) Large-scale integrating project, (iii) Project targeted to special groups such as SMEs and other smaller actors), Network of Excellence, Coordination Action, Support Action.

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project, and it cannot be changed. The project number **should appear on each page of the grant agreement preparation documents** to prevent errors during its handling.

2. Project acronym

Use the project acronym as indicated in the submitted proposal. It cannot be changed, unless agreed during the negotiations. The same acronym **should appear on each page of the grant agreement preparation documents** to prevent errors during its handling.

3. Project title

Use the title (preferably no longer than 200 characters) as indicated in the submitted proposal. Minor corrections are possible if agreed during the preparation of the grant agreement.

4. Starting date

Unless a specific (fixed) starting date is duly justified and agreed upon during the preparation of the Grant Agreement, the project will start on the first day of the month following the entry info force of the Grant Agreement (NB : entry into force = signature by the Commission). Please note that if a fixed starting date is used, you will be required to provide a detailed justification on a separate note.

5. Duration

Insert the duration of the project in full months.

6. Call (part) identifier

The Call (part) identifier is the reference number given in the call or part of the call you were addressing, as indicated in the publication of the call in the Official Journal of the European Union. You have to use the identifier given by the Commission in the letter inviting to prepare the grant agreement.

7. Activity code

Select the activity code from the drop-down menu.

8. Free keywords

Use the free keywords from your original proposal; changes and additions are possible.

9. Abstract

10. The month at which the participant joined the consortium, month 1 marking the start date of the project, and all other start dates being relative to this start date.

11. The number allocated by the Consortium to the participant for this project.

12. Include the funding % for RTD/Innovation – either 50% or 75%

13. Indirect cost model

A: Actual Costs
S: Actual Costs Simplified Method
T: Transitional Flat rate
F :Flat Rate

Workplan Tables

Project number

284845

Project title

REWARD—Real Time Wide Area Radiation Surveillance System

Call (part) identifier

FP7-SEC-2011-1

Funding scheme

Collaborative project

WT1
List of work packages

Project Number [1]	284845	Project Acronym [2]	REWARD

LIST OF WORK PACKAGES (WP)

WP Number [53]	WP Title	Type of activity [54]	Lead beneficiary number [55]	Person-months [56]	Start month [57]	End month [58]
WP 1	Analysis & Requirements	RTD	1	35.00	1	35
WP 2	Sensor Development	RTD	6	46.00	1	16
WP 3	Mobile Sensing Tag	RTD	1	47.00	3	20
WP 4	Fusion, Detection and Tracking Platform	RTD	2	40.00	9	35
WP 5	Situational Awareness and Decision Making	RTD	5	45.00	10	33
WP 6	Test Bed and Demonstration	DEM	5	58.00	23	35
WP 7	Security Framework	RTD	7	33.00	9	35
WP 8	Exploitation Plan and Dissemination	OTHER	2	36.00	1	36
WP 9	Project Management and coordination	MGT	1	18.00	1	36
			Total	358.00		

WT2:
List of Deliverables

Project Number [1]	284845	Project Acronym [2]	REWARD

List of Deliverables - to be submitted for review to EC

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D1.1	Best and Common Practices Summary	1	1	7.00	R	PU	6
D1.2	Sensor Technology for Detection of Radioactive and Nuclear threats	1	1	7.00	R	CO	6
D1.3	Characterization of the Reference Scenario, v1	1	3	11.00	R	CO	6
D1.4	Gap Analysis and Required Capabilities, version 1	1	2	2.00	R	CO	12
D1.5	Characterization of the Reference Scenario, v2	1	2	6.50	R	PU	35
D1.6	Gap Analysis and Required Capabilities, version 2	1	2	1.50	R	PU	35
D2.1	Gamma detector unit	2	6	12.00	P	PU	12
D2.2	Peak identification unit	2	6	12.00	P	PU	16
D2.3	Neutron detector unit	2	1	8.00	P	PU	12
D2.4	Sensor Test Report	2	3	14.00	R	CO	16
D3.1	Mobile sensor tag specifications	3	1	6.00	R	CO	12
D3.2	Sensor subsystem module	3	1	20.00	P	PU	18
D3.3	Communication subsystem module	3	2	5.00	P	PU	18

WT2: List of Deliverables

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D3.4	Mobile Sensing Tag unit	3	1	8.00	P	PU	20
D3.5	Mobile Sensing Tag test report	3	3	8.00	R	CO	20
D4.1	DAL/SAL Requirements and design analysis	4	2	4.00	R	CO	12
D4.2	DAL/SAL Design Specifications Document	4	2	6.00	R	CO	12
D4.3	DAL/SAL Integration and test plan.v1	4	2	1.00	R	PU	12
D4.4	DAL/SAL Plan for validation and assessment.v1	4	2	1.00	R	PU	12
D4.5	Software Platform (DAL).v1	4	2	6.00	P	PU	24
D4.6	Middleware Interface (SAL).v1	4	2	7.00	P	PU	24
D4.7	DAL/SAL Integration and test plan.v2	4	2	1.00	R	PU	24
D4.8	DAL/SAL Software Installation Manual	4	2	2.00	O	PU	24
D4.9	DAL/SAL Plan for validation and assessment.v2	4	2	1.00	R	PU	24
D4.10	DAL/SAL Assessment report .v1	4	2	2.00	R	CO	24
D4.11	Software Platform (DAL).v2	4	2	3.00	P	PU	35
D4.12	Middleware Interface (SAL).v2	4	2	3.00	P	PU	35

WT2:
List of Deliverables

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D4.13	DAL/SAL Integration and test plan.v3	4	2	1.00	R	PU	35
D4.14	DAL/SAL Assessment report .v2	4	2	2.00	R	CO	35
D5.1	Requirements and architecture design	5	5	3.00	R	CO	12
D5.2	GIS Software module and GUI	5	5	10.00	P	PU	24
D5.3	Sensor data analysis	5	5	9.00	R	CO	30
D5.4	Computer simulation model	5	5	11.00	R	CO	30
D5.5	Final demonstration	5	5	12.00	D	PU	30
D6.1	Operational Scenarios Sketching	6	5	8.00	R	PU	30
D6.2	Architectural Design Document of Integration Test Bed	6	5	2.00	R	PU	30
D6.3	Interface Control Document	6	5	4.00	R	CO	35
D6.4	Test Scenario Monte Carlo Simulation Result	6	3	10.00	R	CO	35
D6.5	Integration Test Bed	6	5	7.00	R	CO	35
D6.6	Test & Validation Plan	6	5	14.00	R	CO	35
D6.7	Demonstrator Assessment Report	6	5	13.00	R	CO	35
D7.1	Security Framework Requirements	7	7	3.00	R	PU	12
D7.2	Security Framework	7	7	2.50	R	CO	12

WT2: List of Deliverables

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
	Design Specifications						
D7.3	Integration and Test Plan.v1	7	7	3.00	R	CO	12
D7.4	Security Framework Assessment Plan. v1	7	7	2.00	R	CO	12
D7.5	Security Framework Package. v1	7	7	5.00	P	CO	24
D7.6	Integration and Test Plan.v2	7	7	2.00	R	CO	24
D7.7	Security Framework Installation Document	7	7	2.00	O	CO	24
D7.8	Security Framework Assessment Plan. v2	7	7	3.00	R	CO	24
D7.9	Security Framework Assessment report. v1	7	2	3.00	R	PU	24
D7.10	Security Framework Package. v2	7	7	3.00	R	PU	35
D7.11	Integration and Test Plan.v3	7	7	2.00	R	PU	35
D7.12	Security Framework Assessment report. v2	7	2	2.50	R	PU	35
D8.1	Dissemination Plan	8	2	10.50	R	CO	6
D8.2	Project website	8	2	4.00	O	PU	6
D8.3	Advert. Material	8	2	5.50	R	PU	30
D8.4	Exploitation Plan	8	2	14.00	R	CO	30
D8.5	Project Results	8	2	2.00	R	PU	36
D9.1	Consortium Kickoff Meeting	9	1	2.00	R	CO	1

WT2: List of Deliverables

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D9.2	Rules & Project quality handbook	9	2	3.00	R	CO	3
D9.3	Consortium Progress Meeting.v1	9	1	2.00	R	CO	6
D9.4	Consortium Progress Meeting.v2	9	1	2.00	R	CO	12
D9.5	Consortium Progress Meeting.v3	9	1	2.00	R	CO	18
D9.6	Consortium Progress Meeting.v4	9	1	2.00	R	CO	24
D9.7	Consortium Progress Meeting.v5	9	1	2.00	R	CO	30
D9.8	Consortium Final Meeting	9	1	3.00	R	CO	36
			Total	358.00			

WT3:
Work package description

Project Number [1]	284845	Project Acronym [2]	REWARD

One form per Work Package

Work package number [53]	WP1	Type of activity [54]	RTD
Work package title	Analysis & Requirements		
Start month	1		
End month	35		
Lead beneficiary number [55]	1		

Objectives

WP1 will analyse the best and common practices for detection of difficult-to-detect radioactive sources and nuclear materials, in particular in urban crowded environments. Furthermore it will define the "reference operational scenarios" to be successively used to identify required capabilities to be delivered and used for REWARD testing and validation. Based on reference scenarios it will analyse and discriminate which sensor technology is more suitable.

Description of work and role of partners

Task 1.1 Best and common practices
Lead Partner: CSIC; Other partner(s): ITN, ALU-FR, DIP
This task is responsible for the collection of all information relevant to the detection procedure for difficult-to-detect radioactive sources and nuclear materials from standard bodies. This includes information on best practices, on-going projects across the world and, ultimately, about common practices (as opposed to "best" practices). The outcome will be a common ground to be shared among all partners. We believe that the key for the success of the REWARD approach is to demonstrate its cost effectiveness not only on replacing actual systems, but in preventing most common pitfalls and enhancing the overall efficiency.

Task 1.2 Simulation of potential events
Lead Partner: ITN; Other partner(s): CSIC, ALU-FR
In order to have a realistic estimation of the radiation levels that can be detected by the sensing tag, Monte Carlo simulations will be performed.

Task 1.3 Analysis of sensor technology for detection of radioactive sources and nuclear materials
Lead Partner: CSIC; Other partner(s): S&C, XIE
Sensor performance varies considerably as a function of range of targets, environment conditions, nature of the observed target, etc. This task will analyse impact of the sensor technology on the detection effectiveness: it will investigate the data generated by each sensor typology and their relevance to the detection process. For each type of sensor it will be outlined in which scenarios the sensors can be used and how this technology can improve the accuracy or reliability of the detection.

Task 1.4 Characterization of reference operational environment
Lead Partner: S&C; Other partner(s): CSIC, VCT, EDI
The operational environment analysis plays a critical role in laying the groundwork for developing the project; in this task it will be performed in close collaboration with several end-user experts, to help define specific user inter-face and user performance requirements, and quantifiable usability metrics to ensure that subsequent design and development efforts respect the users' interests. A relevant technical specificatins subset corresponding to "Reference scenarios" will be outlined with reference to the information classes and associated parameters.

Task 1.5 Gaps analysis and identification of required capabilities
Lead Partner: S&C; Other partner(s): CSIC, VCT
The first scope of this task will be to point out the gaps in current systems and techniques to use them as guidelines in the design and implementation of the project components.

WT3: Work package description

The second scope will be the precise identification of the requirements for the elements of REWARD in order to reach identified goals in provided operational areas. The requirements will be analyse in terms of information management, information reliability, situation assessment, threat analysis, threat facing capabilities and required decision support. The identification of the required capabilities will take into account the results obtained in the previous tasks and activities.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	CSIC	9.00
2	S&C	6.00
3	ITN	9.00
4	ALU-FR	5.00
5	VCT	1.00
6	XIE	3.00
7	EDI	1.00
8	DIP	1.00
	Total	35.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D1.1	Best and Common Practices Summary	1	7.00	R	PU	6
D1.2	Sensor Technology for Detection of Radioactive and Nuclear threats	1	7.00	R	CO	6
D1.3	Characterization of the Reference Scenario, v1	3	11.00	R	CO	6
D1.4	Gap Analysis and Required Capabilities, version 1	2	2.00	R	CO	12
D1.5	Characterization of the Reference Scenario, v2	2	6.50	R	PU	35
D1.6	Gap Analysis and Required Capabilities, version 2	2	1.50	R	PU	35
		Total	35.00			

Description of deliverables

D1.1) Best and Common Practices Summary: [month 6]

D1.2) Sensor Technology for Detection of Radioactive and Nuclear threats: Report on the state-of-the-art radiation detector technology [month 6]

D1.3) Characterization of the Reference Scenario, v1: Report on the reference scenario including results of simulation of potential events [month 6]

D1.4) Gap Analysis and Required Capabilities, version 1: Using the methodology of Gap Analysis an initial description current systems and techniques and needed requirements is reported [month 12]

D1.5) Characterization of the Reference Scenario, v2: final report on the characterization of operational environment after real tests [month 35]

D1.6) Gap Analysis and Required Capabilities, version 2: After project conclusion, using the methodology of Gap Analysis a critical comparison between actual final performances with potential performances of the system will be reported. [month 35]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS1	Base definition of system requirements and dissemination plan	1	10	In MS1 the Sensor Technology and Scenario Characterization documents have to be ready and accepted by all the partners, specially the SEC.

WT3:
Work package description

Project Number [1]	284845	Project Acronym [2]	REWARD

One form per Work Package

Work package number [53]	WP2	Type of activity [54]	RTD
Work package title	Sensor Development		
Start month	1		
End month	16		
Lead beneficiary number [55]	6		

Objectives

The outcome of this work package is the two sensing units for gamma rays and neutrons. In both cases, state-of-the-art sensing technologies that offer superior performances and/or lower mass and lower cost compared to conventional sensors, will be used.
The sensor unit for the gamma-ray detection will be realized by state-of-the-art (Cd,Zn)Te detectors using the Co-Planar-Grid (CPG) design. These detectors offer a high efficiency due to the high absorption coefficient of (Cd,Zn)Te for gammas and high energy resolution for a wide energy range. These spectroscopic capabilities will be used for peak identification and implemented in the read-out electronics for analysis of the radioactive materials. The CPG sensors have a compact design and can be used in portable detector systems.
A compact Gamma-Ray Multi Channel Analyzer (GMCA) will be used as read-out electronics for the CPGs. This GMCA offers the possibility of multiple inputs for working in coincidence mode for further improvement of the energy sensitivity.
To detect high energy neutrons (>10keV) planar silicon PIN diodes covered by plastic moderators rich in hydrogen will be used. In this structure protons (hydrogen nucleus) are extracted from the plastic by elastic collisions with the fast neutrons and are detected in the silicon bulk.
For thermal neutron detectors silicon micromachined structures covered with suitable Boron or Lithium neutron converter materials will be used. Standard planar PIN silicon diodes covered with 10B or 6Li converter layers are commonly used as thermal neutron detectors but the main drawback of this structure is its low efficiency, This problem can be overcome by etching 3D structures, such as holes or pillars, into the silicon bulk, and filling them with the converter material. In this way, detection efficiencies higher than 35% are predicted by simulations. The energy information of the impinging neutrons is lost, as only the energy of the particles emitted by the converters can be measured in the silicon. Therefore, the spectroscopic capabilities of the neutron unit will be limited to two channels: fast and slow neutrons.

Description of work and role of partners

Task 2.1 Gamma ray detector
Lead Partner: XIE; Other partner(s): ITN, ALU-FR
The gamma-ray detector unit consists of (Cd,Zn)Te detectors. The detector unit will be processed using (Cd,Zn)Te detectors with Co-Planar-Grid design. The active detector volume will be 15x15x15 mm3 detector area. The detec-tors will be tested and calibrated for an optimum in efficiency and energy resolution.

Task 2.2 Peak identification electronics
Lead Partner: XIE; Other partner(s): ITN, ALU-FR
The identification electronics for the gamma-ray detector unit will use a FPGA board working as a Multi Channel Analyzer. This Gamma-Ray Multi Channel Analyzer GMCA will be adjusted to the CPG detectors and allows the combination of two detectors for large volume detector in coincidence mode. This will increase the energy resolution and the identification of radioactive material. The GMCA will be ready for the combination of versatile electronics components like the GPS module and the networking function.

Task 2.3 Neutron detector
Lead Partner: CSIC; Other partner(s): ITN
The neutron detector will consist of two sensing units, both based on silicon. The first unit, for energetic neutrons, consists of a planar PIN diode covered with hydrogenated plastic. The second unit, optimized for slow

neutrons, is a silicon micromachined 3D diode filled with a 10B or 6Li-based converter material. Both sensing elements share a common readout electronics with counting output.

Task 2.4 Sensor testing
Lead Partner: ITN; Other partner(s): CSIC, ALU-FR
Once assembled in their final package, the sensors will be tested in a high-throughput facility equipped with test radioactive sources and dedicated electronics for data acquisition. The aim of this activity will be the verification of the basic electrical functionality of the sensors.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	CSIC	9.00
3	ITN	8.00
4	ALU-FR	19.00
6	XIE	10.00
	Total	46.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D2.1	Gamma detector unit	6	12.00	P	PU	12
D2.2	Peak identification unit	6	12.00	P	PU	16
D2.3	Neutron detector unit	1	8.00	P	PU	12
D2.4	Sensor Test Report	3	14.00	R	CO	16
		Total	46.00			

Description of deliverables

D2.1) Gamma detector unit: Working prototype of Co-Planar-Grid detectors with Cd(Zn)Te sensors [month 12]

D2.2) Peak identification unit: Working Gamma Ray Multi Channel Annalyzer read-out electronics of CPGs [month 16]

D2.3) Neutron detector unit: Prototype of neutron detector unit with silicon devices [month 12]

D2.4) Sensor Test Report: Sensor Test report [month 16]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS2	Operating sensor prototypes	6	17	In MS2 the neutron and gamma detectors, including peak

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
				identification are working under specifications.

WT3:
Work package description

Project Number [1]	284845	Project Acronym [2]	REWARD

One form per Work Package

Work package number [53]	WP3	Type of activity [54]	RTD
Work package title	Mobile Sensing Tag		
Start month	3		
End month	20		
Lead beneficiary number [55]	1		

Objectives

The outcome of this work package is the electronic system that holds the sensor devices and the communication interface, and forms the tag that will be used as a mobile radiation monitor.
The system will also integrate a GPS chip or module. New technologies for improved location calculation will be considered for indoor use or to improve the precision of the GPS chip.
The tag will be conceived modularly, and will separate the sensors from the communications subsystem, so the latter can be treated as a plug-and-play unit. In this way the dependence with the communication network used is eliminated. The first tests of the complete system will be made with the TETRA security network, but alternative networks can be used with other electronic units.

Description of work and role of partners

Task 3.1 Sensor subsystem specifications
Lead Partner: CSIC; Other partner(s): ITN, ALU-FR, XIE
The required specifications for the sensing tags will be determined.

Task 3.2 Sensor subsystem integration
Lead Partner: CSIC; Other partner(s): ITN, ALU-FR, XIE
The REWARD system is based in two different sensing units, one for neutrons and the other for gamma rays, the latter with spectroscopic capabilities. In this task, the two sensing units will be integrated together in a single elec-tronics board, each sensor with its own readout and signal analysis electronics. A signal concentrator will deal with the information of each unit and will transfer the data to the communications subsystem using a common information protocol.

Task 3.3 Communication and positioning subsystem
Lead Partner: S&C; Other partner(s): CSIC
A complete communication subsystem will be developed in this task. The base system will be developed for its use with the security network TETRA to ensure a large interoperability. Furthermore, with TETRA, many communication security issues (such as terminal and user authentication, disabling of stolen terminals and encryption) are al-ready covered.
This subsystem will be conceived as a plug-and-play unit for the complete tag, ensuring a fast reconfiguration of the tag in case a different network is used.
This subsystem also incorporates a positioning system. It will be based on a GPS module, although new technologies for improved location calculation will be considered (for indoors use or to improve the precision of the GPS).

Task 3.4 Tag integration.
Lead Partner: CSIC; Other partner(s): S&C
The final task consists of the complete integration of the two subsystems. System issues as powering, housing, etc. will be covered in this task and a fully operational prototype will be delivered.

Task 3.5 Tag testing.
Lead Partner: ITN; Other partner(s): CSIC, S&C
Several tests will be conducted to ensure the sensing tags meet the goals defined in Task 3.1.

WT3:
Work package description

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	CSIC	16.00
2	S&C	10.00
3	ITN	6.00
4	ALU-FR	10.00
6	XIE	5.00
	Total	47.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D3.1	Mobile sensor tag specifications	1	6.00	R	CO	12
D3.2	Sensor subsystem module	1	20.00	P	PU	18
D3.3	Communication subsystem module	2	5.00	P	PU	18
D3.4	Mobile Sensing Tag unit	1	8.00	P	PU	20
D3.5	Mobile Sensing Tag test report	3	8.00	R	CO	20
		Total	47.00			

Description of deliverables

D3.1) Mobile sensor tag specifications: Mobile sensor tag specifications document [month 12]

D3.2) Sensor subsystem module: Working prototype of the sensor subsystem incorporating both types of sensors [month 18]

D3.3) Communication subsystem module: Working prototype of the communication subsystem incorporating GPS positioning unit [month 18]

D3.4) Mobile Sensing Tag unit: Working prototype of the complete sensing tag [month 20]

D3.5) Mobile Sensing Tag test report: Report of tag testing [month 20]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS3	Working unit of mobile sensing tag	1	22	In MS3 the mobile sensing tag, with radiation detectors,geo-localization, and communication is working within specifications.

WT3:
Work package description

Project Number [1]	284845	Project Acronym [2]	REWARD

One form per Work Package

Work package number [53]	WP4	Type of activity [54]	RTD
Work package title	Fusion, Detection and Tracking Platform		
Start month	9		
End month	35		
Lead beneficiary number [55]	2		

Objectives

The outcome of WP4 is a software platform for the management of: - users (operators/administrators), including a user interface, - wireless sensor networks, - remote data acquisition, - alarms/events, - database storage.
This WP will also address the creation of a DAL (Domain Abstraction Layer) that will hide the complexity of the wireless sensor network and the data management. The DAL will help third party software development companies to easily incorporate the technology for their own requirements. In order to search for a reusable baseline solution, the team will consider the most recent outcomes of other EU-funded R&D projects, open frameworks and reference implementations, like HYDRA platform (The Hydra project is co-funded by the European Commission within the Sixth Framework Programme in the area of Networked Embedded Systems under contract IST-2005-034891)
The starting point will be a software platform that has already been developed to monitor and control people with a certain degree of dependency. The modular architecture of this platform allows it to be adapted very easily to other areas of application. For example, it can be connected to any hardware platform that generates alarms, incidences and/or positioning information by means of specific drivers. This adaptation work will be carried out during this WP4.
This task will develop software functions to ensure that all the entities from the real world (sensors) and the logical world (application) provide a reliable platform for the target application(s) / requirements and user needs coming from WP1.

Description of work and role of partners

Task 4.1 High level specifications.
Lead Partner: S&C; Other partner(s): VCT, EDI
This task will analyze and evaluate the user requirement specifications from WP1 and other relevant work packages like WP2 and WP5, and use the results of this process to specify and describe the software platform. The output of this task will be a set of documents setting the software platform specifications that will be developed in tasks 4.2 to 4.4 and its corresponding test protocol.

Task 4.2 Software Platform Core (DAL).
Lead Partner: S&C; Other partner(s):
As the software platform will be reused from one that is currently in use, part of the needed functions defined in task 4.1 may totally or partially exist already. In consequence, an adaptation of the existing features of the software platform and the implementation of the new functionalities will take place in this task.

Task 4.3 Middleware Interface (SAL).
Lead Partner: S&C; Other partner(s):
The DAL will be completed with a middleware interface layer that will form a complete abstraction layer for the sensor network.
The output of tasks 4.2 and 4.3 will be a software package that will provide a complete set of functions and web services to the REWARD system.

