



ALMANAC

RELIABLE SMART SECURE
INTERNET OF THINGS FOR SMART CITIES

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1. Executive summary

The work-package 8 focuses on evaluation and demonstration activities of the ALMANAC Smart City platform. For this purpose, three types of prototype applications have to be specified, developed, deployed and evaluated within the respective tasks:

- T8.2: Water Management Application
- T8.3: Waste Management Application
- T8.4: Citizen-centric Application

This deliverable provides a detailed description, a brief collection of related resources (and a formal specification of the "Citizen-centric Application domain" underlying the implementation of the task T8.4.

Three target areas have been recognised in relationship with the Citizen-centric domain, being respectively: i) Information accessibility; ii) Citizen awareness and iii) Citizen engagement.

Based on the identified target areas, an overall co-creation methodology was selected to address the citizen-centric application domain. Co-creation brings different parties together in order to jointly produce a mutually valued outcome and promote knowledge co-generation. In this case, ALMANAC has selected two groups of end-users to interact and co-create with: Turin's Citizens and Developers' Community:

- Turin's Citizens: due to the large number of Turin's Citizens and ALMANAC limited resources for developing T8.4 activities, the project has chosen to consider a limited number of citizens. Moreover, ALMANAC considered that these citizens should belong to a heterogeneous and dynamic community, with the aim to select a significant sample of the city's citizens. In this sense, the SHARING¹ community from the City of Turin was selected to represent the citizens from Turin, and jointly develop part of the activities related to the citizen-centric domain.
- Developers' Community: part of the citizen-centric domain activities will be carried out together with the Developers' Community that can be defined as a group of curious citizens with social interests and IT literacy (either as interested IT users or IT developers). In this case, ALMANAC will try to attract developers through hackathons and/or workshops in order to test some of the developed assets as well as the platform's scalability and stability, and thus obtain valuable feedback from the developers to improve the developed platform.

Considering the three target areas identified and together with the two groups of end-users considered, four application scenarios were defined: i) Recycling support, ii) Issue reporting, iii) Bike SHARING and iv) Developers' Engagement.

In this document an analysis and scenario-based application description is presented along with references to related resources. This is followed by a formal specification according to IEEE 42010, intended to guide the software prototype development done in two iteration steps scheduled for the months M24 and M36. The formal specification defines the three parts of the citizen-centric application (i.e. recycling support, issue reporting, and bike SHARING), the involved actors, all the corresponding use cases and the information views associated to them. The developers' engagement scenario will not be described using this approach since an actual software application does not need to be developed

¹ SHARING is a Housing Project in the City of Turin, for further information please refer to the website www.sharing.to.it

2. Introduction

2.1 Purpose, context and scope of this deliverable

This deliverable provides an informal description and a formal definition of the Citizen-centric Application Domain developed within task 8.4. The application is intended to showcase the capabilities and help to demonstrate the ability of the ALMANAC platform to provide access to open data and enable high-level semantic interoperability with the other applications developed within the project. Its development will be done iteratively and materialized in a series of prototype deliverables "Prototype Citizen Centric Application" 1 and 2, ID8.7.1 due at M24 and ID8.7.2 due at M36 respectively. At each stage newly discovered or updated user requirements, research findings and technologies will be considered.

For the writing of this document following relevant deliverables were consulted:

- D2.1 Scenarios for Smart City applications (M2)
- ID2.3 Prototype Application Specification 1 and 2 (M9, M18)
- ID8.1 Evaluation Framework (M9)

An alignment with the deliverables "D8.2 Application Definition – Water Management" and "D8.4 Application Definition –Waste Management" was sought concerning a shared conceptualization and definition of ALMANAC prototype applications.

3. Application Description

3.1 Introduction

A description of the citizen-centric scenario was given by deliverable ID2.3.2. The first section of this document aims to summarize and generalize the findings in order to make them extensible to other European cities and communities. A description of the activities' current status, identified problems and requirements is provided in order to motivate the solutions proposed in subsequent sections.

