

# Robotic solutions for sewage systems in urban environments

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## Abstract

Sewer inspections require many people to work in risky and unhealthy conditions. A European ECHORD++ project introduces a robotic solution in this process aiming to reduce the labour risks, improving the precision of sewer inspections and optimizing sewer cleaning resources of cities. This system should be able to determine the state of the sewer in order to identify sewer segments where its functionality has been reduced either by sediments or by structural defects. Other functionalities required are sewer monitoring and water, air and sediment sampling. To well carry out these tasks, some general functions are required like remote operation, video and images capture, scanning and map building, among others. The ECHORD++ innovative proposed solution is carried out in Barcelona as pilot city.

The current need of the City of Barcelona is to mechanize sewer inspections in order to objectify sewer inspections and optimize sewer cleaning expenses of the city. The sewer network of Barcelona is 1,532 km long, from which approximately 50% is accessible, which means that the pipe is at least 1.5 m high and workers are allowed to go inside it. In order to determine the state of the network, visual inspections are done with different frequencies depending on the slope and other characteristics of the sewer. Workers walk all along the pipe, in some sections even four times a year, and decide where it is necessary to clean. Moreover, sewers are classified as confined spaces which require special health and safety measures, in addition to other risks like slippery sections, obstacles or biological risks from the eventual contact with wastewater.

These features made the process of sewer inspection a risky and expensive process that requires improvements urgently. Sewer inspection is a service included in the public management of the sewers of Barcelona. Nowadays, sewer inspections are done by people performing visual inspections and collecting information about the state of the sewage like sediment level and type, pipe obstructions, etc. In this paper the technological proposed solution (a semi-autonomous green robotic solution) is explained. The requirements for the new technology are given by the inherent sewer characteristics, that is, different ranges of pipe sizes, possible high concentration of, not explosive, but toxic gases as hydrogen sulphide, slippery areas, obstacles, atmosphere with 100% humidity, water temperature at 16 °C, and no telecommunication coverage in the sewer. The ECHORD++ project seeks to facilitate real-time decision making, innovation that makes inspection devices more autonomous, to have more degrees of freedom to move around the network, and the possibility to intensify the checking of a zone where impairment has been detected. This technological solution will fulfill environmental legislation and policies.

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