D4.2 - Report on research equipment and inventory

Grant Agreement nr.	31 6296
Project acronym	Future Cities Project
Project title	Expand the Centre of Competence in Future Cities of the University of Porto to Strengthen Inter-Disciplinary Research and Knowledge Transfer to the Industry in the Norte Region of Portugal
Funding scheme	Coordination and Support Actions (Support Action) – CSA-SA
Due date of deliverable	30/09/2013
Actual submission date	30/09/2013
Main editor (s)	Universidade do Porto
Contributor (s)	Universidade do Porto

Project Co-funded by the European Commission within the ICT Policy Support Programme	
DISSEMINATION LEVEL	
PU	Public

DOCUMENT CHANGE LOG				
Version	Date	Editor	Modified pages	Summary of modifications
0.1	29/09/2013	Paulo Calçada		First draft of the document
0.2	30/09/2013	Paulo Calçada	All	Corrections and update
1.0	30/09/2013	João Barros		Final review and acceptance

FINAL VERSION (V1.0) CIRCULATED TO		
Recipient	Entity	Date
Coordinator	Universidade do Porto	30/09/2013
Consortium		
European Commission	Colombe Warin (PO)	30/09/2013

Disclaimer

This document contains materials which are copyrighted by the Future Cities Project consortium partners and may not be reproduced or copied without written permission. All Future Cities Project consortium members have agreed to publish in full this document. The commercial use of any information contained in this document may require a license from the owner of that information.

Neither the Future Cities Project consortium as a whole nor any individual party of the Future Cities Project consortium, provide any guarantee that the information contained in this document is ready to be used as it is, or that use of such information is free from risk, and will accept no liability for any loss or damage experienced by any person and/or entity using this information.

Statement of Originality

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

Executive summary

The present deliverable (D4.2 - Report on research equipment and inventory) is part of the work package WP4 - Deployment of Test beds and Living Labs. This work package focuses on offering researchers the opportunity to expand their large-scale experimental facilities for future cities by aggregating existing test beds accessible through clearly defined interfaces to build more complex systems. Living labs and live deployments in the city of Porto will complement and profit from these test beds, taking research results closer to the market.

We will extend our existing sensor and wearable technology test beds into an urban scale sensor network by adding other type of sensors, like high and low resolution video cameras, wireless-enabled devices, and mobile phones connected through Wi-Fi or cellular technology, as well as by increasing the number of existing sensor nodes and wearable technology equipment. We will also expand the vehicular network test bed by increasing the number of vehicles (taxis and buses) equipped with DSRC technology and adding seamless integration of mobile phone sensing. The environmental monitoring prototypes will be enhanced with relevant sensors, which will incorporate Wi-Fi transmitters and data processing electronics, creating a wireless network of environmental sensors, which will be installed at mobile (buses) and static (city spots) units.

The deliverable *D4.1 - Research equipment specification and acquisition procedures* provided a detailed description of each test bed, defined the technical specifications of the equipment to be acquired, described the general acquisition procedures to be adopted and presented the acquisition budgets. The present deliverable is directly linked with D4.1 and provides details about the public procurement procedures that have been made and the inventory of the equipment acquired.

Table of Contents

1 Introduction to the deliverable and scope

1.1 Short introduction to the deliverable

The present deliverable provides details about the public procurement procedures that have been made and the inventory of the equipment acquired.

1.2 Work package description

This deliverable is part of the work package WP4 - Deployment of Test beds and Living Labs, whose main objectives are described below.

This work package focuses on offering researchers the opportunity to expand their large-scale experimental facilities for future cities by aggregating existing test beds accessible through clearly defined interfaces to build more complex systems. Living labs and live deployments in the city of Porto will complement and profit from these test beds, taking research results closer to the market. Modularity and open interfaces are critical for enabling the integration of the different test beds within the Centre and with external living labs and experiments.