Task 4.4 Integration & Testing.
Lead Partner: S&C; Other partner(s): VCT

WT3:
Work package description

In this step the middleware and the wireless sensor network functionality will be integrated into the software plat-form. Software functional tests will be conducted at laboratory level. These functional tests will be coordinated with the real deployment tests that will take place in WP6.
The output of this task will be a document with the integration and test results.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
2	S&C	30.00
5	VCT	5.00
7	EDI	5.00
	Total	40.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D4.1	DAL/SAL Requirements and design analysis	2	4.00	R	CO	12
D4.2	DAL/SAL Design Specifications Document	2	6.00	R	CO	12
D4.3	DAL/SAL Integration and test plan.v1	2	1.00	R	PU	12
D4.4	DAL/SAL Plan for validation and assessment.v1	2	1.00	R	PU	12
D4.5	Software Platform (DAL).v1	2	6.00	P	PU	24
D4.6	Middleware Interface (SAL).v1	2	7.00	P	PU	24
D4.7	DAL/SAL Integration and test plan.v2	2	1.00	R	PU	24
D4.8	DAL/SAL Software Installation Manual	2	2.00	O	PU	24
D4.9	DAL/SAL Plan for validation and assessment.v2	2	1.00	R	PU	24
D4.10	DAL/SAL Assessment report .v1	2	2.00	R	CO	24
D4.11	Software Platform (DAL).v2	2	3.00	P	PU	35
D4.12	Middleware Interface (SAL).v2	2	3.00	P	PU	35
D4.13	DAL/SAL Integration and test plan.v3	2	1.00	R	PU	35
D4.14	DAL/SAL Assessment report .v2	2	2.00	R	CO	35
		Total	40.00			

Description of deliverables

D4.1) DAL/SAL Requirements and design analysis: DAL/SAL Requirement and design analysis [month 12]

D4.2) DAL/SAL Design Specifications Document: Software overall specification document [month 12]

D4.3) DAL/SAL Integration and test plan.v1: Integration of sensors into software package [month 12]

D4.4) DAL/SAL Plan for validation and assessment.v1: Lab test report [month 12]

D4.5) Software Platform (DAL).v1: First version of software package ready for installation [month 24]

D4.6) Middleware Interface (SAL).v1: First version of software package ready for installation [month 24]

D4.7) DAL/SAL Integration and test plan.v2: Integration of sensors into software package [month 24]

D4.8) DAL/SAL Software Installation Manual: Software Installation Manual [month 24]

D4.9) DAL/SAL Plan for validation and assessment.v2: Lab test report [month 24]

D4.10) DAL/SAL Assessment report .v1: Assessment report [month 24]

D4.11) Software Platform (DAL).v2: Final version of software package ready for installation [month 35]

D4.12) Middleware Interface (SAL).v2: Final version of software package ready for installation [month 35]

D4.13) DAL/SAL Integration and test plan.v3: Integration of sensors into software package [month 35]

D4.14) DAL/SAL Assessment report .v2: Assessment report [month 35]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS4	Software platform and security framework	2	25	In MS4 the software platform for tracking the sensing tags and the security framework are operative.

WT3:
Work package description

Project Number [1]	284845	Project Acronym [2]	REWARD

One form per Work Package

Work package number [53]	WP5	Type of activity [54]	RTD
Work package title	Situational Awareness and Decision Making		
Start month	10		
End month	33		
Lead beneficiary number [55]	5		

Objectives

The outcome of WP5 is a Central Monitoring System that will continuously analyse the radiation sensor information and correlate it with the radiation background data of the surrounding area in order to generate alarms when abnormal situations are detected. The main functionalities of this system are: (1) The system should take decisions when a suspicious level of radiation is detected in a specific area. This decision will be taken after analysing the historical background data and correlating them with the current data; (2) The system will also compare different areas in order to take decisions in case that in one specific area there is an unusual level of radiation.
In particular, the platform will enable: the representation and statistical analysis of historical scenarios of back-ground radiation, the identification of the radiation sources present in the area in semi-real time, and if it applies, prediction of future radiation scenarios (e.g. mobile sources).

Description of work and role of partners

Task 5.1 - GIS-based architecture for the representation (including 3D) of maps of environmental radioactivity (measured and predicted).
Lead Partner: VCT; Other partner(s): S&C, EDI
The objective of Task 5.1 is to design and implement a monitoring and control station, where real-time environmental data are presented, not only through classic 2D representations (e.g. maps), but also through innovative Visual Simulations with 3D viewing. In particular, the urban areas will be virtually rebuilt (i.e. with geo-referenced models), and the fixed and mobile monitoring stations will be included in the simulation. The reference radiation data collected in real-time will be represented in a new form of 3D layers by displacement of semi-transparent data clouds. This will allow understanding the links between the radiation data and the morphology of the territory and other possible conditions/triggers (indoors/outdoors, etc).
Main activity lines: (1) Analysis of the requirements and architectural design of the 2D/3D GIS control station; (2) Development of the Software Module "3D virtual environment"; (3) Development of the user interface (GUI) and I/O module.

Task 5.2 - Creating the radiation map
Lead Partner: VCT; Other partner(s): S&C
This task will merge the information from the specific detection sensors in the area and assess how the possible radiation sources in the area contribute to the data recorded, creating a radiation map. The readings from the different sensors will be analysed and compared to reference databases to identify the radiation sources. Standard statistical analysis methodologies will be joined with network analysis methodologies to provide, for each radiation source, an impact index at both single sensor and overall area level, helping to pinpoint the location of the source(s).
This task will be divided into two specific activities: (1) Analysis of the radioactive data detected; (2) Identification of the impact of the radioactive sources through Network Analysis; (3) Identification of the nature and position of the radiation sources. The first activity concerns the integration of the collected data with topography data that are relevant for the analysis, and mono-, bi-and multivariate analysis procedures to identify relationships between different variables. The second activity concerns the in-depth analysis of output data of first activity through network analysis methods, in order to correlate the data collected by individual sensors to the distance between these and all sources of radioactive emissions. In the third activity, the results obtained will be compared to reference databases and the nature and real-time location of the radioactive sources will be given.

Task 5.3 - Modelling the map of estimated RN emissions
Lead Partner: VCT; Other partner(s): EDI
A dynamic simulation model aims to simulate a real phenomenon in the virtual world and allows building a virtual laboratory to study and reproduce the characteristics and dynamics of the complex phenomena under scrutiny. Such a model will be constructed using a simulation methodology based on interacting agents which, taking into account a variety of complex phenomena and mutual interdependencies in specific socio-spatial context will provide an advanced prediction tool and, simulating the effects of specific policy actions, a tool for decision making in the scope of RN emergencies.

Task 5.4 - Architecture for the dissemination of signals/messages –
Lead Partner: VCT; Other partner(s): S&C
The objective is to design and implement an architecture for the dissemination of the signals/messages generated by the Control Station. Such architecture will disseminate the data related to the radioactive emissions (nature, activity, mid-long-term forecasting, warning of harmful emissions), and possible targets (i.e. dirty bombs prepared to explode in a sport dome or stadium) to a large audience, with heterogeneous skills and roles. The final scope is to provide the government and the security agencies with a powerful and smart tool to support timely operational decisions.
Main activity lines: (1) Analysis of the context, identification of stakeholders, preliminary architectural requirements and specifications of the dissemination system; (2) Prioritization of dissemination rules; (3) Architectural design; (4) Development of the prototype demonstrator; (5) Testing and validation.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
2	S&C	5.00
5	VCT	35.00
7	EDI	5.00
	Total	45.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D5.1	Requirements and architecture design	5	3.00	R	CO	12
D5.2	GIS Software module and GUI	5	10.00	P	PU	24
D5.3	Sensor data analysis	5	9.00	R	CO	30
D5.4	Computer simulation model	5	11.00	R	CO	30
D5.5	Final demonstration	5	12.00	D	PU	30
		Total	45.00			

Description of deliverables

D5.1) Requirements and architecture design: [month 12]

D5.2) GIS Software module and GUI: Software module of GIS 2D-3D virtual representation and GUI [month 24]

D5.3) Sensor data analysis: Analysis of the sensor data and identification/location of the various sources in the area [month 30]

D5.4) Computer simulation model: Computer simulation model of RN incidents, for short/mid/long forecasts and decision making [month 30]

D5.5) Final demonstration: Final demonstration in a laboratory environment [month 30]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS5	Analysis and decision making tools operative	5	31	In MS5 the analysis and decision making tools are ready and integrated within the software platform.

WT3:
Work package description

Project Number [1]	284845	Project Acronym [2]	REWARD

One form per Work Package

Work package number [53]	WP6	Type of activity [54]	DEM
Work package title	Test Bed and Demonstration		
Start month	23		
End month	35		
Lead beneficiary number [55]	5		

Objectives

This WP will provide the capability to orchestrate exercises over a networked communication system to allow demonstration for users/operators at their normal bases within a realistic threat environment accommodating a number of key scenarios.
The demonstration is mainly a computer-based test capability, already including operational hardware as far as feasible and cost efficient. It is used to verify that systems, and/or components, within the REWARD architecture, can interoperate effectively across the spectrum of threats, deployments and contingencies of relevant operational requirements.
The final scope is to evaluate the operational concepts, permitting an overall performance check, including integration and interoperability, of all the equipment and system elements.

Description of work and role of partners

Task 6.1. Definition of scenarios and real sketching
Lead Partner: VCT; Other partner(s): DIP
Some different scenarios will be defined and prioritized as a mock-up of the urban scenario analysed in WP1, in accordance with a rigorous methodology of sketching and field trial planning.

Task 6.2 Radiological Environment Monte Carlo Simulation
Lead Partner: ITN; Other partner(s): CSIC, VCT, DIP
The radioactive emission of different types of sources will be simulated by Monte Carlo techniques in order to have a realistic overview of the scenario and the dose to be detected in the places where the demonstration will be performed.

Task 6.3. Test Bed implementation
Lead Partner: VCT; Other partner(s): CSIC, S&C
The test bed will be implemented in three subsequently phases; (i) Simulation. The main architecture components (Instrumented Cars equipped with radiation sensors and tags, Wireless System and Control Station, etc. will be simulated by adequate models to preliminarily verify the successful integration. (ii) HWIL (Hardware-in-the-Loop). REWARD architecture will consist of a mesh of simulated systems and physical components. (iii) Real Sketching. REWARD architecture will consist of the following main physical components; (a) Instrumented Cars (IC), consisting of some cars equipped with tags and radiation sensors. The IC will represent the authority cars operating in realistic environment, (b) Wireless positioning and communication interface, in order to accurately calculate the positions of the tags and (c) Control Station (CS) for processing and analysing the environment data in order to establish diagnosis, detect and anticipate the risks associated with radioactive emissions.

Task 6.4. Test and Validation
Lead Partner: VCT; Other partner(s): CSIC, S&C
The emphasis on testing will be to validate all the elements of the prototype are integrated to meet the operational requirements.
Upon completion of all system integration tests, the Consortium will conduct a Final Trial with large audience of end-users and stakeholders in order to validate the delivered release of the overall demonstrator/prototype.
After the Final Trial, the Consortium will provide a detailed Final Test Report including all test validation results.

Task 6.5. Final Assessment
Lead Partner: VCT; Other partner(s): S&C, DIP
The scope of the activity is to evaluate and assess the results originating from the test study and the demonstrator activity and to prepare appropriate reports, as well as identifying areas where concepts and architecture can be improved.
The outcome of this task will be; (i) set of parameters emanating from the demonstration activities resultant data; (ii) Evaluation criteria allowing objective measurements and (iii) Validate measured results against pre-qualified user requirements and assess the level of fulfilment (considering that the demonstrators might only implement a subset of all possible capabilities).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	CSIC	4.00
2	S&C	5.00
3	ITN	4.00
5	VCT	35.00
8	DIP	10.00
	Total	58.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D6.1	Operational Scenarios Sketching	5	8.00	R	PU	30
D6.2	Architectural Design Document of Integration Test Bed	5	2.00	R	PU	30
D6.3	Interface Control Document	5	4.00	R	CO	35
D6.4	Test Scenario Monte Carlo Simulation Result	3	10.00	R	CO	35
D6.5	Integration Test Bed	5	7.00	R	CO	35
D6.6	Test & Validation Plan	5	14.00	R	CO	35
D6.7	Demonstrator Assessment Report	5	13.00	R	CO	35
		Total	58.00			

Description of deliverables

D6.1) Operational Scenarios Sketching: Technical report on the definition of scenarios and real sketching [month 30]

D6.2) Architectural Design Document of Integration Test Bed: [month 30]

D6.3) Interface Control Document: [month 35]

D6.4) Test Scenario Monte Carlo Simulation Result: [month 35]

D6.5) Integration Test Bed: [month 35]

D6.6) Test & Validation Plan: [month 35]

D6.7) Demonstrator Assessment Report: [month 35]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS6	Definition and simulation of test scenario	5	32	In MS6 the test scenario is defined and simulated. The complete system is ready to start the real operation.
MS7	Final project report, exploitation plan and test bed results	1	36	MS7 is the Final project report, including the results of the test bed and the exploitation plan.

WT3:
Work package description

Project Number [1]	284845	Project Acronym [2]	REWARD

One form per Work Package

Work package number [53]	WP7	Type of activity [54]	RTD
Work package title	Security Framework		
Start month	9		
End month	35		
Lead beneficiary number [55]	7		

Objectives

WP7 will provide the security framework for the REWARD architecture. This will take into account given reference architectures and implementations for Service-Oriented Architectures (SOA), but also address the particular, operational security requirements as derived from WP1.
In line with the overall work plan and particularly WP4, WP7 will follow a standard system engineering process with phases for the requirements of elicitation, design, implementation and integration (see WP3-4-5) and final validation and assessment (coordinated with WP6).

Description of work and role of partners

Task 7.1 – Requirements and Design Analysis for Security Framework
Lead Partner: EDI; Other partner(s): S&C, VCT
The objective of this task is two-fold: first, the operational - mission requirements for the security framework will be established on the basis of the outcomes of WP1, namely with respect to the characterization of the reference operational environment and the corresponding functional, technical and other requirements, for example access control and authentication, security policy management, security of communication, data protection etc. and also regulatory/legal constraints.
The second objective is to validate which standards and technologies are in line with the requested level(s) of security. For this analysis, the team will consider the OASIS and other well-known security standard frameworks as well as state-of-the-art solutions in the field of web services security and e-security frameworks (e.g. Shibboleth), mobile security and also cooperative systems. In order to search for a reusable baseline solution, the team will consider the most recent outcomes of other EU-funded R&D projects, open frameworks and reference implementations.

Task 7.2 – Security Architecture Components Specification and Design
Lead Partner: EDI; Other partner(s): S&C, VCT
In close relationship with WP4, this activity is aimed at the specification and detailed design of all components and services comprising the REWARD security framework. As mentioned under Task 7.1, the team will promote the re-use of a reference implementation to be further customized and extended in order to satisfy the particular operational requirements (e.g. security levels and policies) and also the general technological framework of REWARD (e.g. wireless technologies, functional capabilities for cooperation between distributed system components for in-formation sharing, triangulation etc.).

Task 7.3 – Implementation and Integration of Security Components and Services
Lead Partner: EDI; Other partner(s): S&C, VCT
This task covers the software implementation and integration for all security components. Integration will follow the established plan (D7.4) which is also tuned to the corresponding master plan in WP4. In order to manage this process, integration will be achieved first under lab (local test bed) conditions and later passed to WP6 for the system integration level and testing. It should be noted that the implementation and integration will be managed in several cycles, allowing the team to follow the general flow of other parallel project activities and to focus first on more critical components and services.

Task 7.4 – Security-Assessment of selected REWARD Prototypes
Lead Partner: S&C; Other partner(s): EDI, VCT

WT3: Work package description

The final task of WP7 aims to assess the compliance of the REWARD security framework, i.e. on the basis of selected prototypes and scenarios, with established mission-operational requirements. Hence, within the flow of activities this task bases on the requirements specification (D7.1), is however indirectly linked to WP1 (with respect to the operational scenarios and requirements) and WP6 (with respect to demonstration and final assessment).

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
2	S&C	5.00
5	VCT	5.00
7	EDI	23.00
	Total	33.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D7.1	Security Framework Requirements	7	3.00	R	PU	12
D7.2	Security Framework Design Specifications	7	2.50	R	CO	12
D7.3	Integration and Test Plan.v1	7	3.00	R	CO	12
D7.4	Security Framework Assessment Plan. v1	7	2.00	R	CO	12
D7.5	Security Framework Package. v1	7	5.00	P	CO	24
D7.6	Integration and Test Plan.v2	7	2.00	R	CO	24
D7.7	Security Framework Installation Document	7	2.00	O	CO	24
D7.8	Security Framework Assessment Plan. v2	7	3.00	R	CO	24
D7.9	Security Framework Assessment report. v1	2	3.00	R	PU	24
D7.10	Security Framework Package. v2	7	3.00	R	PU	35
D7.11	Integration and Test Plan.v3	7	2.00	R	PU	35
D7.12	Security Framework Assessment report. v2	2	2.50	R	PU	35
		Total	33.00			

Description of deliverables

D7.1) Security Framework Requirements: Requirements and Design Analysis [month 12]

D7.2) Security Framework Design Specifications: Design Specification Document [month 12]

D7.3) Integration and Test Plan.v1: Integration and test plan for security components as part of integrated platform; detailed test cases descriptions [month 12]

D7.4) Security Framework Assessment Plan. v1: Plan for Validation and Assessment.v1 [month 12]

D7.5) Security Framework Package. v1: Software packages ready for installation.v1 [month 24]

D7.6) Integration and Test Plan.v2: Integration and test plan for security components as part of integrated platform; detailed test cases descriptions [month 24]

D7.7) Security Framework Installation Document: Software Installation Manual for security components [month 24]

D7.8) Security Framework Assessment Plan. v2: Plan for Validation and Assessment.v2 [month 24]

D7.9) Security Framework Assessment report. v1: Assessment Report.v1 [month 24]

D7.10) Security Framework Package. v2: Software packages ready for installation.v2 [month 35]

D7.11) Integration and Test Plan.v3: Integration and test plan for security components as part of integrated platform; detailed test cases descriptions [month 35]

D7.12) Security Framework Assessment report. v2: Assessment Report.v2 [month 35]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS4	Software platform and security framework	2	25	In MS4 the software platform for tracking the sensing tags and the security framework are operative.

WT3:
Work package description

Project Number [1]	284845	Project Acronym [2]	REWARD

One form per Work Package

Work package number [53]	WP8	Type of activity [54]	OTHER
Work package title	Exploitation Plan and Dissemination		
Start month	1		
End month	36		
Lead beneficiary number [55]	2		

Objectives

The main objective of WP8 is to carry out a set of dissemination activities at the project level and to facilitate the successful exploitation of the results. The exploitation strategy will be set out in the Dissemination Plan. In particular, the different possibilities of business models will be identified, working closely with target users, so as to de-fine a commercialization route, assess the opportunities and risk associated with them, define the effort and the approaches to be used (pre-business planning), and initiate some first contacts with potential business partners and clients.
The activities that will be carried out within WP8 are:
• Open up channels for dissemination and for exchanging technical information and results.
• Implement communication activities targeted to different stakeholders (authorities, security forces, security companies, etc.).
• Produce publicity materials for project outputs awareness.
• Actively participate in conferences, workshops and courses.
• Prepare for the commercial exploitation of the system (patent filing, market research, business models, etc.).
• Actively promote the results of the project to the European Commission and foster relationships with other framework projects.
• Analysis of the critical success factors for the widespread use of the results of the project and for commercial exploitation by industrial partners.

Description of work and role of partners

Task 8.1 Dissemination Plan
Lead Partner: S&C; Other partner(s): CSIC, ITN, ALU-FR, VCT, XIE, EDI, DIP
A Dissemination Plan to ensure that the project continues to achieve full potential impact on target groups will be implemented. Planned actions will include the following:
• At least one workshop will be organized with the presence of security forces in each participating country in order to raise awareness and demonstrate the European added value of the international cooperation.
• Articles and information material will be published in journals, newsletters and the international and na-tional press.
• Information about the project outcomes will also be made available on the Internet as it is the basis of the project. The project will be also promoted via individual partners' websites that already exist.
• The project consortium will establish close relationships with other projects covering similar problems within other EU-funded or national programs.

Task 8.2 Publicity Materials and Web site update and Maintenance
Lead Partner: S&C; Other partner(s): CSIC, ITN, ALU-FR, VCT, XIE, EDI, DIP
This task will include the following set of actions:
• Creation of logo and system guidelines;
• Production of project leaflets, press releases, folders, posters and brochures, and conducting a press aware-ness campaign;
• Producing the project website as a first set of publicity material, which will be kept, updated and used throughout the project to guarantee proper dissemination of the results and the setting up of a robust and coherent exploitation plan.

Task 8.3 Exploitation
Lead Partner: S&C; Other partner(s): ITN, ALU-FR, VCT, XIE, EDI
The REWARD system will be commercially exploited by the industrial project partners and/or the associated commercial partners. Due to IP issues and confidentialities, exploitation will be undertaken by the partners individually and/or collectively. At the project level, however, this work package will facilitate and oversee such activities by maintaining the Consortium Agreement.
Based on the analysis of the user requirements and the technical solutions envisaged in the pilots, it will be possible to peel out the economic possibilities of the embedded accessibility solutions and to identify and quantify market targets and to set up an exploitation plan. To avoid conflict with IPR, an Exploitation Agreement will be set up.
This task will also identify models for business and use, and pave the way for widespread use in commercial exploitation by the industrial partners of the project. Critical success factors in the business domain will be analysed: complexity of business models - single-actor vs. networked business; identification of a suitable consortium of exploiting actors, being able to provide the necessary resource to achieve wide customer reach, and an acceptable quality of service.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	CSIC	1.00
2	S&C	15.00
3	ITN	3.00
4	ALU-FR	1.00
5	VCT	6.00
6	XIE	2.00
7	EDI	5.00
8	DIP	3.00
	Total	36.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D8.1	Dissemination Plan	2	10.50	R	CO	6
D8.2	Project website	2	4.00	O	PU	6
D8.3	Advert. Material	2	5.50	R	PU	30
D8.4	Exploitation Plan	2	14.00	R	CO	30
D8.5	Project Results	2	2.00	R	PU	36
		Total	36.00			

Description of deliverables

D8.1) Dissemination Plan: Document with the plan for dissemination activities [month 6]

D8.2) Project website: Web of the project, will be periodically updated [month 6]

D8.3) Advert. Material: Logo project leaflets, press releases, folders, posters and brochures [month 30]

D8.4) Exploitation Plan: Document with business models and technology exploitation. [month 30]

D8.5) Project Results: Document with the results of the project, In word format and PowerPoint presentation. [month 36]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS1	Base definition of system requirements and dissemination plan	1	10	In MS1 the Sensor Technology and Scenario Characterization documents have to be ready and accepted by all the partners, specially the SEC.
MS7	Final project report, exploitation plan and test bed results	1	36	MS7 is the Final project report, including the results of the test bed and the exploitation plan.

WT3:
Work package description

Project Number [1]	284845	Project Acronym [2]	REWARD

One form per Work Package

Work package number [53]	WP9	Type of activity [54]	MGT
Work package title	Project Management and coordination		
Start month	1		
End month	36		
Lead beneficiary number [55]	1		

Objectives

The overall objective of WP9 is to establish an efficient and professional project management and coordination unit in order to continuously orientate all the activities towards the project objectives and to ensure their fulfilment. Specific objectives are:
- To perform the administrative, technical, and financial management of the project.
- To co-ordinate the contacts with the EC.
- To secure that the deliverables are submitted on time and under the agreed quality standards and to complete the project within the required time frame.
- To ensure the communication flow among the partners.
- To monitor on-going activities.
- To promote communication and organization among the partners involved.
- To solve any problems that may come up during the project's completion

Description of work and role of partners

Project Management, meaning all non-scientific management activities, will be jointly carried out by the project coordinator (CSIC) and the Deputy Project Coordinator (S&C). CSIC has a long-standing EU project management expertise and complementary experiences and skills, and S&C is experienced in balancing academic and commercial interests.

Task 9.1: Overall management
Lead Partner: CSIC; Other partner(s): S&C
S&C will carry out all the overall management activities, assisted by CSIC. Both partners are committed to a professional administrative management of the REWARD project following the sub-tasks below:
- Work flow and planning: S&C will be responsible for the overall maintenance of the work plan, the general time planning, and scheduling. However, the specific scientific, coordination and support workflow within the seven other WPs shall be coordinated by the respective WP leader. The work plan may be adapted by the consortium if necessary and the European Commission will be directly informed of any changes. (Months 1-30)
- Contractual and legal compliance: CSIC will ensure that all project activities comply with the EC Grant Agreement, the project specific Technical Annex and the Consortium Agreement that will be established before the project starts. CSIC will oversee the achievement of the contractual deliverables and the milestones accord-ing to defined deadlines. S&C will be responsible for the maintenance of the Consortium Agreement through-out the project duration. If any changes are required, S&C will present them to the General Assembly that will make the final decision on any amendments to the Consortium Agreement. (Months 1-30)
- Reporting: S&C will compile the partners' input, assisted by CSIC and according to the FP reporting guide-lines, and will submit two period reports and one final report to the European Commission within 60 days after each reporting period.
- Settlement of disputes: According to the decision making process the Consortium will efficiently manage any conflicts arising during the project implementation. Control procedures may be changed according to rules which are to be laid down in the Consortium Agreement.

Task 9.2: Consortium communication
Lead Partner: CSIC; Other partner(s): S&C

Communication is crucial for the success of the REWARD consortium and the effective use of the full potential of the project results. All partners will undertake all possible measures to facilitate efficient communication processes and to comply with the communication structure. S&C will create and maintain a project website which includes a document management system and communication functionalities to foster a continuous and transparent communication flow between all partners. This website will also be used for the dissemination of results.
• Meetings: S&C will be responsible for the preparation and follow-up of five consortium meetings (agenda and minutes) while different partners will ensure the local organization at the meeting locations. (Months 1, 15, 30)
• Collaboration with stakeholders: CSIC will act as a single point of contact with the European Commission, to guarantee a prompt response and to disseminate the information provided by the European Commission to the partners. All partners will interact with external (dissemination/ application) partners where appropriate in order to put the dissemination/application plan into action. (Months 1-34)

Task 9.3: Financial Management
Lead Partner: CSIC; Other partner(s): S&C
CSIC will assume responsibility for the overall financial management of the REWARD project whereas all partners will be solely responsible for their own budgets. S&C will advise all partners on financial issues as questions may arise that are specific to collaborative projects.
• Payments: CSIC will distribute the EC contribution to the partners according to the payment scheme laid down in the Consortium Agreement and according to the rules laid down in the Model Grant Agreement and within 30 days upon receipt.
• Controlling: CSIC will oversee and verify the proper deployment of resources (personnel, materials, equipment etc.). S&C will assist all partners in financial matters throughout the project implementation. (Months 1-30)
• Financial reporting: Each partner will provide cost statements and, if required, costs certificates to S&C. Additionally each partner will contract an auditor to control its expenditures that will be included in the management reports.

