Open Source Architecture for "Nuovo CEP"

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Abstract. The Open Source Architecture (OSArc) is a new collaborative way to design common and shared areas at an architectural level, but also at an urban and technological level, etc.. It allows you to participate in the design phase both practically, with your technical contributions, and actively, with constructive criticism and intelligent and innovative suggestions.

We thought of using this new "design paradigm" to make the Nuovo CEP project feasible and economically sustainable through the cooperation of both professionals and non-professionals (i.e. inhabitants, students, etc.). Nuovo CEP is a project, which aims to redevelop a suburban neighbourhood and transform it into a mini *smart solar city*.

The OSArc for Nuovo CEP is realized by means of a wiki website where all interested users can register and insert their contributions together with others members of the community.

In this paper, we are going to explain the Nuovo CEP project and its objectives, which will be a guideline and an inspiring source for users' contributions. Then we will explain the wiki website structure used to implement the platform for the OSArc that is the object proposed by this paper.

Introduction

We think that a real democratization process does not start "exporting democracy" but by letting people realize it autonomously. Usually, exporting democracy means forcing people to accept external thoughts, external desires, external economies and, in some cases, external cultures too. In different countries around the world, unfortunately this includes Italy, politics and institutions often make decisions to invest in public works for not closely social objectives [1,2]. That is to say, someone in a position of power is convinced that only he knows what the citizens need or, even worse, will act only to gain consensus around election time or during their appointment. This means they tend to "export" their own democracy infected by interests that are not really those of the citizens [3]. Now, more than in the past, most Italian cities suffer this condition, this is especially so in southern Italy: Reggio Calabria is an example.

Despite this, Internet and new communication technologies are making people's awareness grow letting them share information and cooperate [4]. From this cooperation *open source* operating systems, applications and tools are born.

This means real *open source communities* are born, communities that seek to meet the "real" needs of their own community as well as ones that have the same, or similar, needs [5]. Thus, one can relate open source culture with the concept of democratization [6,7]. The Open Source Architecture is the paradigm that follows this concept "for the design, construction and operation of buildings, infrastructure and spaces" [8].

Due to its characteristic of democratization, the Open Source Architecture can bring out the hidden potential [9] of the Archi CEP , taking advantage of this to redevelop the area, as well as the city of Reggio Calabria.

Introduction to the Nuovo CEP project

The Archi CEP neighbourhood. Situated in the north of Reggio Calabria, District X of the city (Fig. 1), the Archi CEP neighbourhood consists of a cluster of public housing built since the 60s. It is notorious for having been the stage of the "second war of the 'ndrangheta", in the 80s. An event that has negatively labeled the territory and negatively "branded" thousands of honest people who, in all these years, have sought, and still seek, to revive the territory. Aiming at giving it a new face and getting the social redemption they deserve.
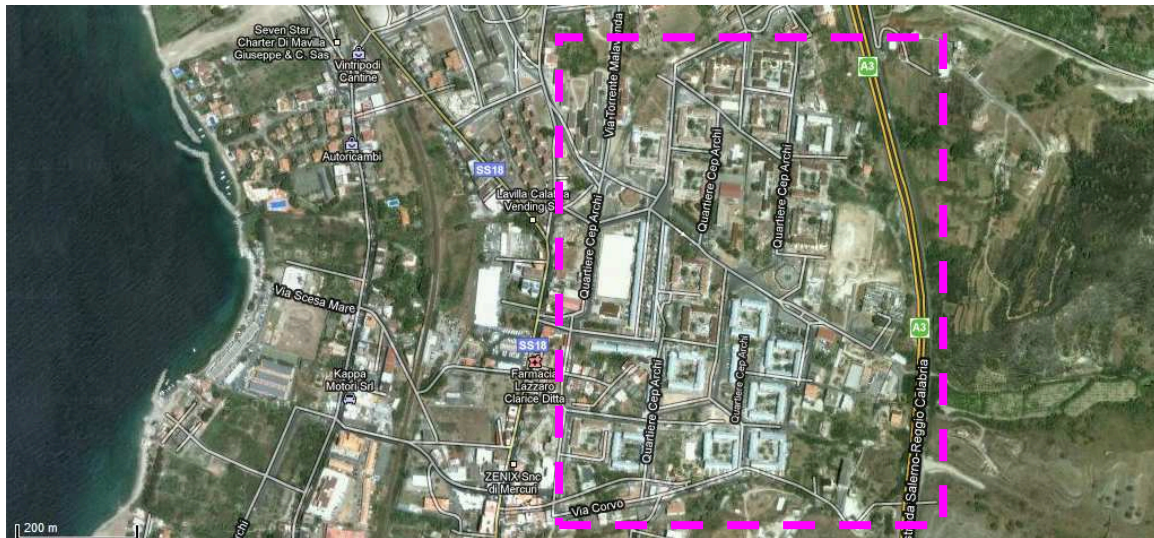

Fig. 1 The CEP neighbourhood inside the District X, Archi

This project will start from this specific cluster of public housing, *CEP*, (Case Economiche Popolari), built in the 60s and will project it into the future with the "new face" of the *New Polyenergetic Eco-friendly Centre*, *Nuovo CEP* (Nuovo Centro Ecosostenibile Polienergetico).