In Deliverable D2.1 "Scenarios for Smart City Applications", three target areas and four possible scenarios were identified for the citizen-centric domain. With the development of the activities in T8.4, these areas and scenarios have evolved. The evolution of the citizen centric application domain, including the relations between the target areas and the possible scenarios is shown in Figure 1.

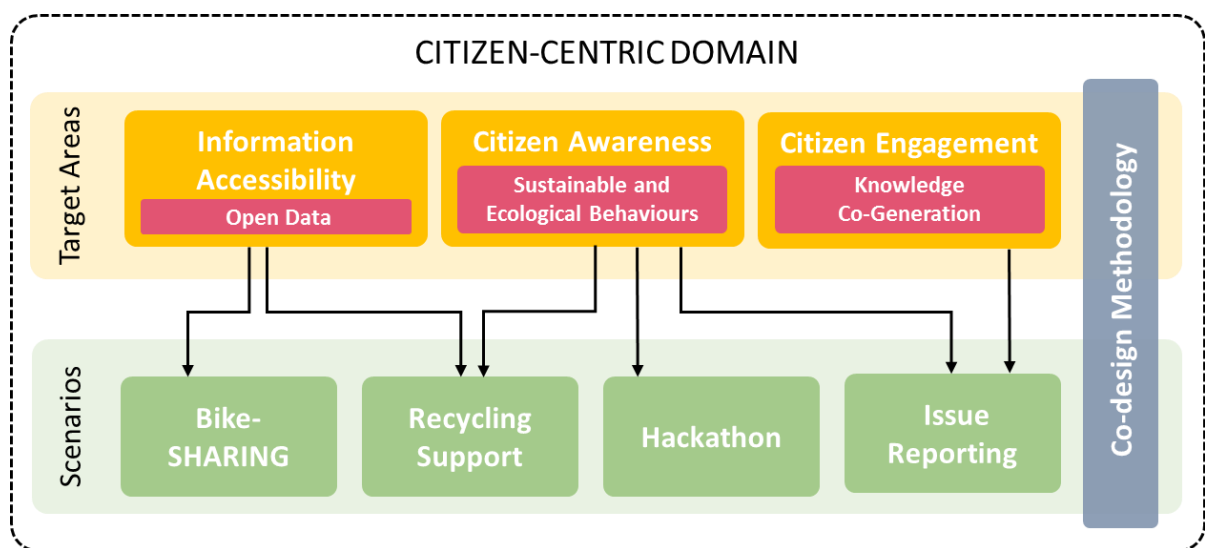


Figure 1. Citizen-Centric application Domains

As shown in Figure 1, the three identified target areas are the following:

- Information accessibility: providing access to open and public data, either from the City Municipality or from other open data sources such as weather forecast, public transport, data from services with open APIs, etc.
- Citizen awareness: actively involving citizens in sustainable solutions for their city and local community by providing them with relevant data placed in context, also in order to provide useful feedback from citizens to public authorities and other stakeholders.
- Citizen engagement: providing tools for real time contextualization of information maximizing citizens' knowledge co-generation.

During Y1 and part of Y2 a series of activities and analysis were carried out aiming at addressing the evolution of the possible scenarios (initially defined in D2.1) presented in Figure 1, while also aiming to define the first prototype of the citizen-centric application that will be delivered at M24 and further described in ID8.7.1.

Having recognised the citizen-centric domain target areas, four relevant scenarios related to them can be identified:

- Bike-SHARING: service enabled by the ALMANAC platform integrating private bike sharing data from the SHARING community and the open bike sharing data from the city of Turin, including bike paths and route calculation.

- Recycling Support: support guide aimed to aid citizens in the recycling process by providing relevant information in a clear and easily accessible way.
- Hackathon: focused on engaging the developers' community in the co-creation of Smart City applications.
- Issue Reporting: supported service that enables citizens to report problems, both at a community and at a city level.