Task 9.4: Overall coordination
Lead Partner: CSIC; Other partner(s): S&C
S&C will coordinate the general project activities whereas the WP leaders will coordinate their respective WP team. Regular communication between CSIC and the WP leaders as well as all other partners is essential.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	CSIC	10.00
2	S&C	8.00
	Total	18.00

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D9.1	Consortium Kickoff Meeting	1	2.00	R	CO	1
D9.2	Rules & Project quality handbook	2	3.00	R	CO	3
D9.3	Consortium Progress Meeting.v1	1	2.00	R	CO	6
D9.4	Consortium Progress Meeting.v2	1	2.00	R	CO	12
D9.5	Consortium Progress Meeting.v3	1	2.00	R	CO	18
D9.6	Consortium Progress Meeting.v4	1	2.00	R	CO	24

WT3: Work package description

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D9.7	Consortium Progress Meeting.v5	1	2.00	R	CO	30
D9.8	Consortium Final Meeting	1	3.00	R	CO	36
		Total	18.00			

Description of deliverables

D9.1) Consortium Kickoff Meeting: Report of the Kickoff meeting. Review of contingency plan [month 1]

D9.2) Rules & Project quality handbook: This deliverable will act as guide for all project partners. It will contain all information necessary to take part in the project. Examples are: coordinates of participants and their personnel or procedures ensuring quality of deliverables. [month 3]

D9.3) Consortium Progress Meeting.v1: Report of the meeting. Review of contingency plan [month 6]

D9.4) Consortium Progress Meeting.v2: Report of the meeting. Review of contingency plan [month 12]

D9.5) Consortium Progress Meeting.v3: Report of the meeting. Review of contingency plan [month 18]

D9.6) Consortium Progress Meeting.v4: Report of the meeting. Review of contingency plan [month 24]

D9.7) Consortium Progress Meeting.v5: Report of the meeting. Review of contingency plan [month 30]

D9.8) Consortium Final Meeting: Project's final report [month 36]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS7	Final project report, exploitation plan and test bed results	1	36	MS7 is the Final project report, including the results of the test bed and the exploitation plan.

WT4: List of Milestones

Project Number [1]	284845	Project Acronym [2]	REWARD

List and Schedule of Milestones

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS1	Base definition of system requirements and dissemination plan	WP1, WP8	1	10	In MS1 the Sensor Technology and Scenario Characterization documents have to be ready and accepted by all the partners, specially the SEC.
MS2	Operating sensor prototypes	WP2	6	17	In MS2 the neutron and gamma detectors, including peak identification are working under specifications.
MS3	Working unit of mobile sensing tag	WP3	1	22	In MS3 the mobile sensing tag, with radiation detectors,geo-localization, and communication is working within specifications.
MS4	Software platform and security framework	WP4, WP7	2	25	In MS4 the software platform for tracking the sensing tags and the security framework are operative.
MS5	Analysis and decision making tools operative	WP5	5	31	In MS5 the analysis and decision making tools are ready and integrated within the software platform.
MS6	Definition and simulation of test scenario	WP6	5	32	In MS6 the test scenario is defined and simulated. The complete system is ready to start the real operation.
MS7	Final project report, exploitation plan and test bed results	WP6, WP8, WP9	1	36	MS7 is the Final project report, including the results of the test bed and the exploitation plan.

WT5:
Tentative schedule of Project Reviews

Project Number [1]	284845	Project Acronym [2]	REWARD

Tentative schedule of Project Reviews

Review number [65]	Tentative timing	Planned venue of review	Comments, if any
RV 1	18	Rome, IT	System definition, sensing tag and tracking platform
RV 2	36	Barcelona, ES	Final review

WT6:
Project Effort by Beneficiary and Work Package

Project Number [1]	284845	Project Acronym [2]	REWARD

Indicative efforts (man-months) per Beneficiary per Work Package

Beneficiary number and short-name	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	WP 9	Total per Beneficiary
1 - CSIC	9.00	9.00	16.00	0.00	0.00	4.00	0.00	1.00	10.00	49.00
2 - S&C	6.00	0.00	10.00	30.00	5.00	5.00	5.00	15.00	8.00	84.00
3 - ITN	9.00	8.00	6.00	0.00	0.00	4.00	0.00	3.00	0.00	30.00
4 - ALU-FR	5.00	19.00	10.00	0.00	0.00	0.00	0.00	1.00	0.00	35.00
5 - VCT	1.00	0.00	0.00	5.00	35.00	35.00	5.00	6.00	0.00	87.00
6 - XIE	3.00	10.00	5.00	0.00	0.00	0.00	0.00	2.00	0.00	20.00
7 - EDI	1.00	0.00	0.00	5.00	5.00	0.00	23.00	5.00	0.00	39.00
8 - DIP	1.00	0.00	0.00	0.00	0.00	10.00	0.00	3.00	0.00	14.00
Total	35.00	46.00	47.00	40.00	45.00	58.00	33.00	36.00	18.00	358.00

WT7:
Project Effort by Activity type per Beneficiary

Project Number [1]	284845	Project Acronym [2]	REWARD

Indicative efforts per Activity Type per Beneficiary

Activity type	Part. 1 CSIC	Part. 2 S&C	Part. 3 ITN	Part. 4 ALU-FR	Part. 5 VCT	Part. 6 XIE	Part. 7 EDI	Part. 8 DIP	Total
1. RTD/Innovation activities									
WP 1	9.00	6.00	9.00	5.00	1.00	3.00	1.00	1.00	35.00
WP 2	9.00	0.00	8.00	19.00	0.00	10.00	0.00	0.00	46.00
WP 3	16.00	10.00	6.00	10.00	0.00	5.00	0.00	0.00	47.00
WP 4	0.00	30.00	0.00	0.00	5.00	0.00	5.00	0.00	40.00
WP 5	0.00	5.00	0.00	0.00	35.00	0.00	5.00	0.00	45.00
WP 7	0.00	5.00	0.00	0.00	5.00	0.00	23.00	0.00	33.00
Total Research	34.00	56.00	23.00	34.00	46.00	18.00	34.00	1.00	246.00
2. Demonstration activities									
WP 6	4.00	5.00	4.00	0.00	35.00	0.00	0.00	10.00	58.00
Total Demo	4.00	5.00	4.00	0.00	35.00	0.00	0.00	10.00	58.00
3. Consortium Management activities									
WP 9	10.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	18.00
Total Management	10.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	18.00
4. Other activities									
WP 8	1.00	15.00	3.00	1.00	6.00	2.00	5.00	3.00	36.00
Total other	1.00	15.00	3.00	1.00	6.00	2.00	5.00	3.00	36.00
Total	49.00	84.00	30.00	35.00	87.00	20.00	39.00	14.00	358.00

WT8: Project Effort and costs

Project Number [1]	284845	Project Acronym [2]	REWARD

Project efforts and costs

Benefi-ciary number	Beneficiary short name	Estimated eligible costs (whole duration of the project)						Total receipts (€)	Requested EU contribution (€)
		Effort (PM)	Personnel costs (€)	Subcontracting (€)	Other Direct costs (€)	Indirect costs OR lump sum, flat-rate or scale-of-unit (€)	Total costs		
1	CSIC	49.00	241,697.00	2,000.00	176,000.00	430,221.00	849,918.00	0.00	661,013.00
2	S&C	84.00	543,400.00	24,000.00	50,000.00	356,040.00	973,440.00	0.00	789,420.00
3	ITN	30.00	180,000.00	0.00	24,250.00	122,550.00	326,800.00	0.00	243,200.00
4	ALU-FR	35.00	210,000.00	0.00	63,250.00	163,950.00	437,200.00	0.00	330,800.00
5	VCT	87.00	489,440.00	2,000.00	24,000.00	419,520.00	934,960.00	0.00	499,680.00
6	XIE	20.00	147,000.00	0.00	53,250.00	120,150.00	320,400.00	0.00	245,600.00
7	EDI	39.00	175,500.00	0.00	17,365.00	105,300.00	298,165.00	0.00	167,082.00
8	DIP	14.00	70,000.00	0.00	11,250.00	48,750.00	130,000.00	0.00	84,000.00
	Total	358.00	2,057,037.00	28,000.00	419,365.00	1,766,481.00	4,270,883.00	0.00	3,020,795.00

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project. It cannot be changed. The project number **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

2. Project acronym

Use the project acronym as given in the submitted proposal. It cannot be changed unless agreed so during the negotiations. The same acronym **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

53. Work Package number

Work package number: WP1, WP2, WP3, ..., WPn

54. Type of activity

For all FP7 projects each work package must relate to one (and only one) of the following possible types of activity (only if applicable for the chosen funding scheme – must correspond to the GPF Form Ax.v):

- **RTD/INNO** = Research and technological development including scientific coordination - applicable for Collaborative Projects and Networks of Excellence
- **DEM** = Demonstration - applicable for collaborative projects and Research for the Benefit of Specific Groups
- **MGT** = Management of the consortium - applicable for all funding schemes
- **OTHER** = Other specific activities, applicable for all funding schemes
- **COORD** = Coordination activities – applicable only for CAs
- **SUPP** = Support activities – applicable only for SAs

55. Lead beneficiary number

Number of the beneficiary leading the work in this work package.

56. Person-months per work package

The total number of person-months allocated to each work package.

57. Start month

Relative start date for the work in the specific work packages, month 1 marking the start date of the project, and all other start dates being relative to this start date.

58. End month

Relative end date, month 1 marking the start date of the project, and all end dates being relative to this start date.

59. Milestone number

Milestone number:MS1, MS2, ..., MSn

60. Delivery date for Milestone

Month in which the milestone will be achieved. Month 1 marking the start date of the project, and all delivery dates being relative to this start date.

61. Deliverable number

Deliverable numbers in order of delivery dates: D1 – Dn

62. Nature

Please indicate the nature of the deliverable using one of the following codes

R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

63. Dissemination level

Please indicate the dissemination level using one of the following codes:

- **PU** = Public
- **PP** = Restricted to other programme participants (including the Commission Services)
- **RE** = Restricted to a group specified by the consortium (including the Commission Services)
- **CO** = Confidential, only for members of the consortium (including the Commission Services)

• **Restreint UE** = Classified with the classification level "Restreint UE" according to Commission Decision 2001/844 and amendments

• **Confidentiel UE** = Classified with the mention of the classification level "Confidentiel UE" according to Commission Decision 2001/844 and amendments

• **Secret UE** = Classified with the mention of the classification level "Secret UE" according to Commission Decision 2001/844 and amendments

64. Delivery date for Deliverable

Month in which the deliverables will be available. Month 1 marking the start date of the project, and all delivery dates being relative to this start date

65. Review number

Review number: RV1, RV2, ..., RVn

66. Tentative timing of reviews

Month after which the review will take place. Month 1 marking the start date of the project, and all delivery dates being relative to this start date.

67. Person-months per Deliverable

The total number of person-month allocated to each deliverable.

Part B - Table of Contents

B1. Concept and objectives, progress beyond state-of-the-art, S/T methodology and work plan

B1.1. Concept and project objective(s)

Motivation for REWARD

In the last decade an increasing risk has arisen at world level coming from the unknown location of nuclear and radioactive sources that were mainly fabricated in the former Soviet Union and that, since its disintegration, have not been as strictly controlled as prior to the disintegration. Added to this other states such as Pakistan, who also have their own nuclear material, are known to have been causing concern to security intelligence agencies such as those of the United States, the United Kingdom and Russia who are not 100% sure that Pakistan can keep control of all such material. In the period 1993-2009, the IAEA Illicit Trafficking Database (ITDB) [Itd10] confirmed a total of 1,773 incidents involving nuclear materials, reported by the participating States and some non-participating States. Of these confirmed incidents, 351 involved unauthorized possession and related criminal activities, fifteen of them involving highly enriched uranium or plutonium. 500 incidents involved reported theft or loss (in 45% of the cases the lost or stolen materials were never recovered), and 870 incidents involved other unauthorized activities and events.

As an example, in 1994 almost three kilograms of highly-enriched uranium were seized from nuclear smugglers in the Czech Republic. In 2007 one kilogram of the same material was seized in Slovakia, dramatically illustrating the breakdown in controls over weapon-usable nuclear material in the former Soviet Union (the suspected source of the material) and making clear that terrorist groups are seeking to build a nuclear device.

Another type of radioactive threat, more common, is the loss or abandonment of equipment containing radioactive materials such as medical radiotherapy sources, or industrial radiology or densitometry systems. In some of the cases, as the ITDB report quotes, the sources are recovered. Unfortunately this is not always the case, and this can have disastrous health, social and economical consequences. The Goiânia accident in Brazil in 1987 is one such shocking example, in which four people died, 249 were seriously contaminated and more than 100,000 were called for monitoring when an old nuclear medical source was scavenged from an abandoned hospital and released into the public environment [Ans10].

Because of the high risk to citizens' health if these radiation sources are deliberately or accidentally manipulated (death is possible in less than one hour if the exposure is high), most Western Countries have deployed a set of detection systems and maintain communication networks in order to try to avoid their introduction and spread. However, these systems are mostly set-up at borders (roads, ports, airports and rail controls) and do not cover a large surveillance area but only zonal 'pinch point' sites. Moreover they are highly sensitive, expensive, of large dimensions and not at all portable. It is therefore imperative to explore alternative and complementary detection strategies to the systems already in place.

Thus, as a complement of such limited, zonal systems, a breakthrough solution is proposed based on the implementation of much smaller detectors, able to detect both gamma radiation and neutrons, combined with GPS location systems and a wireless network. The proposed solution will be a complete radiation monitoring system that can be installed to any form of mobile transportation (car, motorbike, helicopter, etc,) or can be installed in a network fashion across many fixed sites of a wide area. In this manner, REWARD will be able to constantly monitor large, wide areas, hugely improving the needed surveillance of radiation sources whilst greatly incrementing the safety of the population at large.

Main features of the REWARD project

The REWARD project will develop portable, intelligent radiation detectors that can determine the flux and energy of the incoming radiation, as well as their own location. Multiple individual detectors will be integrated in a ubiquitous radiation sensing system in order to continuously monitor an area, generate an alarm if an anomalous situation is encountered and locate and identify the radiation sources. The main features of the REWARD system will be:

- Real-time system with wide area coverage
- Based on novel solid-state detector technologies
- Scalable in terms of complexity and costs
- Very high precision on both the quantification and the location of the radiation source
- Portable and adaptable to any type of environment

The proposed system will be useful for many diverse scenarios such as nuclear terrorism, radioactive pollution, nuclear accidents or lost or stolen radioactive sources. The autonomous monitoring units will be designed for deployment in emergency units or law enforcement vehicles, and also in fixed stations in buildings or infrastructures (e.g. airports, ports, etc) and the units will operate without needing any human intervention and will be highly portable thanks to the low weight, small size and low energy consumption of the solid-state based detectors and electronics. The complete system will be scalable in terms of complexity and cost and will offer very high precision on both the measurement and the location of the radiation. The modularity and flexibility of the system will allow for a realistic introduction to the market. Authorities may start with a basic, low cost system and increase the complexity based on the latest needs and budget constraints.

The REWARD system is composed of the following main elements:

- Small, autonomous monitoring tags based on the integration of new miniaturized solid-state radiation sensors: a (Cd,Zn)Te detector for gamma radiation and a high efficiency neutron detector based on novel silicon technologies. The tags will include a GPS device to calculate the position of the tag and a wireless communication interface to send the measurement and position data remotely to a monitoring base station.
- Middleware and high level software to provide web-service interfaces for the exchange of information, and that will offer top level functionalities, such as management of users, mobile tags and environment data and alarms, database storage and management and a web-based graphical user interface. Effort will be spent to ensure that the software is modular and re-usable across as many architectural levels as possible.
- An expert system that will continuously analyze the information from the radiation sensors and correlate it with historical data from the tag location in order to generate an alarm when an abnormal situation is detected.
- A security framework to implement access control and authentication, security policy management, security of communications, data protection and regulatory/legal constraints.

Figures 1 and 2 show a graphical representation of how the REWARD system operates. The tags will be installed in mobile and/or fixed stations in the area selected for monitoring. For instance, if the area of interest is a city, then the law enforcement or emergency vehicles, or even public transport vehicles such as buses or taxis, could carry a monitoring tag. The tags will continuously sample their environment and both the sampling information and the tag location will be stored into an internal memory. The tags will also have small information processing capabilities so in case an abnormal level of radiation is detected an alert will be immediately sent to a monitoring station, indicating the location and the value of the radiation. The central station will analyze and correlate the data with historical records for that specific location, and will report the situation to the authorities.

REWARD brings together a Consortium of eight institutions: three academic partners (Instituto Tecnológico e Nuclear, University of Freiburg and CSIC), two SMEs (Sensing and Control, XIE), two large companies (EDISOFT, Vitrociset) and one final user (Civil Protection Campania). Also participating as external experts are two other final users (Spanish Guardia Civil, Civil Protection Catalonia).

Figure 1. The monitoring tags of the REWARD system will be installed in law enforcement vehicles or other mobile or fixed stations and will send their location and measurement data to a central monitoring station if an abnormal situation is detected.

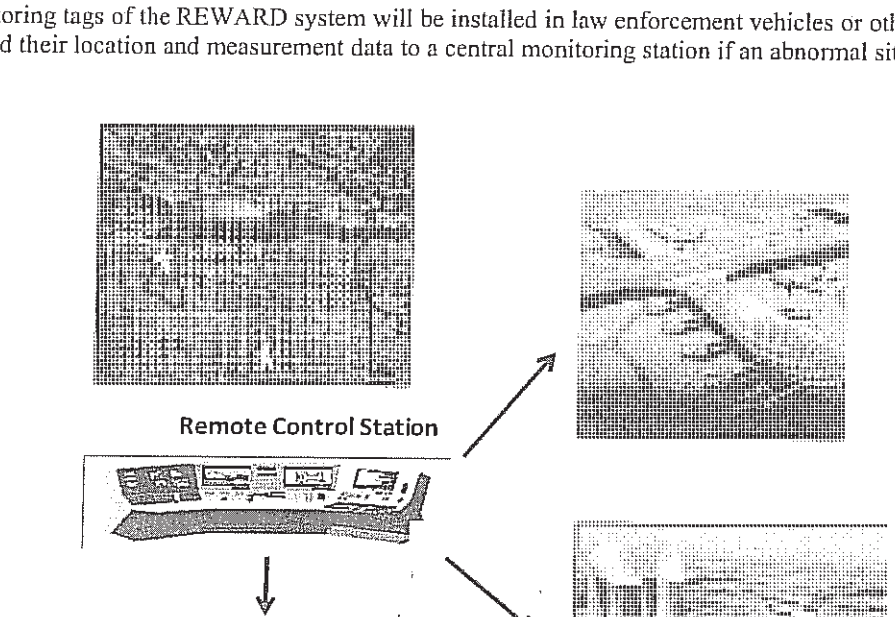


Figure 2. The areas where the system has been deployed will be controlled in real time from a central remote control station. An expert system will continuously analyse the sensor information received from the monitoring tags in order to detect risk situations not predictable through the analysis of data from isolated stations.

Scientific & Technical Objectives

The REWARD project aims to address the recommendations from the Final Report of the ESRIF CBRN Working Group [Esr09] that underline: "Prevention is crucial and should receive particular attention by equipping intelligence agencies and policy makers with improved information analysis tools. Consequence management to overcome CBRN attacks and hoaxes requires networked warning and situational awareness systems with development of more effective and reliable detection and identification capabilities." The report also quotes among the Research and Innovation Priorities: "Increased capacity (for Radiological/Nuclear incident preparedness) with small mobile detection devices."

REWARD also addresses the following recommendations from the EU CBRN Action Plan [Euc09] and included in the present FP7-SEC call: to improve the detection and identification capabilities of RN materials, especially of difficult to detect radioactive sources and nuclear materials or masked and shielded sources, and also of radiation sources in large crowds. To this end, the plan recommends the prioritisation of technology research into detection technologies and electronic tracking systems for radioactive sources; integration of different technological solutions; improving the detection software; and enhancing the mobility and portability of detection solutions.

REWARD's main S&T objectives, and the Milestones and months in which they will be realised (see WT4 for the complete list), are as follows:

High efficiency radiation detectors (MS2 – month 17)

Radiation detectors, both for gamma radiation and for neutrons, will be developed using state-of-the-art technologies that offer superior performances, lower volume, lower power consumption and lower cost compared to conventional sensors. The detectors will be optimized for detection efficiency and energy resolution.

Mobile sensing tags (MS3 – month 22)

The gamma and neutron detector units will be integrated in the same monitoring tag to make it easier to identify correctly both radioactive sources and nuclear materials, improving identification accuracy and reducing the occurrence of false identifications. Also integrated will be a GPS positioning unit and a communications unit capable of communicating geo-location information and radiation information over a wireless network.

Central monitoring and decision support system (MS5 – month 31)

An analysis and decision making system will be developed with the ability to process the data from the sensing units and to compare them with the data accumulated from historical records. This will provide improved detection capabilities even for low signal rates and also will reduce the number of false alarms.

Security framework (MS4 – month 25)

A robust security framework will be implemented to ensure protection against unauthorized access to the network and data, ensuring the privacy of the communications and contributing to the overall robustness and reliability of the REWARD system.

The state-of-the-art and the developments targeted by the REWARD project as an integrated system and in each of these separate areas are detailed in the next section B1.2.

B1.2. Progress beyond the state of the art

The REWARD System

The environmental radiation monitoring networks currently displayed in the Euratom Member States consist mainly of fixed stations and the infrastructures for remote data transmission, if any, are old-fashioned and heavy in most cases [Eur10].

In contrast, the REWARD system will be comprised by **low-cost, small, mobile** detection devices. The REWARD sensors will continuously monitor the environment at the sensor location and immediately send the sampling and location information to a monitoring station, enabling the continuous monitoring of **large, variable areas** in **real time**. The coverage area of the mobile sensor nodes will not be restricted to the wireless transmission range of a local network (i.e. a nuclear plant), but will extend to the area covered by the wide area network in place. The TETRA communications network, which was designed for use by government agencies, will be used preferentially in order to ensure communication success even during overload situations, unlike the GSM/GPRS/3G options preferred by other networked sensor systems [Lot10, commercial systems below]. Furthermore the modularity and flexibility of the system will make it easily adaptable to different situations and environments.

We have identified other mobile platform radiation detection systems commercially available:

- NAI-SS from Ortec [Ort11]
- Matrix Mobile ARIS Detection System from Thermo Fisher Scientific [The11]

These systems are designed to be carried on a vehicle but weigh tens of kilos and their volume is several litres. These are increased significantly if neutron detection capabilities are required. More importantly, the high cost of a single detection unit makes it impossible to implement a wide network.

The sensitivity of detecting sensors is proportional to the sensing material volume and, as we are aiming for a light and low cost system, this will come at the cost of reduced sensitivity when compared to the above systems, with much larger sensitive volumes. The main advantage of our system is its scalability and, if higher sensitivities are needed for critical applications, it is possible to use larger volumes at a higher cost.

REWARD is a natural step forward from the Euratom FP7 project DETECT: Design of optimised systems for monitoring of radiation and radioactivity in case of a nuclear or radiological emergency in Europe. DETECT's objective is to develop a methodology for optimising the design of monitoring systems for use in conjunction with state-of-the-art decision support systems for decision making in RN emergencies. REWARD aims to interact with DETECT and make use of their expertise to achieve the required impact.

New solid-state detector technologies

Solid-state neutron and gamma detectors are the choice for the REWARD project thanks to their robustness, low mass, low size and low power consumption.

(Cd,Zn)Te gamma detectors

The detection of gamma-ray photons, which are roughly in the tens of keV to few MeV energy range, requires spectroscopic systems with high efficiency for photon conversion. In order to identify the radioactive element that emitted the photon, a good energy resolution is an important characteristic of the detector. Conventional high energy resolution and high efficiency systems for detecting such gamma-rays are normally based on the use of HPGe detectors and need to be equipped with a liquid nitrogen cooling system for operation. Such detectors are frequently connected to standard NIM electronics with analogue pulse shaping, an Analogue to Digital Converter (ADC) and a Multi-Channel Analyzer (MCA). Such systems would be inapplicable to use in fast, mobile and real-time monitoring networks.

By contrast, the (Cd,Zn)Te gamma-ray detectors we propose to use can be operated at room temperature and hence do not require any cooling. A number of such detectors were already processed at Freiburg in the Coplanar Grid

design [He98] and have been successfully operated as photon detectors for identification of radioactive nuclides [Dam10].

For an environmental monitoring network application developed together with the German Federal Office for Radiation Protection (Bundesamt für Strahlenschutz, BfS), which in many aspects resembles key features of our proposed mobile radiation detection tags, these (Cd,Zn)Te gamma-ray detectors have been connected with the analogue electronics designed in-house along with new low power charge sensitive RC-feedback preamplifiers. The digital signal processing is implemented in the recently developed digital MCA, the GMCA, and allows much better performance than conventional analogue systems. Digital pulse shaping is performed using a customized deconvolution algorithm which is executed inside an FPGA. The deconvolution of the slowly decaying preamplifier signal results in trapezoidal shaping which has a much better signal to noise ratio than Gaussian shapers used in standard analogue systems.