To achieve these goals, the Centre will promote a set of test bed interconnection application programming interfaces (API) that enable the exploitation of synergies among the test beds. For this purpose, we shall

- Expand existing test beds.
- Acquire equipment to add currently unavailable but necessary building blocks that are critical for future city research.
- Design interconnection interfaces that enable the aggregation of the test beds into more complex test beds, living lab and real-life deployments under low time and manpower overhead. The existing test-beds require an upgrade at several levels, namely in terms of number of sensing nodes, data aggregation gateways and intermediate processing capabilities. Furthermore, the core will also scale up accordingly in order to support the increased data flows and number of end nodes.

This work package is broken down into tasks T4.1 to T4.4, described below.

T4.1 - Definition and implementation of the API for each test bed

We shall define interfaces for the test beds so that they can easily be used as building blocks for prototyping and demonstrating more complex systems. For that purpose, clear interfaces abstracting functionality and parameters relevant to Future Cities must be agreed on in an early phase. These interfaces shall be implemented in each test bed by the responsible team.

T4.2 - Extension of currently available test beds for vehicular networks and mobility, urban scale sensor network and processing and human computer interaction

We will extend our existing sensor and wearable technology test beds into an urban scale sensor network by adding other type of sensors, like high and low resolution video cameras, Bluetooth-enabled devices, and

mobile phones connected through Wi-Fi or cellular technology, as well as by increasing the number of existing sensor nodes and wearable technology equipment. We will also expand the vehicular network test bed by increasing the number of vehicles equipped with DSRC technology and adding seamless integration of mobile phone sensing. The environmental monitoring prototypes will be enhanced with relevant high-end equipment.

T4.3 - Deployment of the test bed for data centre and backend support

Cooperative intelligent transportation systems, social media platforms and many other services powered by urban sensing require large clusters of storage and computation machines, as well as a networking infrastructure whose reliability is critical for the interconnection and coordination of different technological components. We will deploy a test bed for data centre and backend support for experimenting efficient data management strategies, while providing the building block for future city services and reliable interconnection of the other test beds.

T4.4 - Real-world experimentation in smart city

We shall demonstrate the results of our research in living labs and real world experiments, by deploying fully or partially the designed technologies in the city of Porto, as well as by integrating test bed functionality with experiments of other groups or products, in a best case scenario.

1.3   Deliverable description

The deliverable *D4.1 - Research equipment specification and acquisition procedures* provided a detailed description of each test bed, defined the technical specifications of the equipment to be acquired, described the general acquisition procedures to be adopted and presented the acquisition budgets. The present deliverable is directly linked with D4.1 and provides details about the public procurement procedures that have been made and the inventory of the equipment acquired.

The document is organized in two chapters. Chapter 2 describes the public procurement procedures that have been made regarding the acquisitions of supplies, works and services; Chapter 3 provides an inventory of the equipment acquired.

- Chapter 2: Acquisition procedures
- Chapter 3: Equipment inventory

1.4   Measures of success

There are some measures that can be applied in order to estimate if the proposed goals were achieved. The Future Cities Project will use the following measures and indicators of success:

- Acquisition, setup and maintenance of research equipment: funding for equipment executed to 100 % and equipment in full operation.
- Deployment and experimentation in future city technologies: five prototypes successfully deployed.

2 Acquisition procedures

So far, six public procurement procedures have been made (NP1, OP1, RP1, RP2, RP3 and RP6). The description, specification and list of equipment to be acquired, and also the details about each of the procedures, have been previously provided at the deliverable *D4.1 - Research equipment specification and acquisition procedures*.