A detailed description of these scenarios, and the methodology ALMANAC employed to select and define them will be further explained in sections 3.5 and 3.3 respectively.

Overall, the citizen-centric application will result in a set of co-creation methodologies and software applications, both focussing on the citizens either as active participants during the design and developing phases or as final users of the developed applications.

In the following sections, a summary of the activities related to the citizen-centric domain is presented together with the methodological choice made to develop the application: a co-creation process, involving citizens in the co-design of a mobile application that will help promoting in them more sustainable behaviours, while employing the available ALMANAC platform components and tools.

3.2 Preliminary considerations

Some preliminary considerations regarding the two communities targeted by the ALMANAC project: Citizens and Developers will be described in the following.

3.2.1 Citizens' Community

As stated in ID2.3, to define and delimit the citizen-centric application in ALMANAC that concerns the general citizens in Turin, the following considerations were made:

- Already existing city projects/programs are to be used as starting point² for the development of the citizen-centric application;
- The application will try to focus as much exclusively as possible on integration and interoperability aspects (e.g. integration of city services and third party applications with Open APIs, and Open data sources from the City Municipality, weather forecast, public transportation, etc.);
- All identified citizen-centric scenarios will be tested in a small-scale controlled environment in order to demonstrate the idea; large-scale deployments are not foreseen by the project.

Based on these considerations, the project identified a set of on-going initiatives and active citizens groups in the city of Turin (social innovation projects, active citizens groups, other projects in the city) and subsequently a preliminary selection of the most relevant cases was made. This allowed performing a high-level analysis of the most interesting use cases, where short descriptions, challenges/opportunities in relation to ALMANAC, consistency with the ALMANAC goals, etc. were studied and analysed. Other city groups/projects were also considered, e.g. co-working groups, ecological guards, etc. however the co-housing projects seemed to be the most appropriate scenario to represent, in a very reduced scale, the Smart-City ecosystem.

² The following sources were analysed and considered for the development of the citizen-centric activities: Housing Projects in the city, Ecological Guards and other volunteering groups in the city, Energy saving related projects. Among these, ALMANAC chose to further study into detail the housing projects, specially due to the fact that they are represented by their community and that the needs from a small group of citizens could be extended to generalize the needs of the citizens of Turin. The following housing projects were considered: Buena Vista Social Club, Sharing, Numero Zero, condominio solidale "A casa di zia Jessy", Stesso Piano, Abito al 20. Later three projects were selected based on the similarities with ALMANAC, being; Social Club (<http://www.resocialclub.it/pages/4-casa>), Stesso Piano (<http://www.stessopiano.it/>), SHARING (<http://www.sharing.to.it/index.php/en/home.html>).

These projects were analysed and the results were presented and discussed with the management of the Municipality of Turin to understand which was the most relevant project from the city's perspective. After these interactions, it was decided that the housing initiative "SHARING"³ was one of the most important and successful social initiatives the City of Turin has endorsed while being the most appropriate scenario to be considered for the citizen-centric application of ALMANAC.

SHARING is a temporary housing initiative in Turin, recently established to meet the needs for temporary rental properties at controlled costs and characterised by sustainable and high energy efficiency facilities with low environmental impact. SHARING is characterized for the strong sense of belonging of their residents as a result of the hard work of the SHARING staff demonstrated through the organization of team-building evenings and activities (e.g. aperitivo time, theatre plays, book exchanging, etc.) aiming to cultivate new relationships and collaborations among the SHARING residents. In Table 3, a brief overview of the SHARING project is presented, including a short description, its dimension and other characteristics relevant for ALMANAC.