With this (Cd,Zn)Te detector system, featuring a 12 bit ADC and a 40 MHz clock, we are able to cover the energy range from 10keV to 3MeV with high energy resolution. For the Coplanar Grid (Cd,Zn)Te detector we have measured the 662 keV peak from a ^{137}Cs source with 2.5% precision FWHM [Dam10]. The system has a low power consumption of about 2W.

Silicon detectors for neutrons

State-of-the-art mobile radiation detection systems with neutron detection capability such as the NAI-SS or the ARIS systems are based on ^{3}He proportional counters. These devices are heavy (tens of kg) and need operating voltages of the order of bundreds of volts. Additionally, ^{3}He is a by-product of the nuclear weapon industry and its production has declined with the reduction in the nuclear weapons stockpile; hence supply no longer meets demand [Tim11].

In contrast, silicon-based 3D structured neutron detectors like the proposed for the REWARD system have the advantages of low operating voltages, low cost, low mass and direct coupling of the signal to the readout electronics which makes them ideal for mobile applications. In this area, only three research groups in the world are currently pursuing this technology because in order to produce the base silicon sensor a fully equipped microelectronics clean room is necessary. These groups are: Nikolic et al. from Lawrence Livermore National Laboratory [Nik08] and McGregor et al. from Kansas State University [Gre09], both in the USA, and CSIC in Spain [Pel08]. With this technology measured neutron detection efficiencies of 21% bave been reported [Bel07] although theoretical calculations show that up to 35% can be achieved [Shu09].

There are neutron dosimeters in the market that use silicon planar devices [Bol04], however, to our knowledge, there are no commercial systems that use high these efficiency structured detectors. The aim of REWARD project is to bring to market this new technology by implementing an industrial-level manufacturing technology.

Security in networked services environments

Security is today a key requirement for the conception of any information system and, depending on the particular application context, security concerns relate to the protection of systems against malicious attacks, the management of digital identity and trust, protection of data and privacy etc. On the other hand, security models consider different architectural levels such as network security (depending on the network infra-structure), operating system vs. application security (e.g. hacking an operating system or user application) and also the physical security (e.g. basic system access through passwords). Hence, the number of security issues and corresponding technologies is wide.

As regards the current framework of standards and good practices for Service-Oriented Architectures (SOA), one must consider the OASIS security committee [Oas10] that promotes security standards needed in e-business and Web services applications. These standards range from common identity management to biometric identity assurance, policy management, digital signatures, privacy management, access control etc. to message protection cryptography. Other standardisation organisations and initiatives should also be mentioned such as the Trusted Computing Group (TCG), W3C and the Liberty Alliance, promoting standards, guidelines and best practices for identity management.

As far as the implementation of the mentioned standards is concerned, a wide number of security frameworks have been proposed over the years. These follow conceptually different architectural approaches by implementing security services either at the level of the application logic, as security services (e.g. public key infrastructure (PKI) via

XKMS – XML Key Management Specification) or as infrastructure (through a proxy, e.g. with WS-Security and SAML). The latter approach could be seen as the most advanced one as it best supports the requirements for interoperability (e.g. concerning the connection with legacy systems and federation). As examples for well-known implementations one should mention the Shibboleth security architecture supporting federated administration and access-controlled sharing of resources (built on SAML - Security Assertion Markup Language), the STORK [Sto10] project and Industry Group for cross-border eGovernment identity services (proposed as reference model for EC Services such as ECAS), a larger number of EU-funded projects such as GUIDE and PRIME under FP6, PRIMELife under FP7 as well as European initiatives (e.g. ENISA – the European Network Information Security Agency) and national schemes and implementations for identity management [Jrc10].These are complemented by particular frameworks that emerge in the private market (e.g. RSA Security, Oracle, Microsoft, IBM, specific frameworks, for example the IdenTrust Network for hanking, VeriSign etc.).

Whilst the development of identity management infrastructures is based on standards and given reference architectures, much research is still ongoing for security in highly heterogeneous and distributed, but yet security-critical environments; relevant ongoing R&D projects are for example (under FP7) MASSIF (MAnagement of Security information and events in Service InFrastructures, looking at the detection of upcoming security threats in multi-sensor environments before the occurrence of possible security incidences) and also projects in the area of cooperative systems (e.g. the E-FRAME support action providing a baseline for a European ITS Communication Infrastructure).

The evolution of security technologies is driven by the appearance of new solution architectures such as for GRID and cloud computing, new Web technologies and applications (e.g. social networks), the increasing importance of mobile communication based applications and services, emerging wireless technologies (networks, smart card infrastructures, Near Field Communication (NFC) devices etc.) as well as new forms of interactivity and new authentication technologies (e.g. biometric).

For the REWARD security framework, important design challenges stem from the fact that the solution architecture operates in a distributed, heterogeneous and wireless network environment. REWARD will explore the existing state-of-the-art and conceive a prototype of a security framework for the integrated architecture that fully meets these design challenges, further considering the particular operational use scenarios and corresponding security requirements for a cooperative system.

Data Fusion

The data fusion can significantly increase (1) the confidence with which the presence and identity of a radiation source is declared, (2) the covering range, allowing the potential radiation sources to be included into the interest area, as well as the updating rate of radiation source picture. Therefore, the use of multi radiation sensors may allow us to reach a certain level of confidence and accuracy at longer distances or at an earlier point in time.

From the algorithmic and data analysis point of view, REWARD will improve on the state-of-the-art techniques. One of the main technical roadblocks to data fusion at present, especially in urban applications, is related to the extent of time-consuming access to the huge database(s) containing known environment geospatial information. Fusing data requires many accesses to this database, which can dramatically slow down the computations. The approach proposed is to implement an innovative Environment Service simultaneously considering 3D Modelling, Storage, Querying and Visualisation activities in a time critical context of use, employing the latest research results and techniques brought from the interactive computer graphics domain (i.e. virtual reality, simulation and videogames). To ensure successful resolution, innovative data models and optimisation techniques will be carefully selected, designed and implemented considering the requirements and constraints of both the Fusion Engine and, importantly, its context of use. Furthermore, REWARD will not only enable the Fusion Engine to query urban geospatial information in a very effective manner, but will also enable interactive 3D visualisation of urban environments.

REWARD will contribute innovation to the following four areas: semantic background knowledge integration, fast processing (to yield fast and space-efficient algorithms), methods integration (to combine the results produced by event models with the results from data mining algorithms), and fuzzy processing. In addition to the specialist multi-sensor fusion algorithms developed with REWARD, elements of the solution created by the Data Fusion project will leverage existing technology advances in the technical areas of Master Data Management, Data Fusion,

Data Mash-ups and Non-exact/Fuzzy matching. The level of innovation will also be heightened by ensuring that an 'appropriate number' of sensor types are considered, enabling a subsequent migration path that considers the ease of addition of new sensor types (irrespective of high or low dimension) on an 'API' (plug and play) basis.

The databases and datasets will be the basis of sensor data analysis. The indexing engine must find high level semantic connection points between the different data sets and the retrieval engine needs to provide an API with comprehensive traversal capabilities among the different features. REWARD will extend traditional data access functionalities, as provided by relational database systems (RDBMS), integrating inference over probabilistic models of streaming sensor data. The project will apply model-based views of sensor data [Kan08] to reply to probabilistic queries with not only data stored into the database, but also with data produced by data fusion techniques, as if they were stored in a database. Previous basic concepts for querying over probabilistic databases have been proposed by [Nil04, Sen07]; the REWARD project will improve them by integrating Bayesian techniques for data fusion and inference over the status of the observed scenario. Thus queries formulated in standard querying language (SQL) are to be processed and converted into queries over the probabilistic data by a query interpretation layer. This scheme allows not only extraction of data collected by sensors but also query over probabilistic scenarios with an associated confidence value, e.g. filtering out less probable hypotheses. A query expansion technique will be developed for automatically expanding the feature-based queries with semantically connected terms, thereby enhancing the retrieval results.

Table 1. Benchmarks of the REWARD project

System element	**Performance indicator**
(Cd,Zn)Te gamma ray sensor	Target sensitivity: 2.5 μGy/h for 60Co and 5s exposure
Gamma ray Multi Channel Analyzer peak identification unit	Target energy resolution: 3% FWHM at 662 kcV at room temperature
Neutron detectors	Target sensitivity: detecting area 5 cm^2 1 Ci AmBe detectable at 3 m
Mobile system	Target specifications: Encrypted TETRA network communication GPS geolocation Multiple detection elements integrable Weight: < 5 kg Size: 30 x 20 x 10 cm^3
Security framework	Objective: explore common standards (e.g. OASIS WS-Security and related) and state-of-the-art solutions (e.g. originating from FP6 and FP7 – Security projects) in order to provide an end-to-end security framework considering nature of REWARD as distributed, heterogeneous and wireless network environment, to some extent operating as cooperative system and also in connection with public alerting (e.g. CAP). Indicators: - Openness & interoperability: compliance with common standards and reference implementations, open architecture allowing for re-use (modular approach / middleware etc.) - Scalability: use in a heterogeneous sensor network, large number of sensors

	- Supporting cooperation: between distributed system components - End-to-end security: integrated security framework - Conformance with regard to regulatory/legal constraints: integration and use of accepted security technologies, providing recommended or mandatory levels of security
Fusion, Detection and Tracking Platform	Scalable Connectivity to multiple data sources (apart from mobile system) End-to-End Robustness (self-management of system communication, from mobile devices to high level application) End-to-end Secure connections Alert/Warning messages management & generation Standard communication API (web services) Due to the nature to its architecture, the system is going to be scalable, meaning it will fit the necessities about data in/out throughput. A validator will be created to show performance of system in different configurations, and will be used to match configuration to real necessities as a function of the number of target mobile systems and target operations of central monitoring and support system.

References

[Ans10] A. Ansari, "Radiation Threats and your Safety". CRC Press, 2010.

[Bel07] S.L. Bellinger et al., Nuclear Science Symposium Conference Record, NSS'07. IEEE2007 pp 1904–7.

[Bol04] T. Bolognese-Milsztajn et al., "Active personal dosemeters for individualmonitoring and other new developments", Radiation Protection Dosimetry (2004), Vol. 112, No. 1, pp. 141–168.

[Dam10] M. Dambacher et al.,"Measurements with coplanar grid (Cd,Zn)Te detectors and development of the GMCA (Gamma-ray analysis digital filter Multi Channel Analyzer)", SPIE Proceedings Vol. 7805 (2010), DOI: 10.1117/12.863529.

[Euc09] EU CBRN Action Plan, 2009, http://ec.europa.eu/justice_home/news/summary/docs/com_2009_0273_en.pdf

[Eur10] http://ec.europa.eu/energy/nuclear/radiation_protection/article35/article_35_en.htm.

[Esr09] ESRIF Final Report, December 2009.

[Gre09] D.S. McGregor et al., "Microstructured semiconductor neutron detectors", Nucl. Instr. And Meth. A 608 (2009) 125–131.

[He98] Z. He et al., "Coplanar grid patterns and their effect on energy resolution of CdZnTe detectors", Nuclear Instruments and Methods in Physics Research A 411, 107–113 (1998).

[Itd10] IAEA Illicit Trafficking Database (ITDB), http://www-ns.iaea.org/security/itdb.asp

[Jrc10] JRC Scientific and Technical Reports, "The State of the Electronic Identity Market: Technologies, Infrastructure, Services and Policies", EUR 24567 EN–2010 (2010).

[Kan08] B. Kanagal, et al., "Online Filtering, Smoothing and Probabilistic Modeling of Streaming data," ICDE 2008. IEEE 24th International Conference on Data Engineering, 1160–1169 (2008).

[Lot10] LOTUS Project, "Localisation of Threat Substances in Urban Society", FP7-SEC-2007-1.3-03 grant no. 217925, http://www.lotusfp7.eu/

The Consortium will undertake two risk assessments, coordinated by the Coordinator (CSIC, representing the research centres) and S&C (representing industry), in months 15 and 30 in order to ensure that the milestones of the research and demonstration related WPs (2-7) have been achieved and to foresee any potential future risks. Table 2 lists the technological risks of the project and the proposed solutions the respective WP leaders can implement in order to ameliorate these risks.

Table 2. Potential risks by work package and proposed corrective actions

WP	Potential Risks/Tasks	Probability	Proposed corrective action
all	Partner failing to fulfil role, assigned tasks, for several possible reasons (shortage of resources, losing focus etc.)	Low	Managed through Consortium agreement: provisions for reassigning technical and financial liabilities The technical partners have several technical competencies and can assume others' technical responsibilities.
all	The required applications and services cannot be developed within the time and resource constraints of the project.	Low-medium	Prioritise applications and services development to ensure maximum deployment and evaluation within project constraints.
all	The Consortium experiences disruption, e.g. a partner resigns or fails.	Low	There will be strong management of the project by experienced co-ordinators and senior management within each partner. The Consortium partners have provided full assurance of their commitment to the project.
all	Loss of key person in technical area	High	Losing a key researcher at one of the participating organisations clearly affects the performance within the project areas where this partner is involved. If the partner cannot provide in short term a replacing expert of similar expertise a re-allocation of responsibilities within the Consortium will be considered. This re-allocation can be temporarily or permanently.
all	Communication problems between partners/work packages.	Low	Common events are arranged. Technical Manager will organise cross-work packages meetings to increase communication between partners.
all	Too many different technical aspects are present in the solution. Seems to be ambitious to merge most of them into a final unified solution.	Medium	Proof of concept and early assessment will help to determine how to join technologies and integrate them. The iterative delivery approach will also mitigate this risk.
1,6	Applications/services developed are technically interesting but end-users seem not interested	Low	Strong end-users involvement from the beginning of the project to ensure relevant user requirements are met.
1, 6	Insufficient access to end users.	High	The support of other security authorities through the involved Civil Protection Agencies will be requested. REWARD will establish special users groups that will act complementarily to the users into the Consortium.

WP	Potential Risks/Tasks	Probability	Proposed corrective action
1, 6	Inadequate scenario definition	Medium-High	Follow a rigorous approach with the participation of direct end-users. Re-work the document accepting a slight delay in delivering the first demonstration of the different systems.
1	The user requirements identified are not feasible within the scope of the project. Not all of the requested functionality would be available for the pilot implementations.	Low-medium	The Consortium will manage the user requirements process in order to ensure that the technical expectations are realistic. It will also prioritise those functions that will be essential for piloting and identify any longer term priority requirements, which could be incorporated at a later date into the potential product brought to market.
2	Detector does not reach sensitivity required to function as an effective early warning device.	Low probability, high impact	Aggressive review of alternative sensor possibilities Commercial sensors could be used in the first prototypes allowing the project to continue despite lack of initial sensitivity.
2	Testing scope of detectors and electronics poorly defined. Omission of scenarios that could cause failure in the field.	Medium	Investigation of failure scenarios and solutions while continuing with the following workpackages in parallel.
2	Insufficient time for extended operation tests.	Low-Medium	Incorporate early prototype sensors and electronics into later stages of project while further tests continue.
2	Late scope changes requiring rework of completed detector components.	Low-Medium	Continue project with first prototypes while investigating the problem and performing the necessary reworking.
2	Unavailability of testing and calibration resources as planned.	Low-Medium	Investigate alternative test and calibration resources and facilities.
2	Interfaces with other parts of the project poorly defined.	Low	Review interfaces where the problem has occurred and perform the necessary reworking.
2,3	Risk of technological failure in sensor/tag processing.	Low-medium	Incorporate commercial sensors in the first prototypes. Prototypes will be less efficient, but the sensor network could be deployed anyway as the software functionalities can be achieved.
4,5,6,7	Design complexity for fully integrated solution (prototype)	Low-medium	Project aims to provide a prototype and required technical developments will take into consideration the priority of features, technical feasibility, cost of implementation etc. that are most relevant for validation of the key results and expected innovation; organisations are committed to subsequent developments following the established implementation plan
4,5,6,7	Cost of implementation exceeds planned resources	Low-medium	Project aims to re-use existing frameworks (open-source, from other R&D projects, …) where applicable and develop these further for REWARD. Where software development is too complex, simulators will be built (implementing APIs)

WP	Potential Risks/Tasks	Probability	Proposed corrective action
4,5	Resistance to the adoption of the platform as a result of privacy concerns	High	The Consortium will place extreme emphasis on making the REWARD framework citizen-friendly. In addition to exploiting expertise available within the Consortium and complying with privacy mandates, the project intends to apply mechanisms such as public consultation and, privacy impact assessment towards eliciting and understanding citizens' concerns.
5	Underestimation of challenges in tasks causing delays	Medium-high	Clear and long planning time allocated to this WP at the start of the project. Complete and exhaustive input received from all stake holders.
5	Inaccurate simulation model yielding useless input for simulation.	Medium-high	Regular comparisons against experimental data.
6	The validation process fails to produce consistent evaluation feedback.	Low-medium	Both the evaluation criteria and testing and validation plan will be rigorously specified before the pilot implementations commence. This means that any variations in the feedback received should provide valuable information about real differences in the potential of REWARD.
6	Demonstrator requirements are too demanding	Medium	If the goals set internally by WP1 are too demanding, it is likely that the realisation of the different components will be delayed, or in the worst case not delivered. The delay will have a direct impact on the delivery of the integrated demonstration. The non-delivery case will, similarly to the case above, lead to a system with reduced functionality.
8	Technological evolution & market changes.	Low-medium	Constant technological watch and regular visits to events. Constant analysis and internal meetings to decide how to adapt the project to these changes.
9	Control mechanisms are inefficient	Low-medium	Adequate exchange of information between participants.
9	Budget is exceeded	Low	Adequate planning of proposed solutions.

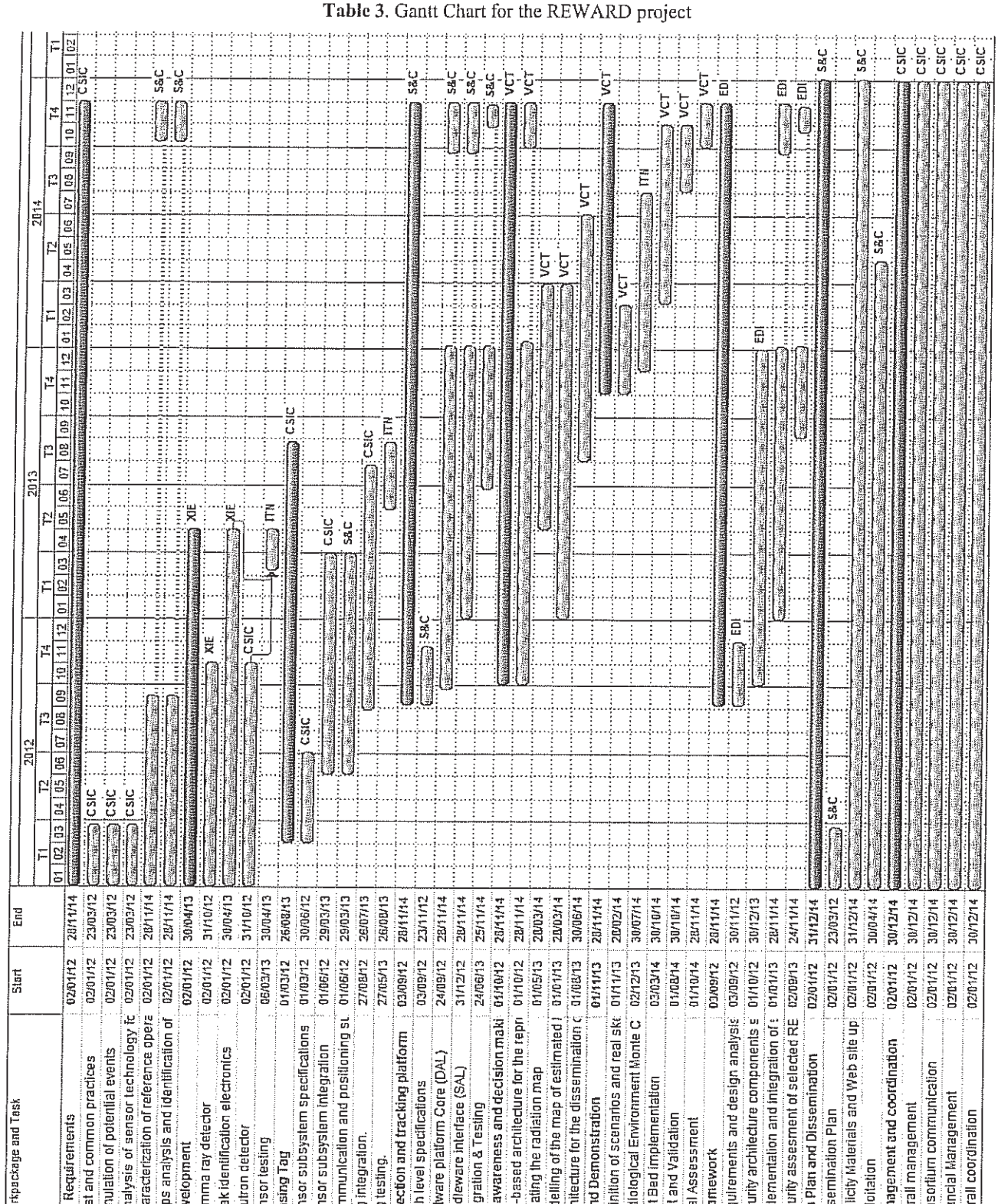
B1.3.2. Timing of work packages and their components:

In a time dimension, the phases in which we can divide the project are organized as follow:

- In a first phase, all the development work will be initiated (WP2, WP3, WP4 and WP5), in parallel with WP1 corresponding to the analysis and requirements. The results of WP1 will be used as a feedback for the remaining development packages.
- A second phase of the project will be carried out with the aim of integrating the different components developed for this project, and making it operational. This phase relates mainly to WP3, but also WP4, WP5, WP6 and WP7.
- The third phase relates to the phase in which we will make visible the results by demonstrations of the system (WP6) and the dissemination and exploitation activities. In this phase we also expect to refine all the software developments (WP4 and WP5) and the Trust Privacy and Security (WP7).

Table 3 shows the time plan for the REWARD project.

Table 3. Gantt Chart for the REWARD project



ID	Workpackage and Task	Start	End
1	WP1 Analysis & Requirements	02/01/12	28/11/14
2	Task 1.1 Best and common practices	02/01/12	23/03/12
3	Task 1.2 Simulation of potential events	02/01/12	23/03/12
4	Task 1.3 Analysis of sensor technology fc	02/01/12	23/03/12
5	Task 1.4 Characterization of reference opera	02/01/12	28/11/14
6	Task 1.5 Gaps analysis and identification of	02/01/12	28/11/14
7	WP2 Sensor Development	02/01/12	30/04/13
8	Task 2.1 Gamma ray detector	02/01/12	31/10/12
9	Task 2.2 Peak identification electronics	02/01/12	30/04/13
10	Task 2.3 Neutron detector	02/01/12	31/10/12
11	Task 2.4 Sensor testing	06/03/13	30/04/13
12	WP3 Mobile Sensing Tag	01/03/12	26/08/13
13	Task 3.1 Sensor subsystem specifications	01/03/12	30/06/12
14	Task 3.2 Sensor subsystem integration	01/06/12	29/03/13
15	Task 3.3 Communication and positioning su	01/06/12	29/03/13
16	Task 3.4 Tag integration.	27/08/12	26/07/13
17	Task 3.5 Tag testing.	27/05/13	26/08/13
18	WP4 Fusion, detection and tracking platform	03/09/12	28/11/14
19	Task 4.1 High level specifications	03/09/12	23/11/12
20	Task 4.2 Software platform Core (DAL)	24/09/12	28/11/14
21	Task 4.3 Middleware interface (SAL)	31/12/12	28/11/14
22	Task 4.4 Integration & Testing	24/06/13	25/11/14
23	WP5 Situational awareness and decision maki	01/10/12	28/11/14
24	Task 5.1 GIS-based architecture for the repn	01/10/12	28/11/14
25	Task 5.2 Creating the radiation map	01/05/13	28/03/14
26	Task 5.3 Modelling of the map of estimated i	01/01/13	28/03/14
27	Task 5.4 Architecture for the dissemination c	01/08/13	30/06/14
28	WP6 Test Bed and Demonstration	01/11/13	28/11/14
29	Task 6.1 Definition of scenarios and real ski	01/11/13	28/02/14
30	Task 6.2 Radiological Environment Monte C	02/12/13	30/07/14
31	Task 6.3 Test Bed implementation	03/03/14	30/10/14
32	Task 6.4 Test and Validation	01/08/14	30/10/14
33	Task 6.5 Final Assessment	01/10/14	28/11/14
34	WP7 Security Framework	03/09/12	28/11/14
35	Task 7.1 Requirements and design analysis	03/09/12	30/11/12
36	Task 7.2 Security architecture components s	01/10/12	30/12/13
37	Task 7.3 Implementation and integration of s	01/01/13	28/11/14
38	Task 7.4 Security assessment of selected RE	02/09/13	24/11/14
39	WP8 Exploitation Plan and Dissemination	02/01/12	31/12/14
40	Task 8.1 Dissemination Plan	02/01/12	23/03/12
41	Task 8.2 Publicity Materials and Web site up	02/01/12	31/12/14
42	Task 8.3 Exploitation	02/01/12	30/04/14
43	WP9 Project Management and coordination	02/01/12	30/12/14
44	Task 9.1 Overall management	02/01/12	30/12/14
45	Task 9.2 Consortium communication	02/01/12	30/12/14
46	Task 9.3 Financial Management	02/01/12	30/12/14
47	Task 9.4 Overall coordination	02/01/12	30/12/14

B2. Implementation

B2.1. Management structure and procedures

The REWARD Consortium is composed of eight legal entities, three national research funding institutions, two SMEs, two industries and one public authority (technology users). Moreover two additional public authorities will participate as external experts committee of technology users.