Project description. The first step of the Nuovo CEP project is to utilize the roof space of the buildings of the CEP neighbourhood for the construction of a *solar park* and transform the whole neighbourhood into a mini *smart solar city*.

The pitched roofs of these buildings are made of zinced sheets fixed on an iron structure. This in turn is fixed to a flat roof made of reinforced concrete. Fig. 2 highlights the roof of the concerned buildings to a total of approximately 37,500 m². Since the average annual insolation on Reggio Calabria is about 1611.75 kWh/m² and considering a photovoltaic module efficiency of 12.5% as well as a BOS (Balance Of System) efficiency of 85%, the *annual electricity produced* would be 171.26 kWhel/m² × 37,500 m² ~ *6,4 GWhel/y*. Furthermore this *reduce CO2 emissions by* 6.4 GWhel/y × 0,531 kg CO2/kWhel ~ *3,4 million kg per year*, where 0,531 kg CO2/kWhel is the emission factor of the Italian electric mix referred to the distribution [10]. You consider we are using conservative factors, therefore these outcomes can be saw as a lower bound.

The particular construction of the buildings' roof, already composed by a reinforced concrete flat roof, allows for easy and immediate installation of photovoltaic panels on either fixed or movable frames to follow the sun's position.

As we shall see below, the Nuovo CEP project does not consider only the solar park installation but involves many other projects regarding sustainability (e.g. sustainability of environment, living, governance, economy, smart growth, etc.) in order to transform the CEP neighbourhood into a mini smart solar city. In our conception the Open Source Architecture is not confined to design the architecture of buildings but it is extended to the design of the architecture of the ICT Infrastructure, the architecture of water and waste processes and so on for the architecture of each context that can become sustainable. In fact the OSArc platform that we will explain later, is an open platform which will be used to develop each of these contexts.

Fig. 2 Emphasis of buildings' roof concerned by the project

Objectives of the Nuovo CEP project

The main objective. With the implementation of the solar park, the project would like to converge objectives apparently different from each other in a single main goal. That is, to *redevelop the territory*. Below is a list of objectives, grouped into three areas, and their return on the main objective.

Economic-Social objectives:

- **Give investors the "right" economic return.** The widespread attitude to try and get the most out of every eurocent invested without paying any attention to the needs of the territory you are investing in is a form of looting inherent in many organizations not only in criminals. Escaping from this attitude can lay the groundwork for an advantageous and synergic growth of the territory.
- **Involve local businesses in the project.** Increasing job opportunities is the first step to developing the territory as it provides dignity to individuals, self-sustenance and consequent possibilities for growth.
- **Involve local authorities and associations.** Both local authorities and associations can take advantage of the nature of the project, which is strongly environmentalist and technologically advanced. This facilitates the promotion of increased respect for the environment, which expresses itself in different forms, as well as in behaviours which reflect this, i.e. energy saving. Highlighting this territory as a concrete example of positive development plants the seeds for an optimistic future.
- **Provide the inhabitants of the concerned buildings with electricity at advantageous prices.** This leads to a reduction of costs and a consequent increase of the state of wellness. In addition, the work will be seen as a "common good" to be safeguard.

Cultural, Scientific and Research objectives:

- **Involve the University "Mediterranea" of Reggio Calabria.** To both establish relationships of national and international collaboration, and new branches of research and development, in the field of renewable energy sources, sustainable building and Smart Grids, that is, the new technology for the smart electricity distribution grid. In such perspective, the project and its implementation would be a *permanent active laboratory* for researchers and professors. However, more importantly it would represent a motivational drive for new generations of local students to invest in research and cultural growth. This in turn would promise job opportunities and professional growth within their own territory.
- **Plan the conversion of the territory into an *smart solar city*.** From this project, Archi can become the Italian reality of so called solar cities such as Linz in Austria, Freiburg in Germany, and BedZED (Beddington Zero Energy) district of London in the UK. Reggio Calabria is a city with a latitude and climate favourable for realizing a solar city. In fact, the sky is clear for most of the year. In this perspective Archi and its inhabitants could be an example to follow, furthermore inhabitants would be encourage to keep up the example.
- **Plan the integration of this project with other already existing projects** by studying and exploiting sources of energy other than those from the sun. For example, the Okeanos laboratory of the University "Mediterranea" of Reggio Calabria, uses the energy of the sea. The whole environment of Reggio Calabria and Messina is characterized by *strong* different sources of renewable energy sources that can be studied and exploited: the *constancy of the sun*, the *force of the sea*, known in ancient Greece as Scilla (the wave energy on the coast) and Charybdis (the energy of the currents); the *pervasiveness of the wind* (which can be exploited in a distributed manner with vertical axis wind turbines). This integration, together with new studies in sustainable architecture, could lay the groundwork for the creation of a National and International Research Centre for Renewable Energies and bring the two cities of the "heart of the Mediterranean", Reggio Calabria and Messina, to be a national and international landmark in renewable energy and sustainable architecture.