Table 1. Housing Project SHARING of the City of Turin

Website	http://www.sharing.to.it/index.php/en/home.html
Project Type	Co-housing
Project Funding	Private
Description	<p>SHARING s.r.l., is a temporary social housing initiative in Turin, recently established to meet the needs for temporary rental properties at controlled costs and characterised by high energy efficiency with low environmental impact. SHARING activates the important process of VENTURE PHILANTHROPY in Turin, sponsored by the CRT BANK FOUNDATION (Fondazione Sviluppo e Crescita), together with OLTRE VENTURE and COOPERATIVA DOC.</p> <p>SHARING IS A SUSTAINABLE BUILDING Sustainability and conscious use of energy resources are guaranteed, as we assert our firm intention to promote sustainability not just as a slogan, but as real everyday practice, as demonstrated by provision of the following means :</p> <ul style="list-style-type: none"> • Photovoltaic plant • Solar thermal plant • System for recovery of rainwater for irrigation of green areas • Use of photocatalytic painting for external surfaces • Low consumption condensing boiler • Photovoltaic plant • Differentiated waste collection in common areas and in all rooms and apartments • Improvement in the building's thermal insulation with the realisation of an internal insulation layer • Use of low consumption lighting systems • Use of water consumption flow reducers.
Dimension	<p>122 residential units:</p> <ul style="list-style-type: none"> - 84 THREE-ROOM APARTMENT (2+1) - 6 TWO-ROOM APARTMENT (2) - 16 ONE-ROOM APARTMENT (2) - 16 ONE-ROOM APARTMENT (1) <p>58 rooms for hotel use</p>
Living period (long-short term)	<p>Residential:</p> <ul style="list-style-type: none"> - RESIDENCE FORMULA minimum stay 14 nights - CAMPUS FORMULA minimum stay 6 months - HOUSING FORMULA minimum stay 12 months <p>Hotel:</p> <ul style="list-style-type: none"> - Short term (days-weeks)

³ SHARING is a Housing Project in the City of Turin, for further information please refer to the projects' website www.sharing.to.it

Target (disabled people, low income families, etc.)	Wide! Special access to controlled prices for people with disabilities or low income. prices and CONTROLLED prices have been provided to even more attentively meet the needs of students, young couples, single parents with children, families, travelling workers, foreigners and in general of all those people who need to spend some quality time in Turin
Technologies available in the building	WI-FI access in the apartment Possibility of monitoring and controlling devices by means of home automation system
Services and Activities	Laundry room Social services

Summarizing, here are some of the most relevant characteristics of the SHARING project and community:

- The community of inhabitants is "temporary" (from one day to 12 months) thus it is a fluid and interchangeable community
- Heterogeneous composition: many foreign students, a smaller number of families with housing difficulties, and a variable number of people who use the service "hotel"
- SHARING offers some services permanently and diffusely, in particular related to the intelligent management of energy, water and waste within the housing units. The building collects data on energy, water, waste widespread throughout the units, but do not have user/citizen-based applications
- There is a strong "educational" orientation on sustainable practices that the inhabitants of SHARING are encouraged to adopt.

3.2.2 Developers Community

As introduced before, ALMANAC has chosen to involve the developers' community in the citizen-centric application related activities. This very particular group of citizens has been identified to test together with them some of the developed assets in ALMANAC, as well as the Smart City platform's scalability and stability, thus obtaining valuable feedback from the developers to improve the project outcomes. This scenario was originally defined in D2.1, as a Hackathon scenario, were curious citizens with social interests and IT literacy (either as interested IT users or IT developers) would attend a Hackathon workshop organised by ALMANAC.