The management structure in REWARD is defined in WP9 and is outlined in Figure 4. It follows closely the organisation of the project across the eight development, demonstration and exploitation WPs in order to ensure a close link between the decision making and the organisation of the work, as well as an efficient communication of decisions to the Consortium.

B2.1.1. REWARD governance

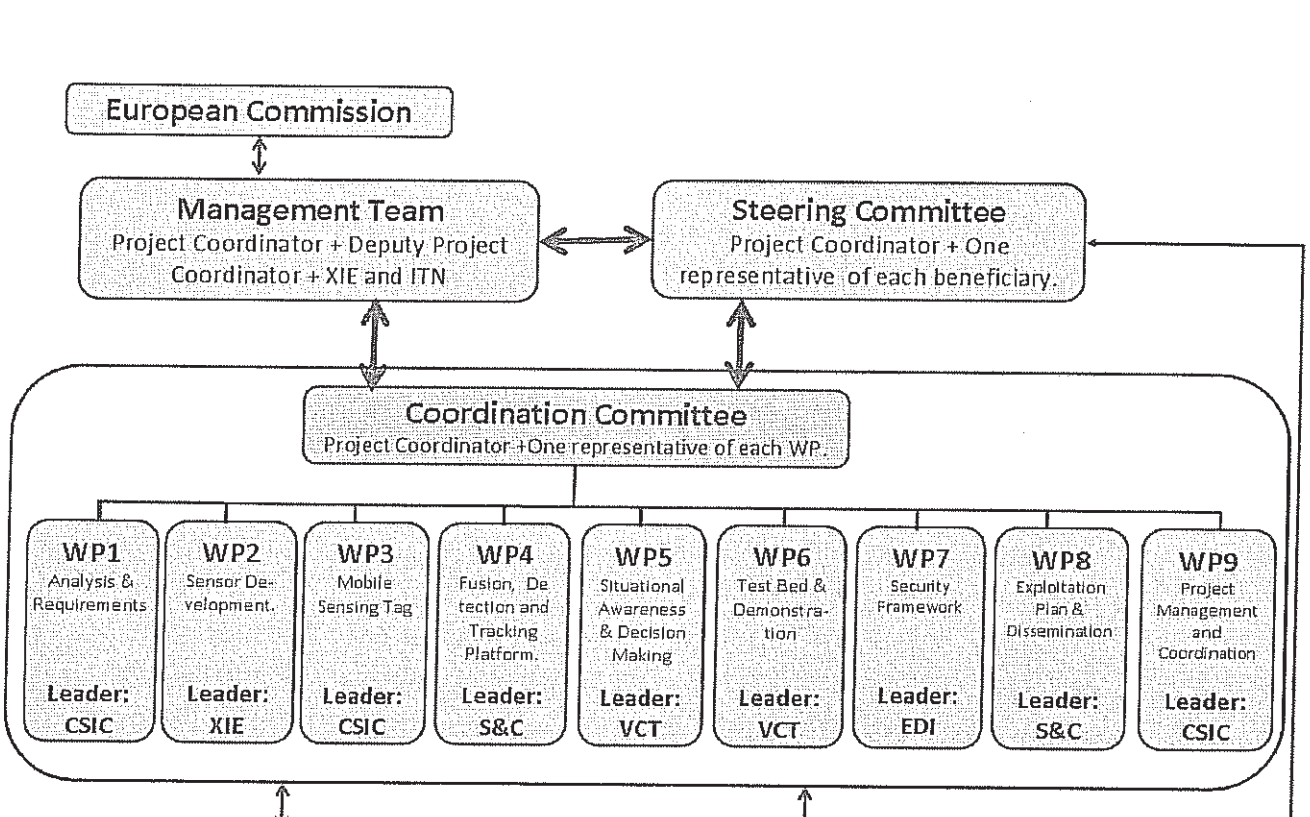


Figure 4. The management structure of the REWARD project

B2.2. Beneficiaries

B2.2.1. CSIC

Brief description of the organization
Consejo Superior de Investigaciones Científicas (CSIC) is the major Public Research Body in Spain. CSIC is composed of around 120 research institutes in all research areas distributed throughout the national territory. This project will be mainly developed at the Institute of Microelectronics of Barcelona (IMB-CNM) which is the largest public microelectronics laboratory in Spain. Founded in 1985, its main activity is research and development in silicon-based micro- and nano- electronics. IMB-CNM staff is around 240 people, about 60 of whom are researchers. IMB-CNM has a fully equipped semi-industrial Clean Room for silicon microelectronic fabrication and electronic prototyping facilities. IMB-CNM is a full member of EPoSS, of the ENIAC Public Authorities Board, and of the Spanish Technological Platform of Nanoelectronics and Smart Systems Integration (Génesis Redes-eniac-ssi), the National mirror for ENIAC and EPoSS.
Main tasks attributed
CSIC will perform the administrative coordination of REWARD project (WP9) supported by S&C. CSIC will also lead the WP1 (Analysis & Requirements), coordinating the contribution of each participant and providing knowledge on the neutron sensor technologies, and WP3 (Mobile Sensing Tag). Moreover CSIC will contribute to WP2 (Sensor Development), WP6 (Test Bed and Demonstration) and WP8 (Exploitation Plan and Dissemination).
Relevant previous experience
IMB-CNM has large experience in the design, simulation, test and fabrication of radiation detectors on silicon substrates. It is one of the few laboratories in the world with a proven experience in microstructured 3D silicon sensing devices, and the only one in Europe to have adapted it to neutron detection. IMB-CNM has also wide experience in the development of electronic systems
Short CV of the staff members who will be undertaking the work
Prof. Manuel Lozano (MSc. 1984, PhD. Physics 1989) is the Head of the Micro and Nano Systems Department at IMB-CNM and has long experience in technology development and characterization along with research management. **Dr. Celeste Fleta** (MSc. 2003, PhD. Physics 2006) has wide experience in silicon detector fabrication technologies. Currently she leads a project for developing silicon detectors for neutron dosimetry in medical environments. **Dr. Giulio Pellegrini** (MSc. Physics 1999, PhD. Engineering 2003) has experience in simulation, advanced technologies for detector fabrication, and characterization. The technical teams of CSIC's Clean Room and Electronics Laboratory will also participate in the project.

B2.2.2. S&C

Brief description of the organization
Sensing & Control Systems S.L. (S&C) S&C is a technology based company specialized in bringing to the market solutions related to remote control, monitoring and real-time tracking of goods and people. S&C has specialized on wireless communication technologies with R&D and integration projects in several markets including Security, eHealth, Energy, Location and tracking. The company was created more than 4 years ago. The co-founders of the company (and current management team) have accumulated extensive experience working with these technologies on R&D and commercial activities, in their earlier professional stages.
Main tasks attributed
S&C is the Deputy Project Coordinator of REWARD, and will have an important role on the global management of the project in WP9. S&C will lead WP4 (Fusion, Detection and Tracking Platform) and WP8 (Exploitation Plan and Dissemination) and will contribute on WP1 (analysis and requirements), WP3 (Mobile Sensing Tag) providing his experience on the communications Interface and WP7 (Security Framework). Finally, S&C will contribute in WP6 (Test Bed and Demonstration).
Relevant previous experience
The S&C team has international experience from working at different embedded system world leading companies such as Nokia and Epson. The team has years of experience across broad and complimentary company activities covering: management, marketing, sales, R&D and product development. S&C has proven experience in Wireless Sensor Network development, monitoring and tracking software development, marketing & sales, as well as System deployment. We have completed WSN projects in many diverse market domains such as Telecare, Security, Smart cities. We have good international exposure and penetration in this upcoming & growing market and are included in market surveys for WSN technology.
Short CV of the staff members who will be undertaking the work
Dr Narcís Avellana: PhD. in microelectronics (Universidad Autónoma de Barcelona-Universität Ulm), BA in Computer Science (Universidad Autónoma de Barcelona) and an MsC in business administration (Universidad Autónoma de Barcelona). He worked in the National Microelectronics Centre for 6 years, where he designed custom chips for their clients. He moved to Germany at the University of Ulm where he developed the PhD in Microelectronics. After his PhD, stay for additional 6 years in Germany working on technology companies (Siemens AG, Epson Europe Electronics GmbH) in different areas. In 2000, he returned to Barcelona to set-up the business & R&D centre that had been entrusted by the Japanese company Seiko-Epson, where he was General Manager for 6 years. After that he has been co-founder of the company Sensing & Control Systems S.L., were he is General Manager of the company since 2006. **Richard Lancaster Croyle BEng CEng MIET.** He holds a First Class Beng (Hons) Electrical & Electronic Engineering degree from Staffordshire University (UK) and Chartered Engineer (CEng) status from the Institution of Engineering and Technology. He previously worked for 11 years at Nokia developing hardware and embedded systems technology for mobile handsets. He held positions from Design Engineer to Platform Manager with his work placing him at the forefront of world leading technology. Most recently Richard has been working as the R&D director for Sensing & Control where his responsibility for growing the R&D department has led him to manage the department to deliver solutions for diverse local markets, as well as to spear head S&C´s entry to EU level projects. **Alberto Fernandez, MSc**, Operations Director. Mr Fernandez holds a Computer Science Degree and Master degree in microelectronics. Alberto worked in the R&D department of the Spanish Microelectronics Centre. Then he worked as R&D engineer at Microson, a Spanish leading company in the development of hearing aid products for the global market. Following this, he worked as Technical Manager of the Seiko Epson Barcelona Design Centre, developing ASICs within the EMEA area.

B2.2.3. ITN

Brief description of the organization
The **Nuclear and Technological Institute (ITN)** is a research centre from the Portuguese Ministry of Science, Technology and Higher Education. ITN provides scientific and technical assistance to the Portuguese Government in the areas of nuclear safety, radiological protection and applications of radiations and radioisotopes in the medical and industrial sectors. Education and Training is another competence of the ITN. In this context, several researchers teach Radiation Protection-, Dosimetry- and Nuclear Engineering-related disciplines in undergraduate and post-graduation courses in several Portuguese universities. ITN also operates the Portuguese Research Reactor and other medium-scale facilities in Portugal, making them available for researchers in other institutions. ITN's researchers are national representatives and delegates in various Committees of the EU, the IAEA, the OECD, etc. and of Working Groups of European and international organizations, such as EURADOS, EURAMET, etc.
Main tasks attributed
ITN will participate in WP1 leading the tasks of simulation of potential events, in WP2 leading the task of sensor testing, in WP3 leading the task of tag sensing and WP6 leading the task of Radiological Environment Monte Carlo. Moreover ITN will participate in WP8 (Exploitation Plan and Dissemination).
Relevant previous experience
The team features extensive experience of participation in national (funded by the Portuguese Foundation for Science and Technology) and international research projects (in the Framework of the EU's 5th, 6th and 7th Framework Programmes) and in the context of organizations such as EURADOS. The team core competences are in several branches of dosimetry and in radiation effects in materials and biological systems, including modelling using several state-of-the-art Monte Carlo simulation programs. Cooperation with academia and research groups in Portugal and abroad is in force.
Short CV of the staff members who will be undertaking the work
The ITN researchers involved in the project are: L. Portugal, P. Vaz, J.G. Marques, and A.C. Fernandes. The team members exhibit a sound expertise in several topics of dosimetry and in radiation effects. Several Ph.D. students will be involved in the project activities. **Pedro Vaz, Ph.D.** and Habilitation, is Coordinator of the Radiological Protection and Safety Unit of ITN. His main areas of expertise are Radiation Protection, Radiation Shielding and Radiation Dosimetry with emphasis on computational aspects in Radiation Physics and Particle Transport Simulation. He is/has been project leader of ITN groups in several 5th, 6th and 7th FP projects in the areas of radiation protection, radioactive waste management and nuclear data measurements. He has an extensive experience of work in international organizations such as CERN and the OECD/Nuclear Energy Agency. He is Portuguese Delegate in different Committees, Working Groups and Task Forces of the European Union and the Nuclear Energy Agency. He is invited professor at the Physics Department of the Technical University of Lisbon teaching disciplines such as Radiological Protection, Dosimetry, Shielding, amongst others. **José Marques, Ph.D.**, is Coordinator of the Nuclear Reactors and Safety Unit of ITN. His main areas of expertise are characterization of materials with nuclear techniques, nuclear instrumentation and nuclear engineering. He is manager of the Portuguese Research Reactor since 2002 and has been project leader of ITN groups involved in 5th and 6th FP projects in the areas of nuclear engineering. He is Portuguese Delegate in different Committees and Working Groups of the European Union and the International Atomic Energy Agency. He is invited professor at the Physics Department of the University of Lisbon teaching disciplines such as Nuclear Techniques and Nuclear Energy.

B2.2.4. ALU-FR

Brief description of the organization
Founded in 1457, the **University of Freiburg** is one of the oldest German universities and is now one of the nation's leading research and teaching institutions as evidenced by its elite status among the nine German Universities of Excellence and its membership in the League of European Research Universities. It actively fosters interdisciplinary research, and it is one of the few universities offering world class research environments in classical as well as in modern disciplines. The university actively promotes international exchange, which is facilitated by its central location in Enrope and its proximity to Switzerland and France. The Institute of Physics of the University of Freiburg has three main research areas: particle physics, atomic and cluster physics, and complex systems, involving 22 professors in total. The group participating in this project works in experimental particle physics and is at present composed of five tenured senior staff members (three physicists and two engineers), seven post-doctoral researchers, 14 PhD students as well as a large number of diploma and masters students.
Main tasks attributed
The University of Freiburg has been assigned key tasks from the very start of the REWARD project. The most crucial of these involve the characterization of the detector response and calibration using a range of different radioactive sources in WP2; in addition we will participate in the assembly of the gamma-ray detector and supporting electronics in WP3. We will also perform intensive testing of the system also in WP3. ALU-FR will also participate in WP1 (Analysis & Requirements), WP6 (Test Bed and Demonstration) and WP8 (Exploitation Plan and Dissemination).
Relevant previous experience
We have actively pursued R&D in the fields of semiconductor sensors and fast readout electronics for particle physics instrumentation for more than 20 years. The development, procurement and production of several hundred silicon detector modules for the ATLAS experiment at the Large Hadron Collider (LHC) at the European Organization for Nuclear Research (CERN) in Geneva has been one of our main projects in the past years. At present, we are involved in the testing of prototype silicon detector sensors as part of an extensive R&D project for the ATLAS experiment upgrade, due for installation in 2020. The sensors are fully characterized, using a combination of laser and radioactive source testing, expertise which is directly applicable to the sensor testing requirements of the REWARD project. The University of Freiburg has a long-term experience in the development of pixel detectors and associated front-end electronics. Freiburg is member of the Medipix2 and Medipix3 collaborations at CERN.
Short CV of the staff members who will be undertaking the work
Dr. Ulrich Parzefall holds a Diploma in Physics from Hamburg University, and a Ph.D. from the University of Liverpool, which he obtained in 1999. Since then, he has had over ten years' further experience in the field of particle detector design. This includes a post as a CERN research fellow, which he held until 2003. Since then, Ulrich has had eight years' experience designing and building semiconductor radiation detectors as a Senior Researcher at the University of Freiburg. **Dr. Thomas Barber** obtained his Master's degree from the University of Cambridge in 2006, where he continued to complete a Ph.D. in Physics in 2010. During this time, he has accumulated seven years' experience in the field of semiconductor detectors. In particular, he has spent two years at CERN as an expert in the Data Acquisition system of the ATLAS experiment's Semiconductor Tracker. Tom has been working as a Research Associate at the University of Freiburg since 2010.

B2.2.5. VCT

Brief description of the organization
Vitrociset's business activity is focused on dedicated technical services for systems with high-level operational performance (i.e., design, HW/SW development, integration and operation) in the field of ATC/ATM, integrated logistics for military or civil applications, space control and launching sites, environmental monitoring. Vitrociset is active in Italy and abroad through its permanent establishments in Germany, Holland, Belgium, French Guiana and Saudi Arabia.
Main tasks attributed
Vitrociset will lead WP5 (Situational Awareness and Decision Making) which tasks match perfectly the experience of the company. Moreover Vitrociset is the leader WP6 (Test Bed and Demonstration) with special collaboration of Italian Civil Protection in this demonstration work package. Vitrociset will contribute on WP1 (Analysis and Requirements), WP4 (Fusion, Detection and Tracking Platform), WP7 (Security Framework) and WP8 (Exploitation Plan and Dissemination).
Relevant previous experience
Vitrociset is involved in national and international programs in the field of security (HS) linked with REWARD, in particular: (1) EC-FP7 capability project: "NI2S3 – Netcentric Information Integration Services for Security Systems" (Role: Coordinator); (2) EDA: "MEDUSA – Multi sensor data fusion grid for urban situational awareness" (Role: Coordinator); (3) EC-FP7 integrated project: "PROACTIVE – Total Airport Security System" (Role: WP Leader); (4) EC-JLS capability project: "THIS – Transportation Hub Intelligent video System" (Role: WP Leader); (5) "SERIT - Security Research in Italy", the national R&T platform for the definition of the Strategic Research Agenda in homeland security that encompasses all security areas. Recently, Vitrociset was awarded the project of "Carabinieri" police force in bringing about the Objective 1.3 for the environmental protection, which is part of the 2007-2013 IT Operations Security Plan, funded by EU and actuated by the Ministry of Interior.
Short CV of the staff members who will be undertaking the work
Dr. Walter Matta received the Dr.Ing. Degree in Electrical Engineering (with honours) and the Professional Engineer Certificate in 1994, both from the University of Cagliari, Italy. His thesis was published in an international journal. After an experiences as Researcher of two-years duration, he has been employed by Vitrociset S.p.A. since 1997, mainly focused in the experimentation of avionic and missile systems at the Experimental Test Range of "Salto di Quirra" (Sardinia), playing a key role in all innovation projects, covering positions of increasing responsibility (Team Leader, Project Manager, Client Manager). Since March 2009, he is the Head of Corporate R&D. Currently, he is also Principal Investigator of several EU and IT projects, as well as he is an accredited expert of: (1) Italian University & Research Ministry, (2) EDA, (3) NIAG (NATO Industrial Advisor Group), (4) Guru Group of QSTP (Qatar Science & Technology Park). **Roberto Caldarella**, after having been employed as Operations Manager for twelve years in Data Management S.p.A. (a company mainly focused in Public & Enterprise Information Systems development and outsourcing), has spent twenty four years in Honeywell, Honeywell-Bull, Bull and Integris (the Systems Integration company inside Bull Group), covering since 1988 positions of responsibility in the Offer Engineering organization for Public Administrations. Since 2003, he has supported Italian Ministry of Environment for its several SDI projects (National Geoportal and wide spatial data infrastructure, according to INSPIRE scenarios) and has acted in SDI working group in DigitPA (Italian Authority for ICTs in Public Administration). He has been employed by Vitrociset S.p.A. since 2008, holding the positions of Engineering Area Manager for Environment and Territory, and being responsible for the same thematic area in the Corporate R&D organization.

B2.2.6. XIE

Brief description of the organization
The company **X-ray Imaging Europe** (XIE GmbH) is developing X- and Gamma-radiation detectors and related electronics. XIE was founded as a start-up of the Freiburg Materials Research Center of the Albert-Ludwigs-Universität Freiburg. The business of XIE GmbH is the development and manufacture of sensors for efficient detection of radiation for medical applications, security monitoring and non-destructive testing. The expertise of XIE is the combination of production and processing of the sensors starting from material production to the complete system. Thus, the possibility opens up for individual sensor development adapted to the requirements for particular application.
Main tasks attributed
XIE is the lead partner for two tasks in the REWARD project. The first involves the fabrication and processing of (Cd,Zn)Te sensors with a large active volume, for use as the gamma-ray detector in WP2. Secondly, XIE has been assigned the task of constructing the supporting read-out and analysis electronics. The aim of this task is to identify the nuclide corresponding to the measured gamma-ray spectrum also in WP2. XIE will also have an important participation in WP3 (Mobile Sensing Tag). Additionally XIE will contribute in WP1 (Analysis & Requirements) and WP8 (Exploitation Plan and Dissemination).
Relevant previous experience
XIE has a history of developing high-performance detectors, including pixel detectors systems using the Medipix2 Photon Counting chip. More recently, XIE has recently developed (Cd,Zn)Te detectors in combination with Gamma-Ray Multi Channel Analyzer (GMCA) electronics for environmental radiation monitoring. The eventual goal for these detectors is to replace the network of 2000 detectors used by the German Federal Office for Radiation Protection. The current system of Geiger-Mueller tubes only offers information about radiation doses, whereas the (Cd,Zn)Te detectors, in combination with GCMA electronics, use gamma-ray spectroscopy to distinguish between radioactive nuclides. The techniques and expertise acquiring developing and building (Cd,Zn)Te detectors and the GMCA electronics will be directly applicable to this project. XIE are the leading company in Europe in the production of (Cd,Zn)Te and CdTe sensors. The digital signal processing of the GCMA electronics package has been shown to offer better performance than standard analogue systems.
Short CV of the staff members who will be undertaking the work
Dr. Dipl. Phys Alex Fauler is the CEO of XIE GmbH, holding a PhD in material science and a German Diploma in Physics. He has worked at the Freiburg Material Research Centre FMF since 2000. Over the last ten years, his field of research has spanned a broad range of activities related to the production and development of CdTe and (Cd,Zn)Te radiation detectors. He is author of more than 25 scientific papers and three patents related to detector technology and material processing. **PD Dr. Dipl. Phys. Michael Fiederle** is the senior scientist and consultant in XIE. He has been project manager of scientific and industrial projects for the development of radiation sensors and related electronics. He is the coordinator of a project with the German Federal Office for radiation protection, in which a Multi-Channel Analyser was developed for the use with (Cd,Zn)Te CPG detector units. He is author of more than 75 scientific papers. **Andreas Zwerger** has worked in the field of radiation detector development for the last 10 years. He has been a senior scientist at the University of Freiburg and has worked for a European company in the design and development of readout electronics.

B2.2.7. EDI

Brief description of the organization
Established in 1988, **EDISOFT** is a Portuguese company that offers technologically advanced software solutions and highly qualified IT consulting services to the design, development and integration of critical real-time command, control, communications, computer and intelligence systems, having delivered a number of technologically advanced solutions to customers in a broad number of organisations and countries. EDISOFT also holds a profound knowledge in the development of integrated business solutions in diverse markets such as defence and security, earth observation and spatial information infrastructures, telecommunication, retail, transports and logistics and others, offering a wide range of value-added products and services with emphasis on system design and development, consultancy and training. EDISOFT has a proven record of successful participation in international R&D programmes and as solution provider to the European Commission, ESA, NATO, the European Defence Agency and other European organisations such as EUMETSAT, EMSA, JRC, and DG ENV/MIC.
Main tasks attributed
The main role of EDI is to act as work package leader and driving technological partner for WP7, i.e. the conception of security framework as integral part of the proposed REWARD solution architecture. In this role, EDI will contribute to the analysis of mission-operational requirements, lead the design, implementation and integration of security services and components and will also contribute to other specific technical (e.g. under WP4 and 5, further exploring its expertise in GIS and control & command systems) as well as to dissemination activities (in WP8). Finally EDI will participate on the WP1 (Analysis & Requirements).
Relevant previous experience
EDISOFT is actively addressing the Security and Homeland Protection markets basing on consolidated products and system engineering capabilities. EDISOFT's systems are operationally used to deploy Monitoring services, Command and Control, Sites protection and Management of Infrastructures. Examples for participation in international R&D projects related to risk and crisis management (solutions) are OASIS (FP6), GLOBE (FP7) and the ongoing project EURACOM (FP7). As regards particular fields of expertise, EDISOFT has profound background in the areas of artificial intelligence and intelligent decision-support in real-time system environments (security monitoring, expert systems, command & control etc.), service-oriented architectures, including mobile services platforms (FP6 USE-ME.GOV, SMITA), spatial-data infra-structures and corresponding security frameworks and applications. EDISOFT is also member of EOS (European Organisation for Security) and contributes in several security areas and corresponding working groups.
Short CV of the staff members who will be undertaking the work
Dirk Tilsner: graduated in Electrical Engineering, Telecommunications and holding a Master in Business Administration (MBA). He is manager of a business unit for geographical decision-support systems. He has a long-term experience in international R&D, including in the area of security (recently under FP7: GLOBE, EURACOM). **João Calado**: Graduated in Electronic Engineering and Co-founder of EDISOFT; he is Business Area Manager of the Defence & Security at EDISOFT and is also manager of several projects for defence and security programs developed for the National and Foreigner Naval Forces. He has been involved in a number of multi-national and NATO projects, mostly in the areas related with operational command & control and tactical data links. **Carlos Figueiredo**: Information technologies technician (1991) working as a Senior GIS System Analyst for EDISOFT, and for many years Technical Manager for a number of SDI related projects, including R&D projects (EuroGEOSS, USE-ME.GOV, LIAISON). Through projects in the domains of SDI (EFICP, GS SOIL) and mobile services platforms (USE-ME.GOV, SMITA) and other commercial activities, he gained a profound knowledge of the current state-of-the art in the areas of web services security and in general in service-oriented architectures and corresponding solutions for access control, authentication, privacy etc.

