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Public entities driven robotic innovation in urban areas

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ABSTRACT

Cities present new challenges and needs to satisfy and improve lifestyle for their citizens under the concept "Smart City". In order to achieve this goal in a global manner, new technologies are required as the robotic one. But Public entities unknown the possibilities offered by this technology to get solutions to their needs. In this paper the development of the Innovative Public Procurement instruments is explained, specifically the process PDTI (Public end Users Driven Technological Innovation) as a driving force of robotic research and development and offering a list of robotic urban challenges proposed by European cities that have participated in such a process. In the next phases of the procedure, this fact will provide novel robotic solutions addressed to public demand that are an example to be followed by other Smart Cities.

Glossary of terms

PPI	Public Procurement of Innovation
PCP	Pre-Commercial Procurement
PDTI	Public end Users Driven Technological Innovation
ECHORD++	The European Coordination Hub for Open Robotics Development Plus Plus
RTD	Research and Technological Development
GDP	Gross Domestic Product
UAV	Unmanned Aerial Vehicle
SME	Small and Medium Enterprises

1. Introduction

The Europe 2020 strategy includes innovative public procurement as one of the key market-based policy instrument for smart, sustainable and inclusive growth. Having reached the 19,4% of the gross domestic product, GDP, [1], public procurement has an immense potential to fully exploit research and technology for innovation and also to deliver more cost effective and better quality of public services. The principal benefit of the Innovative Public Procurement is that innovation is addressed to needs of end users with a sure success in the market. In some cases the technologies needed to make these breakthroughs exist or are closed to the market; in other situations, investment in R&D is needed to ensure the progress of technological solutions that meet the social needs detected. In this last case, the instrument used by public entities is the Pre-Commercial Procurement (PCP) [2].

Despite this policies' deployment, there is little empirical evidence on the implementation of such aspirations put in the innovative public procurement [3,4]. During the last years very few PCP have been initiated in Europe and in some cases the calls have been declared void. The possible reasons of this lack of success are a range of deficiencies in the PCP process including a lack of interaction between buyers and potential suppliers as well as little knowledge of public entities about what technology is suitable to solve their social needs.

In this scenario, ECHORD++ (The European Coordination Hub for Open Robotics Development) project is funded by the Seventh Framework Programme for Research and Technological Development (7FP) of the European Union, developing a PCP in Urban scenarios, giving us the opportunity to check the PCP instrument, proposing a deeper development of the preliminary tasks, and getting optimal results in Urban Robotic Technology.

In Section 2 the objectives and scope of the article will be presented. Then the state of the art in Urban Technology and Robotic Technology in Smart Cities is described in Section 3. Section 4 brings the possibility to bill a general description of urban needs and expose the 14 specific robotic challenges presented by European cities in ECHORD++. The most relevant robotic technology brought to urban environments is sketched in Section 5. The urban robotic technology associated to urban challenges is analyzed in

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Section 6. An overview of the innovative public procurement instruments introducing the novel Public end Users Driven Technological Innovation (PDTI) process is exposed in Section 6. Section 7 describes the Case Study of ECHORD++ PDTI Urban and finally Section 8 concludes the paper.

2. Objectives and scope

The aim of this article is to contribute and to join efforts to improve urban services or create new ones to the boost of the innovative public procurement in robotic technologies. The lessons learned along the ECHORD++ project encourage us to propose three main objectives:

- Foster and facilitate that public entities, in particular local authorities, know what robotic technology is and can offer in response to their urban needs. Urban competitiveness would drive municipalities to engage in innovation, but the innovative solutions, specifically the robotic technology is unknown for most of cities' procurers. The development of technology is the key to mastering the urban challenges and transformations in the European Cities. The processes of innovative public procurement are the right tools to accelerate them.
- Increase the processes of innovative public procurement in urban areas that can be solved by robotic technology. The processes of this public procurement of innovation (hereafter PPI) instruments should be reconsidered checking each one of their phases and proposing improvements addressed to get a real success in the technological solutions achieved. The management of all the stakeholders involved under the coordination of a research team, made mostly by robotic researchers, could offer a successful solution to the actual lack of initiatives.
- The third objective of this article is to offer a list of specific urban challenges proposed by European cities in ECHORD++ project that can be the starter point of new innovative public procurements. Cities are prepared and the Research and Technological Development (RTD) consortia are waiting for real opportunities. The take-off of the robotic technology could be possible: from Lab to Market addressing real urban needs of citizens and cities. The proposals obtained in ECHORD++ could be followed by other cities.