3.3 Methodology

A co-creation [1][2] strategy has been selected to address the set of identified citizen-centric scenarios: both for the set of applications that will be designed in collaboration with the SHARING community as well as for the activities involving the developers' community. Co-creation brings different parties together in order to jointly produce a mutually valued outcome. In ALMANAC the term co-creation will encompass the entire process of design and production of applications prototypes. Thus, the citizen-centric application is developed through a user-centred and co-design approach, involving real communities: the SHARING community in the area of Turin, and a developers' community:

- Regarding the SHARING community, citizens (intended as SHARING residents) are expected to play an important role in the design of the application as experts of their experience. In order for them to take this role they must be given appropriate tools and guidance for expressing themselves. In this context ALMANAC will provide the means for citizens to interact with each other as well as instruments to communicate and share insights allowing them to envision their own ideas. ALMANAC aims at co-designing with the citizens and not for them, making it possible to develop a solution that could easily fit in with the citizen's current behaviours and needs, rather than forcing them to accommodate the generated service or product. Although the co-design exercise will be carried out only with the SHARING community, ALMANAC will try to identify needs that can be extended to the general population and not just to the specific selected community.

- Regarding the developers' engagement scenario, ALMANAC provides developers participating in hackathons and workshops the necessary technical support and access to the relevant software components, thus providing all the essential tools to interact and develop innovative applications in collaboration with the Smart City Platform developed in ALMANAC. Developers will help co-create some of the APIs and components developed by the project by testing them and using them to develop third party applications and by providing valuable feedback for their improvement.

In the following paragraphs more detailed information regarding the approach followed by ALMANAC to develop the citizen-centric applications will be provided.

3.4 Methodology Implementation

3.4.1 Citizens' Community: Co-design Activities

A guided co-design of the application employing user-centered methodologies has been adopted to develop a set of citizen-centric scenarios together with the SHARING community. For this purpose a small group of people has been involved, formed by key-informant representatives of all stakeholders involved (i.e. SHARING community and ALMANAC project). The co-design approach follows the following guidelines:

- The group of participants is formed as follows: SHARING staff member (1 person), SHARING technician (1 person), SHARING residents (4 Italian and/or foreign young students; 1 member from the families' community -chosen with attention to the issues expressed by this target-; 1 professional figure), ALMANAC team (2/3 people), other stakeholders (representatives of public institutions that work closely with SHARING - 2 people). The activities are guided by a facilitator.
- Two co-design workshops with a duration of 4 hours over a period of 6 months are foreseen. The first workshop consisted of a project presentation followed by the identification and collection of needs, mapping them into a first hypothetical "script" of the application. During the second workshop instead, a first prototype of the application will be presented with the aim to gather feedback from the group on the developed prototype.
- The workshops are expected to be held within the spaces of SHARING to create an immersion in the real context: the place where ideas are born, developed, and tested.

In Table 4, the proposed work plan for the development of the citizen-centric application activities is presented. This work plan was defined together with the SHARING management and it was later shared with the rest of the Consortium during the plenary meeting held at Turing during the 5th of February. In the proposed work plan, a detailed description of the activities foreseen for the development of the citizen-centric application is provided, together with the information related to the involved stakeholders, the activity's expected outcomes and the estimated date.

1st Co-design Workshop Outcomes

In this section a summary of the first co-design workshop will be given before providing a more technical view of the scenarios in the subsequent section 3.5. Co-design activities were the drivers that helped define and deepen three scenarios regarding the citizen-centric domain. Discussions and results obtained during the first workshop were translated into use cases and requirements for the ALMANAC project.

The workshop that took place during the evening of April 29th in the SHARING facilities, was structured in the following manner:

- i) Initial presentation of the ALMANAC project and the activities foreseen for the evening;
- ii) Individual round of exercises, consisting of a set of questions that were presented to the participants to identify their needs and desires in a Smart City context;

- iii) Group brainstorming to identify the common needs and desires of the group, translating them into a first rough idea/concept of application and its corresponding high-level requirements.

The co-design workshop included the participation of a group of 15 people of different ages, background and nationalities.

A folder with project information and support material for the workshop was provided, that later was collected, analyzed and translated into system and application requirements.



Figure 2. First Co-design Workshop

Overall, SHARING residents would like to have a more dynamic and interactive insight of the city and the housing structure they live in. Three main subjects emerged from the workshop:

- Recycling support;
- Maintenance Issue management;
- Bike sharing service.