B2.2.8. DIP

Brief description of the organization
The fundamental approach to an effective civil protection operation relies on three key modes of action: Prevention, Preparedness and Response. In order to achieve these objectives the **Civil Protection Unit of Campania** has implemented a number of services addressed to better protect people, their environment, property and cultural heritage in the event of major natural or manmade disasters. *Prevention*: the civil protection unit works in order to reduce and/or avoid risks that could occur in case of natural or manmade disasters through better anticipation and more accnrate assessment at various time and spatial scales of situations at risk. State-of-the-art instruments and equipments and qualified personnel assure the monitoring and analysis of environmental phenomena in order to highlight potential risk situations. Currently the Functional Centre is equipped with 200 peripheral monitoring stations, equipped with state-of-the-art sensors and communication networks allowing real-time data transmission. *Preparedness*: the civil protection unit of Campania assures the availability of qualified personnel prepared for facing emergency situations. The "Civil Protection Regional School" at Pozzuoli is one of the most important Italian centres for the civil protection operators training. *Response*: in dangerous situations the civil protection unit gets involved in response to real and urgent user need with personnel, transport means and equipments able to face any rescue and assistance need, during and post-crisis.
Main tasks attributed
DIP will participate mainly in WP6 (Test Bed and Demonstration) realizing the following tasks: analyze the best and common practice for detection of difficult-to-detect radioactive sources and nuclear materials, in particular in urban crowded environment; define the "reference operational scenarios" to be successively used for the REWARD testing and validation; Scenarios sketching; Assessment of the overall demonstrator in realistic environment. Additionally DIP will have a small participation in WP1 (Analysis & Requirements) and WP8 (Exploitation Plan and Dissemination).
Relevant previous experience
DIP currently manages an operational system for real-time monitoring of meteorological and hydrological processes at regional scale. Dip also manages a regional civil protection alert system, structured in two main parts: 1.-a semi-automatic analysis of hydro-meteorological data for assessing critical conditions leading to potential hydro-geological risks; 2.-a set of procedures for issuing warning messages to local civil protection authorities.
Short CV of the staff members who will be undertaking the work
Francesca Napoli graduated with honours in Environmental Sciences at Parthenope University in Naples on March 2002. She attended post-graduate courses both in meteorology and in computer sciences organised in Italy and in England (at ECMWF, Reading). Her main interests are in weather forecasting and meteorological numerical modelling. She worked within a research group at the University of Salerno, providing expert consultancy for the back-analysis of historical extreme rainfall events occurred in South Italy, by applying a numerical weather model (MM5). Since June 2004 she has been working as a weather forecaster at DIP where she is also responsihle for meteorological numerical modelling. **Mauro Biafore** graduated in Civil Engineering – Hydraulic address at the University of Calabria in 1991 and received his PhD in Environmental Conservation and Soil Defence at the University of Reggio Calabria in 1996. He has been working as Executive Director at DIP and as Chief of Campania Functional Centre. His main activities are in the field of hydrological monitoring and decision support system for hydrogeological and hydraulic risks and in monitoring network planning and realization.

B2.2.9. External Experts

In addition to DIP, full partner of the REWARD Consortium, REWARD includes the support of two other final users as External Experts: the Spanish Guardia Civil (GUCI) and the Catalan General Directorate for Civil Protection (DIRIP).

Both External Experts have expressed their intention of actively supporting the project by providing invaluable end-user feedback as the project progresses as members of REWARD's Industry Advisory Board, participating in end-user workshops and contributing to the dissemination of the project results. Additionally, together with DIP, they will form the Security Committee (SEC), in charge of assessing the sensitivity of the deliverables before publication.

GUCI

The ***Guardia Civil*** (Civil Guard) is the Spanish gendarmerie (the highest level civilian protection and policing force.) It has foreign peace-keeping missions and maintains military status and is the equivalent of a federal military-status police force. As a police force, the *Guardia Civil* is comparable today to the French *Gendarmerie*, the Italian *Carabinieri* and the Dutch Royal *Marechaussee* as it is part of the European Gendarmerie.

Today, they are primarily responsible for policing and/or safety regarding the following (but not limited to): highway patrol, protection of the Royal Family, counter drugs and anti-smuggling operations, control of customs and ports of entry, control of weapons licenses and arms, bomb squad and explosives, security in rural areas and in locations with less than 10,000 inhabitants, anti-terrorism, coast guard, intelligence and counter-intelligence gathering, cyber- and internet crime as well as environmental law enforcement.

The **Security Office** of the *Guardia Civil* who are responsible for Spanish anti-terrorism measures will participate in REWARD's Industry Advisory Board and Security Experts Committee.

DIRIP

The Catalan General Directorate for Civil Protection (***Direcció General de Protecció Civil***) is the Spanish and Catalan legislations accord authority to the Catalan regional government in the field of civil protection.

The management of any emergency which affects exclusively the Catalan territory corresponds to the Catalan regional government, the *Generalitat de Catalunya*. The fire brigades, the largest police force (or law enforcement body) and the emergency medical services that operate in Catalonia are governed by the *Generalitat*. The Catalan government is also in charge of managing the regions civilian emergency telephone centre and number (112), informs the population of self-protection measurements in risk cases such as accidents or natural disasters, and develops and manages civil protection plans, amongst other tasks.

Any radiological emergency taking place in Catalonia is therefore managed by the *Generalitat de Catalunya* (and hence the *Direcció General de Protecció Civil*), with the exception of an emergency caused by one of the three nuclear reactors operating in Catalonia, which, because of the possible extent of the emergency, would be managed by the Spanish government with the collaboration of the first responders units belonging to the Catalan Government.

In further organisational detail, the Catalan emergency operations centre (CECAT), in charge of emergency response planning, is managed by the *Direcció General de Protecció Civil*, a section of the *Departament d'Interior, Relacions Institucionals i Participació* (Department of Interior, Institutional Relations and Participation) of the *Generalitat*.

The *Direcció General de Protecció Civil de Catalunya* are key for providing radiological and nuclear planning and response in the autonomous Catalan Region. They will participate in REWARD's Industry Advisory Board and Security Experts Committee providing greatly valuable feedback on the technology and information on how it can be adapted to the needs of an end user.

B2.3. Consortium as a whole

REWARD aims at developing a real-time radiation surveillance system from which the European security sector will take advantage. The project covers a wide range of multidisciplinary activities as radiation sensor development, wireless communication, expert systems and security. All these activities require a collaborative effort across the EU bringing together expertises and resources from several actors in different fields (sensors, telecommunication, software engineering, civil protection, commercialization) in order to build up a solid framework for collaboration. Figure 5 shows the REWARD partners according to their nature; we feel that this shows a good balance between industrial partners, research partners and end users. Half of the industrials are SMEs and pull the technology developments from the point of view of systems integrators and future commercializers for the new system. This is complemented with the technological push work of the R&D institutions, who are experts in sensor and environmental radiation technologies.

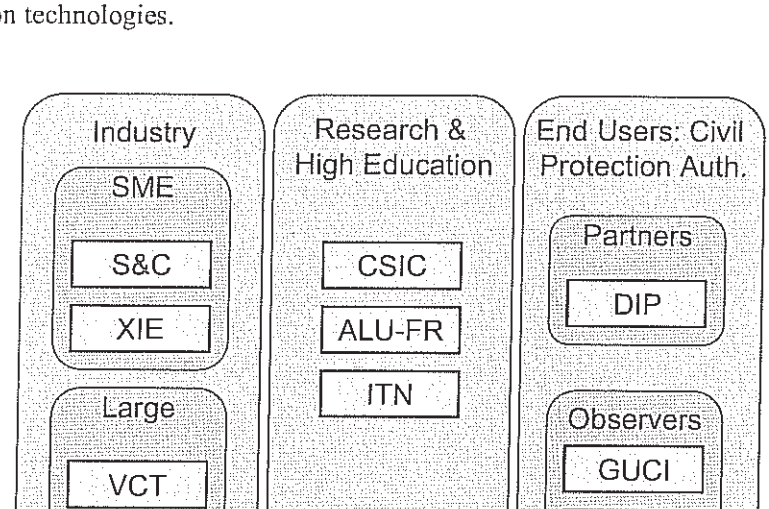


Figure 5. The REWARD Consortium

The project will be carried out by a complete team of experienced partners that:

- **Covers the complete value chain** of the system proposed, from the research of state-of-the-art sensors to system integration and expert system for signal analysis. The Consortium:
  - Includes **Research Centres with associated Large Scale Micro Nanofabrication Facilities** and **Radiation Facilities.** These centres are in charge of the development and production of the iunovative R&D sensors and systems components and thus, they can cope with the requirements in terms of production capabilities and reliability for sensors developed within the REWARD project. In this way the applications that the sector may require in the near future can easily be covered without the need of very high volume foundries being involved at this stage of the project.
  - Involves **industrial partners**, both **large companies** and **SMEs**, having **sensors, communications and security system expertise** in the fields associated to the requirements of the radiological surveillance solutions proposed in the project. They are not natural competitors and are involved in different developments within the project.
  - Includes **experts on commercializing security applications** and **end users** setting-up collaborations and clear, direct paths for exploitation.
  - Brings **test laboratories and sites** on which new sensors components will be validated.

- Combines **multidisciplinary and experienced partners** that have been involved in other European projects in the past and bring to REWARD all the knowledge acquired in those former programmes, thus being an example of the return on the investment already done in the past.
- Brings **Civil Protection authorities** acting as end users and external advisors and fully involves them in the project, not only passing information from end user to the project, but also passing European project information to the end users, thus creating a win-win for all parties.
- Is an example of R&D with a full **European dimension** including partners from **four different countries** (Spain, Portugal, Italy and Germany). In the research arena is a good example of the mobilisation of the resources of several countries in a coordinated way, thus contributing to the "European Research Area" concept.

Figure 6 shows how the proper combination of the expertise of the partners covers the complete value chain of the systems proposed. This guarantees complementary and synergistic business interests and ensures a viable and dynamic route for the technology to the market. In the figure and in the following tables the name of several of the partners appears simultaneously in different columns. This is because they have mixed expertise (sensor and electronic systems) or because they are large enough/have enough prior experience for contributing to several different working groups as specified in the description of the work packages.

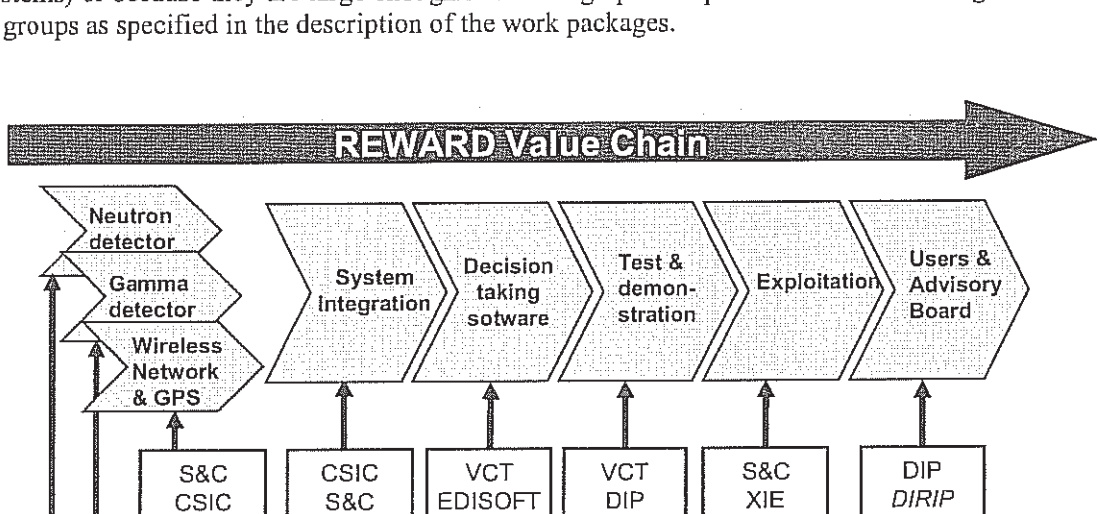


Figure 6. The REWARD value chain. External experts are in italics.

The security market in Europe opens a very promising niche in the field of solid state radiation detectors, both for gamma sources based on (Cd,Zn)Te material and neutron sources based on microstructured silicon. There is still the need of long-term basic and shorter term applied research and dissemination activities for increasing the awareness of these new technologies. The project also offers the opportunity for exploitation of results by the involved partners as no large scale produced/in-production products are available yet.

In order to help facilitate these targets, the Consortium involves industrial partners that are either spin-offs or technological SMEs (XIE, S&C) which in this sector, as in many others today, is the organisational model more adequate to cover the requirements of the industry. The commitment of these companies is an example of the economical potential of the systems proposed in the project.

On the other hand, two large security companies (Vitrociset, EDISOFT) are also participating in the decision taking/expert software and also in a horizontal work package supervising security issues which are extremely important given the nature of this project and arise at all phases of the project. Moreover S&C, with wide ranging international commercial experience in WSN and ITC fields, will provide dissemination, exploitation and technology transfer expertise.

These four industrial partners are complemented by three major R&D institutions (ALU-FR, CSIC, ITN). The University of Freiburg and CSIC are leading lahoratories in the field of electronics, microtechnology and radiation detectors. CSIC's Institute of Microelectronics of Barcelona has a fully equipped semi-commercial clean room to manufacture the complex silicon neutron detectors. ALU-FR has advanced facilities to produce the (Cd,Zn)Te material, the core of the gamma detectors. Finally, ITN offers a unique radiation facility (a nuclear reactor) that allows for thorough testing of neutron detectors, along with a deep expertise in the field of environmental radioactivity that will be fully utilised in the development of REWARD project.

The fulfilment of the project objectives demands a second level of multidisciplinary symbiosis of skills: a merging of radiation, electronics, communications, software and security expertise. In the search for that multidisciplinary effort within REWARD we have: one radiation R&D institution, software industries, electronic and systems oriented research institutes and industrial integrators. In Table 5 the expertise of the Consortium partners is differentiated according to the characteristics of their main contribution, showing that the goals of such an integrated approach will be perfectly achieved.

Table 5. Expertise of the REWARD partners

Radiation	Electronics	Communi-cations	Software	Security
ITN	CSIC	S&C	VCT	EDI
	ALU-FR		EDI	DIP
	XIE		S&C	

The distribution of the partners in the different work packages is shown in Table 6. The technical work packages dealing with sensors and communications (WP2 & WP3) replicate the same trend as the Consortium itself: a collection of electronic systems expertises, complemented with a system integrator and a reference lab as a radiation expert. All the "hardware" partners as well as end users and radiation experts are present in WP1 (Analysis & Requirements), a large amount of simulation is foreseen in this WP to ensure realistic specifications, also taking into account manufacturability issues. The "soft" work packages, WP4 and WP5, dealing with communication network infrastructure, data fusion and decision taking software, are developed by three companies, which will also act in order to commercialize the technology. The same three companies will take care of the "horizontal" work package WP7 dealing with the trust, privacy and security aspects of the whole project.

The demonstration phase of the project, WP6, will be performed by the system integrators, the software companies, the radiation experts and the end users (DIP and external experts). Finally, all the partners will be involved in WP8 (Exploitation & Dissemination). The academic institutions together with the companies will devise the appropriate dissemination channels into the research community, the potential end user community, and additionally a potential, wider, exploiters community.

Table 6. Partner distribution per WP.

WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9
CSIC	CSIC	**CSIC**	**S&C**	S&C	CSIC	S&C	CSIC	**CSIC**
S&C	ITN	S&C	VCT	**VCT**	S&C	VCT	**S&C**	S&C
ITN	ALU-FR	ITN	EDI	EDI	ITN	**EDI**	ITN	
ALU-FR	**XIE**	ALU-FR			**VCT**		ALU-FR	
XIE		XIE			DIP		VCT	
DIP							XIE	
							EDI	
							DIP	

End users are represented in the Consortium via the Civil Protection authorities in the Campania Region of Italy, the Spanish Guardia Civil and the Civil Protection authorities in the Catalonia Autonomic Region of Spain, the first one as full partner, and the rest as external experts within the project's Industry Advisory Board. Funds are foreseen to cover the participation of these partners in the activities of the project.

Sub-contracting

Only the technical part of the development of the web page of the project for dissemination and the certificates on financial statements (CFS) will be subcontracted in REWARD, no major tasks will be subcontracted.

Third partner and other countries

Direct, including financed, involvement of third partners and organisations from other countries than the EU and Associated States is not foreseen in this project. However, indirect input shall be sought from other countries with regards to adjusting the project to the needs of end users from countries outside of the EU and associated states.

The idea is to prepare the ground for international collaboration on such a system and to prepare the project for potential global take up that would be of commercial interest to EU partners directly involved in the project as well as wider area EU exploiters of the project. Target Countries here shall be the US and potentially Russia that recently has moved ever closer to entering within US/EU centric protection bodies such as NATO.

B2.4. Resources to be committed

REWARD proposes a Consortium of partners that have been involved at international and national level in R&D and commercial activities related to radiation sensors, communications and software. As they all have good previous international experience within their individual areas, we believe that this wide range of partners will provide all skill-sets and know-how necessary to successfully complete the project as described within this document.

Moreover, the multidisciplinary working style demanded by the project approach (convergence of technologies: radiation, sensors, communications, software) is fulfilled as well. In the Consortium as a whole, there is an enabling concurrence of expertise and capability in the discipline areas of radiation labs, sensor developers (labs and accordingly equipped clean rooms), electronics integrators and information systems developers.

The individual work packages have been dimensioned to have sufficient resources and enough critical mass to meet the planned objectives. Pre-existing resources are also considerable. Several large scale facilities for MNT fabrication, electronic workshops and complete validation laboratories are available through the partners. The project also benefits from access to samples and to application environments (such as a nuclear reactor and radiation sources) ensuring proper validation and adequate demonstration of required outcomes.

In summary, it is felt that the Consortium provides sufficient resources, facilities and skills for ensuring success in all of the key areas addressed by the Project:

- Different partners provide fully equipped micro-fabrication facilities as well as electronic development workshops (CSIC, XIE). CSIC Clean Room has been recognized as reaching the level of outstanding scientific facility at national level.
- One partner also has capabilities on material growth and physical characterisation. (ALU-FR).
- Radiation testing with neutrons and gamma sources is available in a specialised laboratory offering access to an experimental nuclear reactor (ITN).
- Monte Carlo simulation of realistic environments is an expertise area of one of the partner teams (ITN)
- Data fusion and decision taking software is a field of expertise of two partners, providing adequate computing resources (Vitrociset, EDISOFT)
- Sensors systems integration capabilities and communication testing for the different devices at macro level is also offered by two partners (S&C, CSIC).

In conclusion, the Consortium is perfectly capable of conducting the innovative scientific development proposed in REWARD using the partners' own facilities and the proposed funding of the project.

The total project budget is **4.2 million €** and the **funding amount requested to the EC** for carrying out the project amounts to **3 million €** with the distribution by categories and partners detailed in the A3 forms. Costs corresponding to the External Experts in the Industry Advisory Board are also assigned to the coordinator.

The **project duration is 36 months** and in Figure 7 the graphical breakdown of the funding and human resource allocated (**358 person months** for the whole project) to the different workpackages is shown. The budget breakdown per beneficiaries and categories can be found in Table 7. The number of persons-month per beneficiary per task is shown in Table 8.

From the values it can be seen that the technical work packages (WP1, WP2, WP3, WP4 and WP5) amount to 70% of the total funding, and that demonstration activities to 14% of total funding. The management (WP9) cost, including certificates on financial statements (CFS), coordination of project finances and web administration and meeting costs associated with project management, is around 7% of the total funding. Exploitation, dissemination and training activities (WP8) amount to 9%.

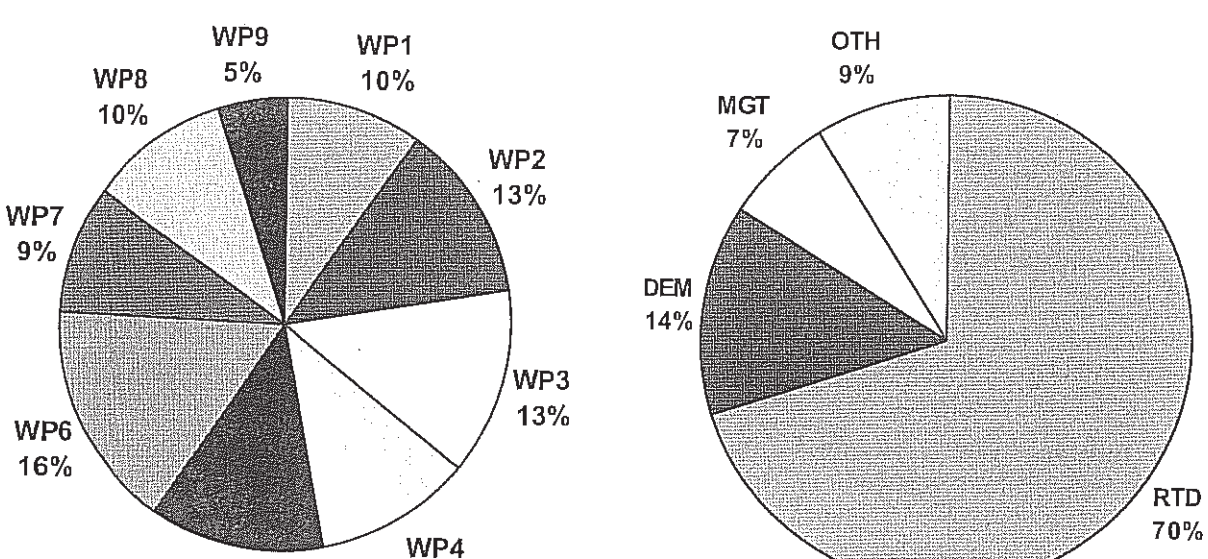


Figure 7. Distribution of the proposed person power (left) and budget (right) among work packages

Table 7: Budget breakdown per beneficiary for each category

CSIC	RTD	DEM	MGT	OTH	Total
Person-month	34	4	10	1	**49**
Personnel costs (in €)	171.224	18.456	46.230	5.787	241.697
Subcontracting (in €)	0	0	2.000	0	2.000
Other direct costs (in €)	171.000	3.000	0	2.000	176.000
Indirect costs (in €)	304.779	32.852	82.289	10.301	430.221
Total budget (in €)	647.003	54.308	130.519	18.088	849.918
Requested EC contribution (in €)	485.252	27.154	130.519	18.088	661.013

S&C	RTD	DEM	MGT	OTH	Total
Person-month	56	4.6	8	15	**83.6**
Personnel costs (in €)	364,000	29,900	52,000	97,500	543,400
Subcontracting (in €)	10,000	0	4,000	10,000	24,000
Other direct costs (in €)	30,000	0	15,000	5,000	50,000
Indirect costs (in €)	236,400	17,940	40,200	61,500	356,040
Total budget (in €)	640,400	47,840	111,200	174,000	973,440
Requested EC contribution (in €)	480,300	23,920	111,200	174,000	789,420

ITN	RTD	DEM	MGT	OTH	Total
Person-month	23	4	0	3	**30**
Personnel costs (in €)	138,000	24,000	0	18,000	180,000
Subcontracting (in €)	0	0	0	0	0
Other direct costs (in €)	23.000	0	0	1.250	24.250
Indirect costs (in €)	96.600	14.400	0	11.550	122.550
Total budget (in €)	257.600	38.400	0	30.800	326.800
Requested EC contribution (in €)	193.200	19.200	0	30.800	243.200

ALU-FR	RTD	DEM	MGT	OTH	Total
Person-month	34	0	0	1	**35**
Personnel costs (in €)	204,000	0	0	6,000	210,000
Subcontracting (in €)	0	0	0	0	0
Other direct costs (in €)	62.000	0	0	1.250	63.250
Indirect costs (in €)	159.600	0	0	4.350	163.950
Total budget (in €)	425.600	0	0	11.600	437.200
Requested EC contribution (in €)	319.200	0	0	11.600	330.800

XIE	RTD	DEM	MGT	OTH	Total
Person-month	18	0	0	2	**20**
Personnel costs (in €)	135,000	0	0	12,000	147,000
Subcontracting (in €)	0	0	0	0	0
Other direct costs (in €)	52.000	0	0	1.250	53.250
Indirect costs (in €)	112.200	0	0	7.950	120.150
Total budget (in €)	299.200	0	0	21.200	320.400
Requested EC contribution (in €)	224.400	0	0	21.200	245.600

EDISOFT	RTD	DEM	MGT	OTH	Total
Person-month	34	0	0	5	**39**
Personnel costs (in €)	153,000	0	0	22,500	175,500
Subcontracting (in €)	0	0	0	0	0
Other direct costs (in €)	17,365	0	0	0	17,365
Indirect costs (in €)	91,800	0	0	13,500	105,300
Total budget (in €)	262,165	0	0	36,000	298,165
Requested EC contribution (in €)	131,082	0	0	36,000	167,082

VITROCISET	RTD	DEM	MGT	OTH	Total
Person-month	46	35.4	0	6	**87.4**
Personnel costs (in €)	257,600	198,240	0	33,600	489,440
Subcontracting (in €)	0	0	2,000	0	2,000
Other direct costs (in €)	24,000	0	0	0	24,000
Indirect costs (in €)	220,800	169,920	0	28,800	419,520
Total budget (in €)	502,400	368,160	2,000	62,400	934,960
Requested EC contribution (in €)	251,200	184,080	2,000	62,400	499,680

DIP	RTD	DEM	MGT	OTH	Total
Person-month	1	10	0	3	**14**
Personnel costs (in €)	5,000	50,000	0	15,000	70,000
Subcontracting (in €)	0	0	0	0	0
Other direct costs (in €)	10.000	0	0	1.250	11.250
Indirect costs (in €)	9.000	30.000	0	9.750	48.750
Total budget (in €)	24.000	80.000	0	26.000	130.000
Requested EC contribution (in €)	18.000	40.000	0	26.000	84.000

TOTAL	RTD	DEM	MGT	OTH	Total
Person-month	246	58	18	36	**309**
Personnel costs (in €)	1.427.824	320.596	98.230	210.387	2.057.037
Subcontracting (in €)	10.000	0	8.000	10.000	28.000
Other direct costs (in €)	389.365	3.000	15.000	12.000	419.365
Indirect costs (in €)	1.231.179	265.112	122.489	147.701	1.766.481
Total budget (in €)	3.058.368	588.708	243.719	380.088	4.270.883
Requested EC contribution (in €)	2.102.634	294.354	243.719	380.088	3.020.795

Table 8: Person-month per beneficiary per task.