Touristic objectives:
- **Tourist business.** The smart solar city, the use of solar energy combined with other forms of energy, the national and international attention to this reality, would give positive prominence to the territory. You can use this prominence to increase tourism, providing fertile ground for the tourist industry and environmental entrepreneurship.
- **Light art.** Recalling the characteristics of the type of energy used, a new kind of art can arise. Artistic high schools and Academies of the Fine Arts could teach *light art* and lay the foundations for new international professions. Special lighting effects and the play of light (e.g. through neon, LED, low-power laser, etc.) can become a futuristic attraction and so strengthen the touristic business and a sustainable economy on the territory.

OSArc for Nuovo CEP project

Wiki Website. In order to implement the OSArc (Open Source Architecture) for the Nuovo CEP project, we used DokuWiki [11], an open source wiki software which allows many users to cooperate easily for creating and updating shared documents.

Structure. The wiki structure is split up in two sections, "Solar Park" and "Smart City". For each of them there are different topics, one of these is "*What You Need to Know*". This explains the section and how to contribute to the topics. On the other hand, the "Info" section contains general information about the wiki site (i.e. regulations, faq and contacts) but it mainly gives information about members of the community. In fact, the topic "Community" contains the profiles of each registered user.

Amongst the topics belonging to the "Solar Park", are the documents required for the submission of a construction project in the Italian state. In this case the project is the building of the Solar Park.

Instead, each topic belonging to the "Smart City", is represented by a page which contains information about the topic and a list of main projects which can be explored in smaller and more feasible projects. Most of the latter will be drawn up with the same structure of the "Solar Park" section, as they need the same documentation for their submission.

Below, the wiki structure:

- **Solar Park**
  - *What You Need to Know*
  - Technical and Explanatory Report
  - Environmental Pre-feasibility Study
  - Architectural Graphics
  - Summary Calculation of Expenditure and Economic Framework
- **Smart City**
  - *What You Need to Know*
  - Government
  - Citizens
  - Buidings
  - Urban Environment
  - Mobility & Transport
  - ICT Infrastructure
  - Energy
  - Water
  - Waste
- **Info**
  - Regulation
  - FAQ
  - Community
  - Contacts

Open Source Community. The wiki site promotes easy collaboration, transparency, communication and knowledge at the same time [12]. Furthermore, it allows to create a network of users who have the same interests and objectives, thus it allows them to spontaneously join in teams.

Users who join the community have a number of different benefits [5]: they can put into practice their knowledge; they can learn a lot from expert users; they can introduce themselves and their work to other professionals; they can network with other professionals; they can introduce themselves to other professionals through their work; they can help to redevelop their territory; they can change a lot with little effort.

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The management is community centered. Inside the community, each user who has particular skills about one or more topics. They can emerge by becoming moderators for these in teamwork with other moderators. The management tends to be meritocratic because it is open to all and transparent similarly to other open source communities.

Future work

The wiki site is the first step and the easiest one to implement a cooperative tool. However it is not enough. The wiki site provides you a blank page upon which you can write contents, rules of management, etc., and allows you to create and fill the OSArc platform structure manually. Despite

this, as the community grows, you will need automated tools for the management of projects, community, for sharing designs in a particular file format, etc.

Future work includes upgrading the wiki site to an open source platform for OSArc that contains a management tool and more automatisms and integrations.

Conclusions

Through the OSArc for Nuovo CEP, local citizens can cooperate actively for their neighbourhood and be assisted by competent users, both local and not.

Furthermore, this platform allows citizens to easily form a dynamic community in which they can both learn and teach at the same time.

It is very useful: for citizens who are involved in the design of their neighbourhood, via suggestions, criticisms and consent; for students who want to write their thesis about the territory; for the public administration, allowing it to have access to information regarding the real changes that citizens want, etc.. At last, this platform is a real way to allow the new generations to face the inertia, immobility and passivity of the institutions that are burdening their lives and their future.

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