Precisely these three themes were the inspiration to define the evolution of the scenarios concerning the citizen-centric domain that will be further explained in the following section. Additional details regarding the results of the first co-design workshop are reported in ID2.3.2 Prototype Application Specification 2.

	Activity	Participants	Expected Outcome	Date
1 st cycle	Technical Meeting with the SHARING team	ISMB, Sharing, TRN	<ul style="list-style-type: none"> Extended knowledge of SHARING monitoring system Knowledge of the available data set from Sharing Preliminary selection of the co-design group participants 	01/2015
	Preliminary activities for the 1 st co-design workshop	ISMB, TRN	<ul style="list-style-type: none"> Preliminary definition of the target scenario Definition of the objectives and expected outcomes of the first co-design workshop Definition of the tools and components available for the co-design of the application (from ALMANAC) 	02/2015
	ALMANAC internal dissemination	ALMANAC Consortium	<ul style="list-style-type: none"> Sharing the work plan and expected results with the consortium Feedback from the ALMANAC Consortium 	02/2015
	1 st Co-design workshop	ISMB, Sharing, TRN	<ul style="list-style-type: none"> First co-design workshop in collaboration with the target audience to gather high-level application requirements and define together with the SHARING community an initial application idea/concept 	03/2015
	Information gathering and processing	ISMB, TRN	<ul style="list-style-type: none"> Translation of the results obtained from the co-design workshop into user-requirements 	03/2015
	Dissemination results (only for workshop participants)	ISMB, TRN	<ul style="list-style-type: none"> Presentation of the results obtained from the co-design workshop to the participants 	03/2015
	ALMANAC internal dissemination	ALMANAC Consortium	<ul style="list-style-type: none"> Presentation of results from the 1st workshop to the consortium 	03/2015
	Application definition and Development	ALMANAC Consortium	<ul style="list-style-type: none"> Implementation of the software requirements derived from the co-design workshop 	03-07/ 2015
2 nd cycle	Preliminary activities for the 2 nd co-design workshop	ISMB, TRN	<ul style="list-style-type: none"> Preparation of the 2nd co-design workshop Internal presentation and discussion of the results from the 1st cycle 	08/2015
	2 nd Co-design workshop	ISMB, Sharing, TRN	<ul style="list-style-type: none"> Second co-design workshop in collaboration with the target audience 	09/2015
	Information gathering and processing	ISMB, TRN	<ul style="list-style-type: none"> Translation of the results obtained from the co-design workshop into useful feedback 	09/2015
	ALMANAC internal dissemination	ALMANAC Consortium	<ul style="list-style-type: none"> Presentation of results from the 2nd workshop 	09/2015
	Application Development	ALMANAC Consortium, ISMB	<ul style="list-style-type: none"> Implementation of new functionalities derived from the new end-user requirements Improvement of the defined application through feedback from the users and the ALMANAC consortium 	09-11/2015
	Continuous DEVELOPMENT	ISMB	<ul style="list-style-type: none"> Continuous development of the citizen-centric applications Integration with the other 2 professional applications developed in ALMANAC 	11/2015-03/2016
	Final Application	ISMB, TRN	<ul style="list-style-type: none"> Citizen-centric application prototype 	03/2016

3.4.2 Developers' Community: Hackathon "The ALMANAC Challenge"

During the iOT360 summit, dedicated to the Internet of Things, that was held in Rome during the 28th and 29th of October 2014, ALMANAC had the opportunity to participate showcasing the prototype developed during the first year of the project, showing how the ALMANAC platform addresses the issue of waste management and water supply in a Smart City context.

At the end of the summit, ALMANAC organized a Hackathon, the "ALMANAC Challenge", in which the main goal was to globally optimize the cost and sustainability of the waste collection system of the city by possibly improving the perceived quality of service. To this end, ALMANAC provided to the participants the necessary technical support and access to the existing software components, thus providing all the essential tools to develop one or more innovative applications for the management of waste collection, guaranteeing also the engagement of citizens in the Smart City governance processes.