	CSIC	S&C	ITN	ALU-FR	VCT	XIE	EDI	DIP	
WP1	**9**	**6**	**9**	**5**	**1**	**3**	**1**	**1**	**35**
Task 1.1	2		3	1				1	7
Task 1.2	1		6	4					11
Task 1.3	3	1				3			7
Task 1.4	2	3			0.5		1		6.5
Task 1.5	1	2			0.5				3.5
WP2	**9**	**0**	**8**	**19**	**0**	**10**	**0**	**0**	**46**
Task 2.1			2	8		2			12
Task 2.2			2	2		8			12
Task 2.3	6		2						8
Task 2.4	3		2	9					14
WP3	**16**	**10**	**6**	**10**	**0**	**5**	**0**	**0**	**47**
Task 3.1	2		2	1		1			6
Task 3.2	5		2	9		4			20
Task 3.3	1	4							5
Task 3.4	5	3							8
Task 3.5	3	3	2						8
WP4	**0**	**30**	**0**	**0**	**5**	**0**	**5**	**0**	**40**
Task 4.1		4			1		5		10
Task 4.2		9							9
Task 4.3		10							10
Task 4.4		7			4				11
WP5	**0**	**5**	**0**	**0**	**35**	**0**	**5**	**0**	**45**
Task 5.1		1			9		3		13
Task 5.2		1			8				9
Task 5.3		0			9		2		11
Task 5.4		3			9				12
WP6	**4**	**4.6**	**4**	**0**	**35.4**	**0**	**0**	**10**	**58**
Task 6.1					6			2	8
Task 6.2	1		4		4			1	10
Task 6.3	1	2			10				13
Task 6.4	2	2			10				14
Task 6.5		0.6			5.4			7	13
WP7	**0**	**5**	**0**	**0**	**5**	**0**	**23**	**0**	**33**
Task 7.1		1			0.5		4		5.5
Task 7.2		1			1		6		8
Task 7.3		2			3		9		14
Task 7.4		1			0.5		4		5.5

WP8	**1**	**15**	**3**	**1**	**6**	**2**	**5**	**3**	**36**
Task 8.1	0.5	4	1		1	1	1	2	10.5
Task 8.2	0.5	5	1		1		1	1	9.5
Task 8.3		6	1	1	4	1	3		16
WP9	**10**	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**18**
Task 9.1	4	2							6
Task 9.2	2	2							4
Task 9.3	2	1							3
Task 9.4	2	3							5
Total	**49**	**83.6**	**30**	**35**	**87.4**	**20**	**39**	**14**	**358**

No significant amount of money has been assigned to the purchasing of durable equipment in any of the work packages. Main contribution is for personnel costs, for the cost of fabrication of the sensing and communication units, and travels associated to the activities of the project. Table 9 lists the major consumables required by the project, representing 4% of the budget, mainly associated to the fabrication of the units.

With the aim of optimising costs, special care has been taken to avoid duplication of effort. This is being achieved by involving as much as possible partners that can develop work that is reusable across other work packages and with other partners and even more importantly, that can bring their pre-existing knowledge and technologies to the project thereby negating the need to re-develop such existing technologies. The synergies and costs saving produced in such teams are welcome in the project.

In conclusion, the Consortium is perfectly capable of conducting the innovative scientific development proposed in REWARD by combining partner's own facilities and resources with funding for the project.

Table 9: Major consumables required by the REWARD Consortium

Partner	**Item**	**WP no**	**Estimated cost (in €)**
CSIC	Mask sets	WP2	12,000
CSIC	Materials for detector fabrication	WP2	30,000
CSIC	Electronic components	WP3	18,000
CSIC	Printed circuit boards	WP3	8,000
CSIC	Boxes, cables, connectors, etc	WP3	5,000
CSIC	Testing material	WP3	18,000
ITN	Foils for neutron dosimetry through activation	WP2 & WP3	2000
ITN	TLDs for photon dosimetry	WP2 & WP3	2000
ITN	Boron-doped polyethylene for dedicated shielding	WP2 & WP3	2000
ITN	Lithium-doped polyethylene for dedicated shielding	WP2 & WP3	2000
ALU-FR	Source materials cadmium, tellurium, zinc metals, chemicals, gases, silica ampoules	WP2	42,000
XIE	CdTe wafers	WP2	20,000
XIE	metals, chemicals, gases	WP2	15,000
XIE	Medipix2 wafers (electronics)	WP2	10,000
EDISOFT	Server equipment	WP7	2,000

2.4.1 Budget justification of individual beneficiaries

Partner Full Name	*Country*	*Type*
CSIC.	*SPAIN*	*RES*

The budget for CSIC in the context of REWARD project can be justified as follows. The audited overhead for 2011 for the CSIC institute where the project will be carried out (Institute of Microelectronics of Barcelona IMB-CNM) is 178%

RTD Personnel Cost: the 34 PMs required are divided among WP1, WP2 and WP3 as described in the proposal. The total CSIC budget for RTD personnel costs is 171,224 €. The work will be carried out by CSIC staff members.

RTD Subcontracting Cost: No subcontracting is foreseen for RTD tasks.

RTD Other Direct Cost: The total amount is 171,000 € split in: 78,000 € for materials needed for the fabrication of the detectors and sensor tags and 93,000 € of travel expenses to attend the different meetings and conferences. It is also included the expenses of the Experts associated to the project, which are members of the Security Experts Committee (Spanish Guardia Civil and Civil Protection Catalonia).

Mask sets	12,000
Materials for detector fabrication	30,000
Electronic components	10,000
Printed circuit boards	6,000
Boxes, cables, connectors, etc	4,000
Testing material	16,000
2 people 2 project workshop per year	15,000
External Experts travel expenses	30,000
International and National Conferences	24,000
Management meetings	9,000
Travels for testing	15,000

MGT Personnel Cost: 10 PMs are required as CSIC is the Coordinator of the project. The total budget for MGT personnel costs is 46,230 €, the work will be carried out by staff personnel.

MGT Subcontracting Cost: 2,000 € have been budgeted for the compulsory certificate on financial statements (CFS) as the requested funding is over 375,000 €.

MGT Other Direct Cost: No other costs are budgeted for management tasks

DEM Personnel Cost: 4 PMs are required for demonstration activities in WP6. The total CSIC personnel costs is 18,456 €, the work will be carried out by staff personnel.

DEM Subcontracting Cost: Not budgeted.

DEM Other Direct Cost: In order to cover the travel expenses associated to demonstration activities, 3,000 € are included in the budget.

OTH Personnel Cost: 1 PMs is foreseen to contribute to the dissemination activities in WP8. The work will be carried out by CSIC staff personnel with a cost of 5,787 €.

OTH Subcontracting Cost: Not budgeted.

OTH Other Direct Cost: 2.000 € have been budgeted for attending dissemination events or conferences.

Partner Full Name	*Country*	*Type*
Sensing & Control Systems S.L.	*SPAIN*	*SME*

The budget for S&C (with overhead 60%) in the context of REWARD project can be justified as follows:

RTD Personnel Cost: the 56 PMs required are divided among all six WPs of REWARD as described in the proposal. The total S&C budget for RTD personnel costs is 364,000 €. They will be distributed in PMs for 3-4 staff members of S&C.

RTD Subcontracting Cost: S&C will subcontract services of a data center for the enhancement of cloud server services for WP4 mainly with expected budget of 10,000 €, this includes development environment for team development:

- Monthly fee for remote load balancer service hosting in the cloud. The fee is 250 €/month (aprox.) and we expect renting for a period of at least 26 month during the project development. Total 6,400 €.
- License for Team Fundation Server. Total 3,600 €.

RTD Other Direct Cost: Includes 15,000 € of the travelling costs for (a) review meetings, (b) technical meetings and (c) inter- and national scientific conferences (d) collaboration with other REWARD teams. It will be also a cost for equipment refers to expenses related to hardware equipment and Development of the infrastructure for two persons (Workstations) and IT infrastructure for communication and enhance security purpose. The total cost is 10,000 € approx. The purchase of durable equipment by S&C will follow the rules specified in article II.15.1.c (page 61) of the guide to financial issues (ftp://ftp.cordis.europa.eu/pub/fp7/docs/financialguide_en.pdf). Finally S&C has budgeted 5,000 € for consumables related to project research.

MGT Personnel Cost: the 8 PMs are required because S&C is the technical coordinator of the REWARD project as described in the proposal. In this sense it will be a close cooperation between S&C and CSIC. The total S&C budget for MGT personnel costs is 52,000 €

MGT Subcontracting Cost: 4,000 € have been budgeted, as S&C should obtain a certificate on financial statements (CFS), because the requested funding is over 375,000 €.

MGT Other Direct Cost: Includes 10,000 € of the travelling costs for management and coordination of the REWARD project. Moreover has been included 2,000 € for international conference and communication for the REWARD management and 3,000 € for consumables and meeting preparation.

DEM Personnel Cost: the 4.6 PMs are required because S&C will contribute also in WP6 for the test bed implementation and validation. The total S&C budget for DEM personnel costs is 29,900 €

DEM Subcontracting Cost: N/A

DEM Other Direct Cost: N/A

OTH Persounel Cost: the 15 PMs are required because S&C is the leader of this WP8, Exploitation Plan and Dissemination. The total S&C budget for OTH personnel costs is 97,500 €

OTH Subcontracting Cost: S&C will subcontract the technical work related to the preparation of the web, including the maintenance. The budget for this activity is 10,000 €.

OTH Other Direct Cost: S&C has budgeted 5,000 € for dissemination activities of the REWARD project, mainly for the production of project leaflets, press releases, folders, posters and brochures.

Partner Full Name	*Country*	*Type*
Instituto Tecnológico e Nuclear (ITN)	*PORTUGAL*	*RTD*

The budget for ITN (with overhead 60%) in the context of REWARD project can be justified as follows:

RTD Personnel Cost: the 23 PMs required are divided amongst the WP1 (9), WP2 (8) and WP3 (6) of REWARD as described in the proposal. The total ITN budget for RTD personnel costs is 138,000 €. They will be distributed in PMs for 4 staff members of ITN.

RTD Subcontracting Cost: N/A

RTD Other Direct Cost (TOTAL 23,000 €): Includes 10,000 € for the travelling costs for (a) review meetings, (b) technical meetings and (c) inter- and national scientific conferences (d) collaboration with other REWARD teams. The remaining costs are associated to the purchase of TLD dosemeters (2,000 €) and activation foils (2,000 €), to the calibration of equipments (1,000 €) and to the purchase of computing power (multiprocessor DELL Workstations, 8,000 €). The purchase of durable equipment (computers) will follow the rules specified in article II.15.1.c (page 61) of the guide to financial issues (ftp://ftp.cordis.europa.eu/pub/fp7/docs/financialguide_en.pdf).

MGT Personnel Cost: N/A

MGT Subcontracting Cost: N/A

MGT Other Direct Cost: N/A

DEM Personnel Cost: the 4 PMs are required because ITN will contribute in WP6 for the Monte Carlo simulation of radiological environments and sequences of radioactive releases for different types of sources, with dose assessment for a few demonstration exercises. The total ITN budget for DEM personnel costs is 24,000 €

DEM Subcontracting Cost: N/A

DEM Other Direct Cost: N/A

OTH Personnel Cost: the 3 PMs are required because ITN is involved in WP8, "Exploitation Plan and Dissemination". The total ITN budget for OTH personnel costs is 18,000 €

OTH Subcontracting Cost: N/A

OTH Other Direct Cost: 1.250 € have been budgeted for attending dissemination events or conferences.

Partner Full Name	*Country*	*Type*
Albert-Ludwigs-Universität Freiburg ALU FR	*Germany*	*RTD*

The budget for *ALU FR* (with overhead 60%) in the context of REWARD project can be justified as follows:

RTD Personnel Cost: the 34 PMs required are divided among three WPs of REWARD as described in the proposal. The total *ALU FR* budget for RTD personnel costs is 204,000 €. They will be distributed in PMs for 1-2 staff members of *ALU FR*.

RTD Other Direct Cost: Includes 12,000 € of the travelling costs for (a) review meetings, (b) technical meetings and (c) inter- and national scientific conferences (d) collaboration with other REWARD teams. The total cost with 50,000 € is covering consumables, electronic parts, semiconductor chemicals and clean room equipment.

MGT Personnel Cost: There is no MGT Personnel Cost.

MGT Subcontracting Cost: N/A

MGT Other Direct Cost: No costs here.

DEM Personnel Cost: N/A

DEM Subcontracting Cost: N/A

DEM Other Direct Cost: N/A

OTH Personnel Cost: the 1 PMs are required because ALU FR is involved in WP8, Exploitation Plan and Dissemination. The total ALU FR budget for OTH personnel costs is 6,000 €

OTH Subcontracting Cost: N/A

OTH Other Direct Cost: 1.250 € have been budgeted for attending dissemination events or conferences.

Partner Full Name	*Country*	*Type*
Vitrociset S.p.A. (VCT)	*ITALY*	*INDUSTRY*

The budget for VCT in the context of REWARD project can be justified as follows:

RTD Personnel Cost: the 46 PMs required are divided among all four WPs of REWARD as described in the proposal. The total VCT budget for RTD personnel costs is 257,600 €.

RTD Subcontracting Cost: N/A

RTD Other Direct Cost: Includes:

- 19,000 € of the travelling costs for (a) review meetings, (b) technical meetings and (c) inter- and national scientific conferences (d) collaboration with other REWARD teams.
- 1,500 € for Workstation for RN situational awareness and decision making necessary for WP5 and WP6.
- 3,500 € for graphic rendering (3D) software for Common Operational Picture generation.

The purchase of durable equipment will follow the rules specified in article II.15.1.c (page 61) of the guide to financial issues (ftp://ftp.cordis.europa.eu/pub/fp7/docs/financialguide_en.pdf).

MGT Personnel Cost: N/A

MGT Subcontracting Cost: 2,000 € have been budgeted, as VCT have to obtain a Certificate on Financial Statements (SFC) because the requested funding is over 375,000 €.

MGT Other Direct Cost: N/A.

DEM Personnel Cost: the 35.4 PMs are required because VCT is the Leader of WP6 for the test bed implementation and validation. The total VCT budget for DEM personnel costs is 198,240 €

DEM Subcontracting Cost: N/A

DEM Other Direct Cost: N/A

OTH Personnel Cost: the 6 PMs are required because VCT will contribute in the WP8, Exploitation Plan and Dissemination. The total VCT budget for OTH personnel costs is 33,600 €.

OTH Subcontracting Cost: N/A

OTH Other Direct Cost: N/A

Partner Full Name	*Country*	*Type*
X-ray Imaging Europe GmbH	*Germany*	*SME*

The budget for XIE (with overhead 60%) in the context of REWARD project can be justified as follows:

RTD Personnel Cost: the 18 PMs required are divided among all six WPs of REWARD as described in the proposal. The total XIE budget for RTD personnel costs is 135,000 €. They will be distributed in PMs for 1-2 staff members of XIE.

RTD Other Direct Cost: Includes 5,000 € of the travelling costs for (a) review meetings, (b) technical meetings and (c) inter- and national scientific conferences (d) collaboration with other REWARD teams. It will be also a cost for materials for detectors, hardware like FPGA units, consumables and FPGA software equipment. The total cost is 47,000 € approx.

MGT Personnel Cost: There is no MGT Personnel Cost.

MGT Subcontracting Cost: N/A

MGT Other Direct Cost: No costs here.

DEM Personnel Cost: N/A

DEM Subcontracting Cost: N/A

DEM Other Direct Cost: N/A

OTH Personnel Cost: the 2 PMs are required because XIE is involved in WP8, Exploitation Plan and Dissemination. The total XIE budget for OTH personnel costs is 12,000 €

OTH Subcontracting Cost: N/A

OTH Other Direct Cost: 1.250 € have been budgeted for attending dissemination events or conferences.

Partner Full Name	*Country*	*Type*
EDISOFT	*Portugal*	*IND*

The budget for EDISOFT (real indirect cost model) in the context of REWARD project can be justified as follows:

RTD Personnel Cost: the 34 PMs (153,000€ direct costs, indirect cost according to predicted real indirect costs) required are divided among WP7 (EDISOFT is WP leader bringing in its core competences for the conception and integration of the security framework), WP5 (contributing to the GIS-based architecture which is another technical core competence of EDISOFT) as well as WP1 and WP4 in order to contribute adequately to the definition of the operational environment (T1.4) and the requirements specification for the software platform (WP4).

RTD Subcontracting Cost: nothing to refer.

RTD Other Direct Cost: Includes 17,365 € of the travelling costs for participation at project and review meetings. Existing technical equipment (servers, PCs etc.) will be used and not charged to the project.

MGT Personnel Cost: nothing to refer.

MGT Subcontracting Cost: nothing to refer.

MGT Other Direct Cost: nothing to refer.

DEM Personnel Cost: nothing to refer.

DEM Subcontracting Cost: nothing to refer.

DEM Other Direct Cost: nothing to refer.

OTH Personnel Cost: 5 PMs (22,500 € direct costs) are required in order to adequately contribute to WP8, Exploitation Plan and Dissemination; EDISOFT contributes as industrial partner.

OTH Subcontracting Cost: nothing to refer.

OTH Other Direct Cost: nothing to refer.

Partner Full Name	*Country*	*Type*
Civil Protection Agency of Campania	*ITALY*	*PBA*

The budget for DIP (with overhead 60%) in the context of REWARD project can be justified as follows:

RTD Personnel Cost: 1PM is required as described in the proposal. The total DIP budget for RTD personnel costs is 5,000 €. They will be distributed in PMs for 1 staff members of DIP.

RTD Subcontracting Cost: N/A

RTD Other Direct Cost: 10,000 € of the travelling costs for (a) review meetings, (b) technical meetings and (c) inter- and national scientific conferences (d) collaboration with other REWARD teams.

MGT Personnel Cost: N/A

MGT Subcontracting Cost: N/A

MGT Other Direct Cost: N/A

DEM Personnel Cost: the 10 PMs are required for the test bed implementation (WP6) and assessment. The total DIP budget for DEM personnel costs is 50,000 €.

DEM Subcontracting Cost: N/A

DEM Other Direct Cost: N/A

OTH Personnel Cost: the 3 PMs are required because DIP will contribute in WP8, Exploitation Plan and Dissemination. The total DIP budget for OTH personnel costs is 15,000 €.

OTH Subcontracting Cost: N/A

OTH Other Direct Cost: 1.250 € have been budgeted for attending dissemination events or conferences.

B3. Potential impact

B3.1. Strategic impact

REWARD's research, demonstration, dissemination and exploitation will result in technological advances that will have a significant impact on Europe's security and more specifically in CBRN security. REWARD will provide a new tool for detecting difficult to detect radioactive sources and nuclear materials, reinforcing Europe's leadership role on CBRN protection.

B3.1.1. Expected impacts listed in the work programme

Table 10. Expected impact of the call topic FP7-SEC-2011.1.5-1

Expected Impact of Topic SEC-2011-1.1-5	REWARD contribution
"This project will make available new or improved technology able to detect low or difficult to be detected radioactive sources and nuclear materials."	Multiple high sensitivity, state of the art detectors optimized for both neutron and gamma detection will be integrated in a new portable, intelligent radiation monitoring system able to locate and identify any radiation source present in the vicinity and generate an alarm.
"It will therefore contribute to minimise the risk of use or disseminating of such substances in the population."	The system will monitor large areas and not only the specific "hot" places (airports, nuclear power plants, etc.) where current zone-focused monitoring stations are located. This larger, wide area coverage will contribute to increase the overall safety of the population.

In order to achieve the mentioned impacts the following conditions are necessary:

1) To achieve the technical requirements of sensitivity specified for the sensor. One important aspect is the simulations tools, provided by the partner ITN in Portugal. This step is covered in WP2.
2) Integration of the sensor, security procedures, analysis and monitoring tools, in a global system that is flexible, scalable, mobile and easy to use and integrate in all environments targeted by this project.
3) That the system is fully adopted by the relevant authorities and used conveniently. In order to reach this outcome, the following steps are necessary:
    - Excellent dissemination and promotional activities in order to present the system to the authorities.
    - A reasonable final monetary (pricing) of the system, that is modular in nature allowing for small introductions followed by wide area installations, as a massive deployment is crucial for the coverage of large areas and hence the security of European (as well as the wider world's) citizens.
    - The system will be intuitive and easy to learn and use, but will be backed up with an adequate and well detailed training program for the personnel that will manage the system. Moreover, most of the functionalities will be performed automatically by the system, but the operators should easily understand how to use it and their perception should be of a "user-friendly system". This is important because the authorities will consider this point before taking the decision of adopting the system.

B3.1.2. Added values at the European level

This project bas a clear need for a European approach, as the dissemination of radioactive or nuclear materials in the population is of international concern. REWARD puts special emphasis on this point in several aspects of the project:

- REWARD will help reinforce existing international cooperation and coordination mechanisms increasing the cooperation between the relevant agencies at international, EU and national level.
- REWARD will contribute directly to the realization of the European Research Area (ERA) by bringing together centres of excellence from across the EU (Spain, Italy, Germany and Portugal) to undertake research and cooperation activities, thereby greatly helping to defragment efforts in the field of technology for radioactive detection.
- In addition REWARD will participate in the structuring of the ERA in the different fields addressed by the project. REWARD's partners are involved in national and international initiatives. Past projects will be used as background for the technological studies and links will be made with ongoing projects in order to reach a critical mass of knowledge.
- The technologies involved in creating REWARD's integrated comprehensive city-wide security system will bring European academia and business to the forefront of the development of security solutions.

REWARD will have a direct impact on most of the goals of the EU CBRN Action Plan (2009). Table 11 shows a brief description of the impact of the REWARD project in these goals, divided into: Prevention, Detection and Preparedness and Response.

Table 11: Impact of REWARD on the EU CBRN action plan.

Prevention Goals		
No	**Goal**	**REWARD Impact**
2	Enhance the security of high risk CBRN materials and facilities	The sensor technologies and platform resulting of the REWARD project may be used to monitor in-situ CBRN materials and facilities.
3	Enhance control over higb risk CBRN materials	A better control and tracking of such materials can be provided by the REWARD system.
4	Contribute to the development of a high security culture of staff	The REWARD system will inform the security forces of the radiation levels in real time, increasing their awareness.
6	Enhance the security of transport	REWARD will be able to detect and track radioactive materials during transportation.
7	Improve information exchange	The REWARD platform will provide a user-friendly mechanism for the exchange of information on radiation levels of different areas.
9	Strengthen cooperation on the security of nuclear materials	The REWARD platform, if adapted by different countries, will be a common tool for the authority bodies to cooperate.
Detection Goals		
No	Goal	**REWARD Impact**
2	Develop minimum detection standards	REWARD aims to provide recommendations for future standards (more details in section B 3.2.3)
3	Establish trialling, testing and certification schemes for CBRN detection in the EU.	REWARD will provide a comprehensive tool for determining the best practices to reach this goal.
4	Identify good practices related to the detection of CBRN materials, awareness raising and training	REWARD will contribute to identify good practices to detect and identify RN materials.

5	Improve the exchange of information and strengthen the monitoring of radiation for security purposes	This goal is the main focus of the REWARD project. The interoperability planned for the communications interface will also make possible the introduction of the system in different countries.
Preparedness and Response Goals		
No	Goal	**REWARD Impact**
1	Improve emergency planning	REWARD's early detection capabilities of radioactive and nuclear sources will help the authorities to a give a correct and timely response to RN incidents.
3	Improve domestic and international information flows in case of CBRN emergencies	As all the data about a potential emergency will be shared by the authority bodies and will be structured for interchange, with a comprehensive data security layers, the information flow capability is an added value of REWARD.
5	Improve the capacity to conduct criminal investigations	The analysis and location information of the radiation sources will be very helpful & most likely key to the investigation of criminal acts related to RN materials.