All the acquisitions made are related with the Crowdsensor SenseMyCity and the Vehicular Ad-hoc Networking test beds. The acquisition of smartphones has been made through RP6; the acquisition of the ECG monitors has been made through NP1; the acquisition of the on-board units (OBUs) has been made through OP1 and RP1; the acquisition of the road side units (RSUs) and has been made through RP2; and the acquisition of the 3G/GPRS and M2M connectivity has been made through RP3.
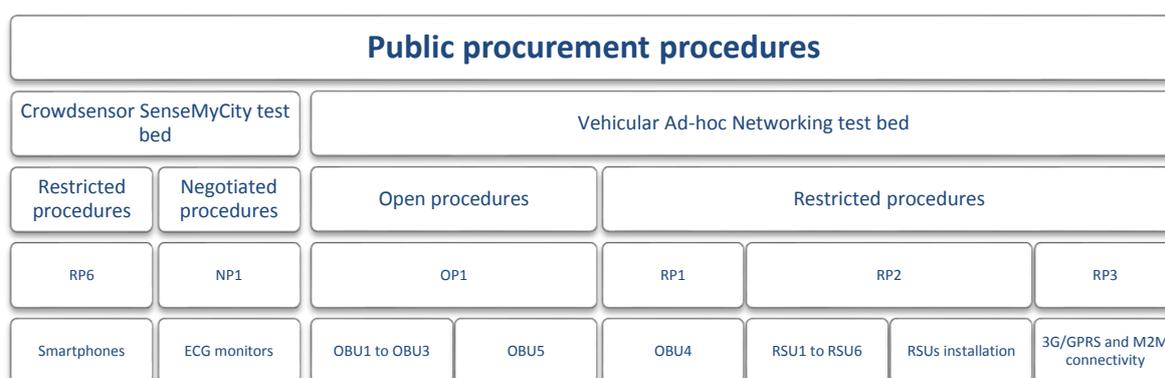

Figure 2.1 – Public procurement procedures.

The following table discriminates the acquisitions of equipment related supplies, works and services made so far.

Table 2.1 – Acquisitions of equipment related supplies, works and services.

Procedure	Supplies	Works	Services	Supplies quantity
OP1	OBU1 to OBU3 OBU5 Accelerometers			450
RP1	OBU4			400
RP2	RSU1 to RSU6	RSUs installation		6
RP3			3G/GPRS and M2M connectivity	
RP6	Smartphones			14
NP1	ECG monitors		SDK licensing	15

If we compare the initial budget with the cost of the acquisitions described before, then the current execution rate for equipment acquisition is 58%.

3   Equipment inventory

The following table lists the inventory of the equipment acquired. The items that have been customized or designed as a system (OBUs and RSUs), can't be linked to any manufacturer or product model.

Table 3.1 – Equipment inventory.

Procedures	Description	Manufacturer	Model	Quantity
	On-board units (OBUs)			450
OP1+RP1	OBUs with 3G/GPRS connectivity	NA	NA	400
OP1	OBUs without 3G/GPRS connectivity	NA	NA	50
OP1	Accelerometers (included at OBUs)	NA	NA	450
	Road side units (RSUs)			6
RP2	RSUs with DSRC and Wi-Fi connectivity	NA	NA	3
RP2	RSUs with DSRC connectivity	NA	NA	6
	ECG monitors			15
NP1	ECG monitors with 1 channel	Biodevices	VitalJacket 1L	10
NP1	ECG monitors with 5 channels	Biodevices	VitalJacket 5L	5
RP6	Smartphones	LG	Nexus 4 16 GB	14

The OBUs and RSUs have been customized and designed as a system, and their bill of materials has been previously described and provided at the Deliverable D4.1. For this reason, we don't list the individual components, modules or sub-modules of the OBUs, or the equipment and infrastructure equipment of each RSU; instead, we list the number of assembled units (OBUs and RSUs).

The following pictures illustrate the on-board units and two examples of the six road side units that have been installed at the city of Porto.

Figure 3.1 – On-board unit and external antennas (Wi-Fi, DSRC, GPS and 3G/GPRS).

(a)   (b)

Figure 3.2 – Examples of the road side units installed at the city of Porto: RSU3: Avenida dos Aliados is installed at a traffic light pole (a) and RSU5: Câmara Municipal do Porto (Trindade) is installed at a public building (b).