Figure 3. Winners of the ALMANAC Challenge and the ALMANAC Project Coordinator Maurizio Siirto

3.5 Citizen-centric application Scenarios

In the following subsections, a detailed description of the four scenarios identified for the citizen-centric application will be provided. Three of these scenarios were derived from the first co-design workshop on collaboration with the SHARING community, while the fourth scenario is related to the developers' engagement that has been implemented during the iOT360 hackathon 2014.

3.5.1 Scenario 1: Recycling Support

It is often unclear how citizens should recycle composite and mixed materials which could lead to frustration and poor recycling habits. This scenario considers that the complexity sometimes associated to the recycling process makes behavioural changes really difficult for citizens to achieve.

In the city of Turin there are three ways to collect the waste: i) door-to-door ii) Underground ecological areas (UEI) and iii) street-based collection or "stradale" (bins on the street). SHARING is located in one of the Turin areas in which the door-to-door collection takes place, and as such garbage is collected following a weekly calendar established by the City Municipality.

SHARING residents and general Turin citizens have sometimes the need to find a specific recycling bin near them either when they live in areas of the city with street-based collection and they approach waste bins that are overfilled, or when they are just walking around in the city and need to dispose some packaging, e.g. a plastic bottle of water.

Citizens sometimes need support in the recycling process, since they do not always know "what goes where". Furthermore, citizens living in neighbourhoods with door-to-door collection sometimes forget or are not completely sure of the type of waste that will be collected on a specific day of the week.

In this scenario, the ALMANAC recycling support application will increase the quality of recycled waste while providing citizens support through the waste recycling process. The goal is to arm

people with the knowledge they need to recycle by making relevant information clear and easily accessible.

Based on the first co-design workshop carried in collaboration with the SHARING community, citizen needs related to the recycling process were identified. In general, citizens would like to have the following resources or features available:

- Waste collection calendar, indicating which type of waste is collected during each day of the week, and the possibility to enable notifications or reminders with this information the day before
- Interactive recycling guide, providing relevant information on “how to” and “what goes where”
- Waste bin locator, based on the user location, type of waste and fill-levels (if available) of the bins in the area

Generally, users should be able to set reminders and configure the application to get notifications periodically (e.g. daily notifications indicating the type of waste that should be disposed based on the collection calendar).

Moreover, for browsing through the recycling guide two possible solutions have been identified to enable citizens to easily tell the app what packaging material they are trying to recycle:

- Using barcodes to link garbage with supplier data to extract packaging material information. This solution is relatively easy to use, however there are packaging without barcodes that could not be supported this way.
- Through manual input, providing the product name or choosing a waste type (glass, plastics, paper, etc.). The application will then provide additional info to help the users narrow down their choice. In this case, although this solution is relatively easy to use, requires more effort from the user (browsing, spelling correctly)

The recycling application will leverage on a crowd-sourcing feature that will allow users to provide recycling information when a particular recycling item or packaging with a bar code has no information associated, promoting citizens’ knowledge co-generation and continuously improving the recycling support resources citizens have at their disposal.

Related resources

http://www.amiat.it/cms/servizi/55-raccolta-e-smaltimento-rifiuti/ecocentri	Ecocenters location within the City of Turin
http://www.amiat.it/cms/guide	Recycling guidelines and support recycling material from the City of Turin service operator (AMIAT)
FP5 European Waste Management Cluster (EUWMC) - 1999 to 2005	The six FP5 EU research projects tackled topics like waste production simulation, methodologies and business models (Pay-as-you-throw, variable rate pricing for reduction of residual waste disposal in order to increase recycling rate).