Moreover, the EU CBRN Action Plan has included a set of horizontal goals applicable to CBRN prevention, detection and response. In Table 12 these goals are summarized with the corresponding impact of the REWARD project.

Table 12: Impact of REWARD on actions applicable to CBRN prevention, detection and response.

Actions applicable to CBRN prevention, detection and response		
No	Goal	**REWARD Impact**
1	Enhance international cooperation	The interoperability, and structured information output of REWARD will help reach this goal.
3	Develop improved information tools for CBRN security	This is directly covered by REWARD as it is the main purpose if the project.
4	Improve training	REWARD will be user-friendly and easy to operate, but even so, the potential users of REWARD will be trained in the correct use of the system
6	Strengthen and prioritise research	RTD activities are the main core of the REWARD project. Moreover the success of REWARD will motivate new research lines.
7	Ensure the criminalisation of acts involving high-risk CBRN materials	REWARD will provide data that may be used for the investigation and criminalization of acts involving RN materials.

B3.1.3. Technological Impact

The REWARD project addresses a topic of great practical interest and will help put Europe at the forefront of security research in the field of RN threats. Additionally REWARD will have a high scientific and technological impact. The novelties and originality of the technology improvements are:

1) <u>In the area of radiation sensors manufacturing</u>

Two new radiation sensors with improved functionalitics relative to current state of the art will be investigated and developed: easy to integrate in any device due to its miniaturized size, being of low cost to allow for massive deployment. These sensors could be used for other purposes: medical, nuclear power plant wide area zone monitoring, personal dosimetry.

The radiation sensors used in the REWARD platform will be specifically tailored to meet the required specifications and will be produced by partners of the REWARD Consortium in their own facilities. New high sensitivity neutron detectors based on structured silicon will be developed for this project by CSIC, being the only institute in Europe that has the necessary technological capabilities. For the detection of gamma rays, advanced (Cd,Zn)Te materials will be produced and the detectors will be fabricated using state-of-the-art Co-Planar designs.

2) **In the area of Fusion, Detection and Tracking Platform:**

The project aims at a novel multipronged wireless sensor network concept - an environmental monitoring platform, REWARD combines a flexible sensor architecture layer (SAL) and a domain abstraction layer (DAL) allowing great modularity and flexibility of the platform. The project consists of the development and integration of sensors, communication technologies, data analysis techniques, security frameworks and user interface systems. By combining the full set of technologies in a modular fashion a product that can be utilized in a multitude of applications in the field of sensing will be achieved. As the different parts are integrated in a seamless way, the product can be optimally configured with other types of sensors (i.e. gas sensors) for the various needs of end users.

At this time there is a lot of ongoing work on various Wired and Wireless Sensor Network (WSN) systems targeted at different applications. It is envisaged that these Sensor Network (SN) systems will form the basis of the "internet of things". The "internet of things" is talked about as the next evolution of the internet and has huge commercial potential. One problem with this vision at the moment is that there is much fragmentation of the market and one SN system cannot be reused with the same high level management software of a different SN system. It is proposed that REWARD will create a Domain Abstraction Layer (DAL) that will create an open standard allowing manufacturers to rapidly create applications for different domains from the same SW platform. The DAL shall include a Sensor Abstraction Layer (SAL) that takes this a step further allowing different lower level sensor networks to be connected to the same upper level management software. In this manner, the Sensors and their networks shall be abstracted from the Management software. It is rather evident how urban environment characterized by unpredictable threats requires a situational awareness and decision making system that has to be flexible and pervasive enough to be automatically reconfigured and quickly redeployed. Moreover, the DAL inherently will be an efficient system as it will allow new sensor networks to be added, or removed as the environment and/or application changes. Additionally, at the SW level the DAL shall dynamically assign resources to different SN as required & then shut down redundant resources when not required.

3) **In the area of Situational Awareness and Decision Making**

This project is aimed toward the exploitation of technological concepts and approaches already proposed for military operational fields toward on the wide ranging area of civil security. The REWARD concepts have practically never been applied in civilian applications, and even in the military sectors are new.

The most relevant impact is the development of an expert SW that may be used to process the data collected during the deployment phase of the project and generates outputs that highlight patterns in the data. The target is to identify patterns between environmental conditions and radiations sources. The patterns extracted will be used in an advanced GIS tool that in a 3D geographical context generates and presents alarms, warning off and controlling terrorism attacks and minimising health impacts to the population due to radiation. This data mining SW together with the GIS tool will be developed by the expert threat detection development company Vitrociset, and will use known advanced algorithmic techniques in order to extract the correct patterns.

It must be stressed that the proposed project and its outcomes are not tailored toward any urban scenario in particular, as we believe that the proposed solution can represent a scalable, affordable and easy methodology for deploying a system that should be applicable to a broad range of urban scenarios or CBRN threats with minimal or practically no effort.

Moreover, in order to cope with the increased complexity, it has been necessary to include in the project rigorous approaches to scenario sketching and field trials for validating and assessing the operational functionality of the detection and monitoring systems. This is a crucial point to ensure that such systems are not a weak point in security per-se, and is an innovative procedure and has never been recommended so far. From this point of view, REWARD can lead in the short-medium term to European recommendations as the initial step of a standardization process.

B3.1.4. Social Impact

The most relevant positive social impacts of REWARD are: improved public health and security, in terms of a reduction in casualties and long-term health problems related to RN incidents, the ability for authorities to disseminate information about REWARD when needed to reduce any localised levels of public fear and anxiety and an increased perception of safety.

The REWARD project could also have a positive effect on governance, as the project result would enhance institutional cooperation and communication, would improve information flows and help to establish protocols, through:

- Better mapping of existing international cooperation and coordination mechanisms addressing CBRN issues;
- Increased cooperation with relevant agencies at international, EU and national level;
- Improved identification and exchange of good practices with international, European and national partners;
- Improved communication with the users of the system.

One possible negative effect concerns the interference with the fundamental right to privacy and the protection of personal data. However, the project and implementation plan of REWARD are designed so as to minimize or avoid completely these effects in the context of WP7 (Security Framework).

B3.1.5. Economic Impact

The REWARD project aims to produce a novel monitoring tool for use in the security field in the ICT industry. In a first instance, REWARD will contribute to the growth of the security, monitoring and sensor technology industries and markets as described in the following sub-sections.

B3.1.5.1. Market Potential

The market studies for Explosion, Chemical, Biological, and Nuclear (ECBN) security applications are treated globally and have recently been summarized by BBC Research in 2010. The global market for ECBN hazard monitoring and auxiliary equipment reached $89.6 billion in 2008. This market increased to $98.3 billion in 2009. It is projected to reach to $191.1 billion in 2014 at a compound annual growth rate (CAGR) of 14.2%, as can be seen in Fig. 9.

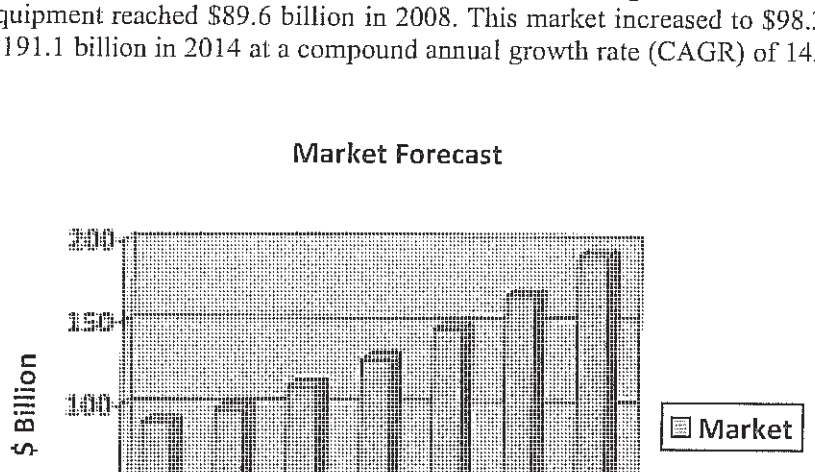


Figure 8. Global market forecast for ECBN monitoring

B3.1.5.2. Commercial Interest of Industrial Partners

X-ray Imaging Europe (XIE GmbH), develops and sells X- and gamma-radiation detectors and related electronics. XIE was founded as a start-up of the Freiburg Materials Research Centre of the Albert-Ludwigs-Universität Freiburg. The business at XIE GmbH is the development and manufacture of sensors for efficient detection of radiation for medical applications, security monitoring and non-destructive testing. Their expertise is in the combination of production and processing of the sensors starting from material production to the complete system. Detectors with the ability to differentiate between different radioactive elements will become invaluable with the increasing threat of a terrorist attack involving radioactive material. As the world leaders in (Cd,Zn)Te detector production and gamma-ray spectroscopy, XIE are excellently placed to develop gamma-ray sensors for the REWARD project.

The REWARD proposal would allow XIE to draw on their current expertise, allowing the company to adapt their existing (Cd,Zn)Te detector design in order to create more market-leading products. In the medium to long term, the project would allow XIE to expand the resource base by investing a dedicated production line for REWARD detectors. The exploitation of these detectors will open new fields of applications of (Cd,Zn)Te based detector systems beyond the REWARD project.

EDISOFT's long-term strategy places the focus on emerging application and services in the security market. As member of EOS (Enropean Organisation for Security), through the participation in security-related research programmes (under FP7, in the scope of NATO, for example with regard to network-centric services infra-structures), EDISOFT is enlarging its expertise to be oriented towards market-oriented activities as well. This also applies to the security framework which is EDISOFT's main contribution to the REWARD project. It is expected that such a framework provides a core for further customisation in other applications developed by the company, in a diverse set of markets such as Location Intelligence, command and control systems, services platforms (mobile services, imagery and earth-observation based services) and security solutions for the protection of critical infra-structures.

Vitrociset has a product policy driven by technological innovation. Its main way for achieving commercial impact is to define and implement technology roadmaps to bring "innovative concepts" toward "innovative products" through the integration of technological and scientific excellences coming from academia, R&T centres and high-tech SMEs.

REWARD is a very flexible and scalable solution for detection of radiological threats as well as for controlling and monitoring their effects, easy to deploy, applicable to a wide range of scenarios and critical urban area, thank to the pervasive and auto-configurable architecture. This framework can be easily extended for other types of NBC threats in urban environment.

Defence and Security are the traditional core business for Vitrociset. Its offer includes products such as: Command & Control Systems, Sensor Fusion & Mediation Systems, Situational Awareness & Decision Making, Simulation & Planning, Critical Infrastructure Protection, ISR systems. In this vision, REWARD represents a relevant opportunity to improve and enlarge the Vitrociset offer to the traditional customers (i.e. Ministry of Interior, Police, Civil Protection, Ministry of Defence, NATO, EDA, ...) and consequently to strength its competitiveness in the international markets.

The core business of **Sensing&Control** is the development, integration and sales of solutions requiring remote tracking, monitoring or automation. Allied to this we have fostered and grown sensor technologies in the security sector. We very much see radiation sensors and ICT monitoring technologies as a key solution for our business direction.

S&C has accumulated more than seven years experience tracking the markets, potential customers and providers worldwide of wireless sensing systems. Having successfully completed several R&D projects we have accumulated a lot of technical know-how and experience in these areas and created several novel products. We see the market potential of REWARD to rapidly expand driven by the current EU, as well as National investments in areas such as Security, Smart Cities and ICT. The system proposed by the REWARD Project will greatly complement our existing technology and allow us to directly target the currently growing ICT security market leading to good commercial benefit for ourselves, our partners and through promotional activities, the wider European ICT community.

Moreover the REWARD project will have a direct impact in the methodologies and procedures of the potential users. For instance, the **Direcció General de Protecció Civil of the Generalitat de Catalunya** is responsible for the planning of radiological emergencies that occur in Catalonia, an autonomous region in north-east Spain. They also coordinate the response of several emergency services: fire brigades, the Catalan police and the emergency health services. All these first responders can communicate among themselves and with the emergency management centre by means of a dedicated TETRA network.

The REWARD project will make it possible to provide these emergency services with sensors for radiation (gamma and neutron) that are not expensive, that can be mounted on emergency vehicles or to fixed sites, and that can transmit data via common wireless networks (such as the TETRA network) to an emergency management centre. The REWARD project includes as well all the required software for the communication system, a complete Expert SW processing AI and a user-friendly interface that will allow the emergency management centre to know promptly when a real alarm exists so that it can react with a minimum delay. The **Direcció General de Protecció Civil of the Generalitat de Catalunya** state that the availability of such a system within their organisation will have an important positive impact. The outcome of the REWARD project will be of a great help to:

- Give an early warning of radiological hazard within Catalonia to the first responders that rush to the site of an explosion, when a radiological dispersion device (dirty bomb) has been exploded.
- Detect a dangerous radioactive source, a rudimentary nuclear bomb or a radiological dispersal device that terrorists try to introduce in plausible targets like train stations, sport venues, tourist sites and other crowded areas. Spain has recently witnessed a non-nuclear strike and even more recently a terrorist attack was thwarted in Barcelona, hence the ability to detect radioactive type attacks would be greatly received.
- Give an early warning of radiological hazard to first responders that are on an emergency site when the shielding of a radioactive source present (legally or illegally) on site bas been damaged because of fire, flooding, falling debris, etc.
- Locate orphan sources, that is to say, radioactive sources that have been lost, stolen or abandoned.

B3.2. Plan for the use and dissemination of foreground

The dissemination and exploitation activities will be performed in a dedicated workpackage, WP8. The main objectives will be to raise public awareness, spread the project results to tbe scientific community and to promote their commercial exploitation.

Table 13. Overview of REWARD's dissemination and exploitation activities

No	Strategy	Activities	Target group
1	Disseminating project idea	▪ Project website ▪ Flash animation	Society/General public
2	Presenting scientific findings	▪ Publications ▪ Presentations ▪ Knowledge transfer	Scientific community, policy and decision-makers
3	Transferring knowledge to industry	▪ Press conferences ▪ Industry workshops ▪ Press releases	Security system providers, electronics industry, ITC industry, sensor industry.
4	Transferring results to users and industry	▪ Demonstration ▪ Press Release ▪ Industry Workshop ▪ Training for users	Authorities and security forces, security system providers, electronics and ITC industry.
5	Exploiting project results	▪ Patent filing ▪ Commercialisation	REWARD industrial partners, associated partners, other industry

In the context of the exploitation and dissemination of the results, the project will rely on tbe following actions:

- **Publications to international journals and conferences**: The REWARD partners, academic and industrial, will pursue dissemination activities in international refereed, scientific and technical, journals and conferences such as Radiation Protection Dosimetry, the IEEE Nuclear Science Symposium, the IEEE Conference on Homeland Security and the SPIE Defence, Security and Sensing Conferences.
- **Project website**: A website dedicated to the project will be designed and developed. This work amongst others requires the initial content collection from all the partners in the Consortium, the creation of additional content related to the project, the regular content update, based on the communication, interaction and feedback provided by the other partners. Another task is the creation of mailing lists with specific-topic inside the context of the project.
- **Project documentation**: Upon the completion of the project a number of documents, papers, deliverables, technical reports, and presentations are expected to be available. Tbe project will provide an extended fact sheet about the project, as well as a 2-pages brochure and an update that presents it. The majority of the project documents will have a common look, while a common template for the presentations, deliverables, reports, meeting minutes, and in general any other document related to the project will be available. Finally, a remarkable general-purpose presentation of the entire project will be created.
- **Projects demos**: A number of demonstrations relating to REWARD middleware platforms and related applications/trials will be specified. These demonstrations will be used to present the project in prominent events relating to interactive multimedia content, multimedia systems and solutions. Also, events relating to project application domains (e.g., security/surveillance of large scale unpredictable environments, online collaboration) will be pursued.
- **Project dissemination beyond Europe**: The innovative character of the project makes it subject to interest beyond the border of Europe. Therefore, the project, and its accompanying technologies, will be presented

to various events outside Europe. Through scientific paper contributions the partners in the Consortium will make their achievements accessible and globally known.

- **Plan for Using and Disseminating (PUD) knowledge**: The plan for the exploitation and dissemination of the project will be flexible and subject to changes. An updated plan will be released yearly for this purpose.
- **Flash studies**: There are topics inside the context of the project that meet extensive scientific and industrial interest. The project plans to create several such flash studies, in the form of small (at most 3 pages) documents.
- **Internal dissemination**: Partners will present the results internally in their organisation, giving boost to internal dissemination. In any case efficient dissemination requires internal knowledge of a project's results.
- **Workshops**: Apart from being present at external conferences and workshops, REWARD will organise its own workshops and events. In addition to workshops, REWARD will organise panel discussions as well.
- **Publications**: Technical papers will be published in several telecom conferences, journals and magazines. This in order to promote REWARD results and promote the visibility of the project.
- **EU Concentration meetings**: REWARD is dealing with a large number of activities and addresses an important set of content and semantics related technologies and solutions. Therefore, REWARD will play an active role in the EU Concentration meetings. Participation in EU Concentration meetings is considered as an efficient way to disseminate results within the EU domain. In addition this will assist the collaboration with other organisations and projects.
- **Liaisons establishment with other projects and activities**: Liaison with other projects is the means to coordinate the activities of REWARD considering the on-going activities in other projects. For these reasons, liaison delegates will be identified, for the projects and organisations.

The above directives make evident that the project places extreme value in the dissemination activities, the publication of the main outcomes and results, and the reception of feedback.

Special Clause 24 of Limited Dissemination of Foreground Outside the Consortium for Security Reasons will apply. Specifically, any foreground generated in the course of the project shall not be disseminated to any legal entity outside the existing consortium, unless agreed otherwise by the beneficiaries and the REA. The Security Expert Committee (SEC) will be in charge of scrutinizing and giving the approval to all documents (including electronic documents) before they are made public.

B3.2.1. Contribution to Standards

The partners of the REWARD project have strong connections with the major standardisation bodies and are well used to contribute to proposals of standards. Selected standards will be enhanced thanks to REWARD as illustrated in Table 14.

Table 14: REWARD's expected Contributions to Standards.

Standard (or Framework)	Standardization Work	Body
RNDT Guidelines RNDT is the National Metadata Repository for Territorial Data, in Italy	Inputs to DigitPA SDIs Working Group will be considered based on the REWARD research results regarding radioactive pollution monitoring sensor networks	DigitPA
Robust Header Compression (ROHC) for use in the TETRA system. ROHC can form a core component for the optimization of the IP transport, reducing the IP header tremendously.	The TETRA work also considers Ad-hoc communication to add value to its direct mode (terminal to terminal) operation.	ETSI
IEEE 802.16 - wireless broadband	Inputs to IEEE 802.16 standardization will be provided	IEEE

	on the basis of communication requirements for the large scale unpredictable environment that is targeted by REWARD.	
IEEE 802.11 – wireless local area networks	Inputs to IEEE 802.11s mesh task group will be considered based on the REWARD research results	IEEE

B3.2.2. Management of Intellectual Property

The management of knowledge (results, copyright, patents, designs, etc.) resulting from REWARD involves the ongoing identification, tracking, and registration of knowledge as it is produced. It also concerns the decisions on ownership of Intellectual Property (IP) and the procedures to be included in a Consortium Agreement. All the participants in the project will identify and register knowledge as it is produced with REWARD. Regulations concerning the dissemination and exploitation of knowledge, and access rights, will be defined in a Consortium Agreement to be signed by all project participants. The process for managing the knowledge produced by REWARD is identified and described herein.

The Coordinator will be responsible for ensuring that a secure and suitable knowledge management system is put in place, which will run as soon as possible after the project, has started. The system will hold relevant and clearly numbered administrative documents, such as project meeting minutes, deliverable lists, implementation plan updates and results portfolios. It is the responsibility of the Coordinator to make sure everyone is able to access and use the system effectively. The Project Manager will ensure that data protection legislation is followed.

The Consortium has already agreed that all Access Rights needed for the execution of this project and for use are granted on a non-exclusive basis. Other than in exceptional circumstances, no transfer costs sball be charged for the granting of Access Rights. The partners have also agreed on the following principles that will govern the IP terms in this project, and form the basis of the IP terms in the Consortium Agreement: 1. Solely generated IP will be solely owned by the generating party with a first option to the project and external experts to a non-exclusive option to license foreground IP for commercialization; 2. All intellectual property generated jointly during the course of the Project (*"Joint Foreground IP"*) shall be jointly-owned by the generating parties, and shall be managed in accordance with the terms of a Joint Ownership and Management Agreement (JOMA).

B3.2.3. Commercial Exploitation by Partners

The business strategy is aimed at an all encompassing and solid demonstration of the real chances of industrial and commercial development of the REWARD technology and solutions.
This strategy is outlined in Figure 9

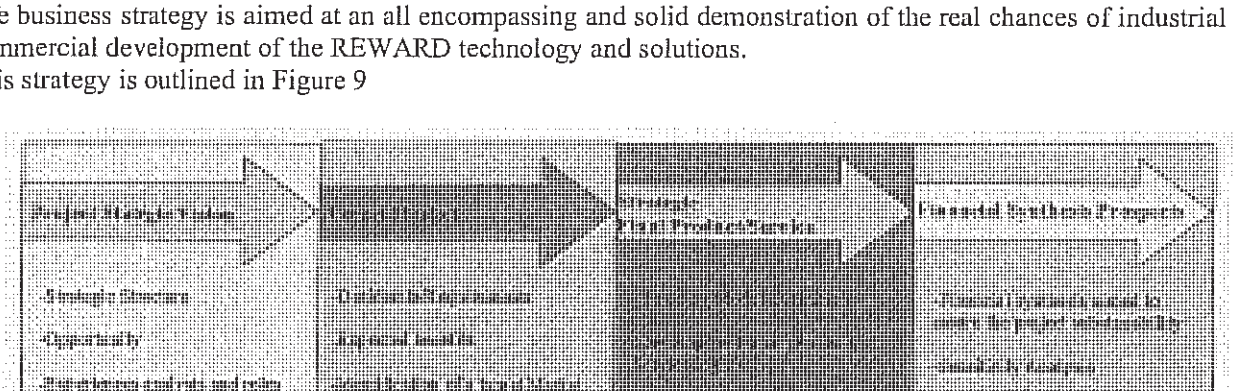


Figure 9. Outline of Business Strategy.

Based on the combined market experience of the industrial partners in the Consortium, we have identified the business potential for REWARD and have estimated a realistic time-to-market and ways of exploitation for each partner as detailed in Table 15.

Table 15. Potential for exploitation by industrial partner

Partner	**Product**	**Further development needed** *(e.g. manufacturing)*	**Time to market** *(in years)*	**Expected revenues** *(€, 3-5 years)*	**Exploitation** *(e.g. sale, licensing, royalties)*
S&C	REWARD system.	Integrate the particular procedures of final user.	1	3-8 M€	Licensing, royalties.
	Fusion, Detection and Tracking Platform	Adapt to new markets where this technology could be applied	2	1-5 M€	Licensing, royalties.
XIE	(Cd,Zn)Te CPG detectors	Integration of larger volumes	2	1-2 M€	Sale.
	MCA electronics	Integration of detectors on system level	2	1-5 M€	Licensing, OEM systems and sale
VCT	Decision Making System for protection against CBRN in urban environment	To define and implement a technology roadmap to advance the TRL up to industrial product, through further internal investment.	2 years	About 5 M€ in the first three years.	The principal channel for exploitation will be the sale.
	Fusion Platform for CBRN detection and tracking in urban environment	Vitrociset developed such concepts for a defence application, integrating radar, visual and infrared sensors. We will integrate radiological sensors.	1 year	About 15 M€ in the first three years.	The principal channel for exploitation will be the sale.
EDI	Flexible security framework solution for several product lines	EDISOFT develops solutions for command & control, mobile services platforms and location intelligence	1 year	About 2M€	Direct sales and open tenders.

B4. Ethics issues

The SEC will ensure that there is no safety risk in tests that involve radioactive sources, especially for the final trials, as requested by the Ethics Committee. In particular:

- SEC will approve D6.6: Test and Validation Plan.
- All radioactive sources will be manipulated only by qualified and legally authorized personnel.
- Field tests will be performed in isolated areas where there is no risk of irradiation for the general public.

B5. Gender aspects

All partners participating in the Consortium are fully engaged and committed to the implementation of measures and principles that ensure equality of women and men, in line with the corresponding policy goals of the European Union and the objectives of particular instruments set up to deal with discrimination based on gender (Article 141 (former Article 119) of the EC Treaty).

From a practical perspective, this commitment is implemented on the basis of the following lines of orientation:

1. The constitution of the project team and assignment of human resources to the project task considers a strong involvement of women as well as men. To this end, each institution will take up any action necessary to increase the number of qualified women in the project.
2. Meeting dates and places will be chosen in advance taking into account issues related to families organization.
3. Whenever applicable, the orientation of technical and any other activity will follow the principle of Council Resolution 1999/C 201/01 which states that "the gender mainstreaming of research policy is not limited to promotion of women as research workers but should also ensure that research meets the need of all citizens and contributes to the understanding of gender-relevant issues".
4. Women representation in dissemination, training and outreach activities will be promoted in order to give visibility to the active participation of women scientists. Partner will also commit in disaggregating all data in terms of person power associated to all the activities in order to keep track of the gender dimension of the project.