Few examples of Public Procurement for Innovation have been developed in Europe during the last years. The last data presented by the European Commission Directorate General for Communications Networks, Content & Technology (DG CONNECT) in December 2015 exposed that the Information and Communications Technology (ICT) procurement supposes the 2.5% in Gross Revenue (GR) and the R&D procurement the 0.1% in GR (European Commission 2015) [5]. The European Commission is involved in enhancing the PPI processes looking to reach the good results at the United States of America public sector, that spend in research, development and innovation 20 times more than Europe [1], 50$Bn a year in PCPs in front of the 2,5€Bn invested in EU.

The outcomes of this study are being disseminated in several forums of Social Sciences and Innovative Public Procurement in Europe.

3. State of the art

The term Smart City refers to a city that applies Information and Communications Technology with the aim to provide an infrastructure that ensures: a sustainable development, an increase in the life quality for citizens, a higher efficiency in the available resources and an active social participation. Therefore, those cities are sustainable in an economic, social and environmental way. Smart cities are born out of the need to maintain a harmony among those aspects. The purpose of a Smart City is to reach an efficient management in the whole areas of the city (urbanism, infrastructures, transportation, services, education, health, public security, energy…) satisfying its needs and the needs of its citizens at the same time [6]. Those needs have to be achieved accordingly to the principles of the Sustainable Development presented in the Agenda21 [7], promoted by United Nations, taking the technological innovation and cooperation among economic and social agents as the main engines for the change. For the next 15 years, a new program has been launched by UN in 2030 Agenda for Sustainable Development [8]. Those principles should be applied specially to aspects as: (1) technological infrastructure: information networks as a mechanism of communication, intelligent platforms, eco-efficient infrastructures…; (2) energetic strategy: use of renewable energies, storage systems and energy harvesting; (3) resource protection and management: land and resource planning based on sustainable criteria, cooperation among administrations…; (4) service provision: development of new collaborative models that allow integrate public and private interests, associate service models…; (5) the Government: data accessibility, transparency in the management, sustainable policies applications.

It is expected that in 2050 a 70% of world population lives in cities (population of London growing at the rate of one full tube train every three days [9]. This expectation makes that in the next decades the urban centers have to face an increasing number of problems linked to this fact such as: energy supply, CO2 emissions, car traffic planning, goods and raw materials supply, health care and security provision to those all people living in these huge and crowded cities. The philosophy "Smart City" starts increasingly to be undertaken in projects that will imply the transformation of many cities into Smart Cities [10].

But the origin of Smart City is in Singapore. This Asiatic city was the first one to coin the term Smart City, and since that time Singapore has led this architectonical trend. This has been done through many innovative ideas as a pioneer underground, highway tolls that vary accordingly to the traffic flows, fingerprint computers for building access, water recycling to obtain drinking water, and with special emphasis in energy efficiency. After Singapore, other pioneer cities have been: Masdar (United Arab Emirates), the first ecological city which is self-sufficient using solar energy, with low consumption buildings; Hammarby Sjöstad, eco-friendly neighborhood of Stockholm municipality, integrates a sustainable management of energy, water and waste in an ecological district that was an old industrial site; BedZED [11] (pioneering eco-village in south London, United Kingdom), the sustainable community that boosted green spaces and transportation; Curitiba (in Latin America), the flourishing of green urbanism; and Songdo (South Korea), high technology integrated. Those last two cities have developed an intelligent transportation system with innovative technology, high speed Wi-Fi in the streets and recharge stations for electrical vehicles.

Following these examples, at present many cities have incorporated some of the main relevant mentioned aspects. In fact, increasingly more cities support this model that allows a lifestyle more comfortable for their neighbors. Some cities are more advanced than others in this sense, but it is possible to find smart projects practically over the world. As a summary of the most relevant examples, the following cities are summarized:

City of Tokyo: it has been considered par excellence the Smart City with projects to improve the energy management, smart urbanism, mobility…. It sticks out the NFC (Near Field Communication) [12] technology deployment in public transportation such as the underground, or in specific malls where the payment can be done using the mobile phone.