3.5.2 Scenario 2: Issue reporting

At a building/community level, users usually report individual maintenance issues at their units (e.g. plumbing, electrical, etc.) and issues regarding the common areas of the residence and neighborhood to the Building Manager. This takes a lot of times that sometimes neither the residents nor the management of buildings have. This is a problem that also exists at a city level, since citizens need to report different issues (e.g. traffic infrastructure problems, electricity or water problems, accidents, etc.) to different bodies (e.g. police, firemen, city administration, city offices, transport authority, etc.). Signaling problems in the city is usually a time consuming operation, and

sometimes citizens avoid reporting city issues in general because of the complexity and time that this procedure takes.

This scenario focuses on the citizens' need to report issues at different levels. This need was identified and elaborated during the first co-design workshop in collaboration with the SHARING residents, and together with them a first sketch of the issue reporting application was made.

In this scenario, the ALMANAC issue reporting will enable users to report problems both at building/neighborhood and city level.

- At a building/community level, users could be able to report the individual maintenance issues they have at their units (e.g. plumbing, electrical, etc.) and issues regarding the common areas of the residence and neighborhood.
- At a city level, citizens will be able to report different issues. Initially, the application will only allow to report a generic city issue englobing all possible issue categories, but eventually the application could be extended –or integrated– to include and differentiate among several issue categories (e.g. traffic issues, strikes' information, public transportation, etc.) including also the waste issues handled by the Waste Application being developed in ALMANAC by the activities in task 8.3.

In the case of the SHARING community, the application integrates also available individual consumption data, enabling residents to control their monthly expenses and thus promoting more sustainable behaviors through a more conscious use of the resources.

An initial application prototype will be tested and improved together with the SHARING residents, through the second co-design workshop foreseen within the context of the Citizen-centric activities.

Related resources

Issue tracking systems (ITS)	This type of software is commonly used to track and manage the overall lifecycle of user requests/tickets (incident, enhancement, change etc.) from their inception until their resolution.
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3.5.3 Scenario 3: Bike SHARING

This scenario assumes that the integration of different bike-related services and other relevant open data from the city of Turin could improve the efficiency of these types of services with a unified application.

Citizens in Turin can subscribe to the city's bike sharing service "TO-bike" which has bike stations all around the city, and provides a mobile application to check in real-time the availability of bikes and docking-spaces in each station.

On top of that, the SHARING residents have at their service an internal bike sharing service provided by the building managers. It consists of a set of bikes at the disposal of the residents they can use whenever they need to. The SHARING management does not really have an automated way to keep track of the residents using the bikes or the problems these bike could eventually have.

In this scenario, the ALMANAC bike sharing application will extend the TO-bike application, allowing users to locate nearby bike stations (including the SHARING station and possibly in a future other private bike-sharing services), check on both bike and dock-spaces availabilities for each of them, view bike paths in the city of Turin and calculate the best route between two points, preferring dedicated bike paths

The application should be able to integrate information from the internal bike sharing system of the SHARING housing project from the city of Turin and information from other European bike-sharing services providing Open APIs.

Furthermore, through the bike sharing app, SHARING residents will be able to manually report/update bike status and availabilities to improve the efficiency of the internal bike sharing service. The SHARING residents themselves will act as "human sensors".

Related resources

http://www.tobike.it/	Bike Sharing Service from the City of Turin
http://api.citybik.es/	Open APIs of bike sharing services across Europe provided by the CityBik service
http://aperto.comune.torino.it/?q=content/piste-ciclabili	Bike paths in Turin from the city's open data portal AperTO

3.5.4 Scenario 4: Developers' Engagement

This scenario is centred on the engagement of a very particular group of citizens: the developers' community. Curious groups of citizens with social interests and IT literacy (either as interested IT users or IT developers) will be engaged through Hackathons and/or workshops to jointly develop ideas and third party applications using ALMANAC components and features. This way developers will interact with the ALMANAC platform face-to-face and would be asked to provide feedback on the components and APIs usability and platform scalability and stability that will be used to improve the projects' assets.

For this purpose, ALMANAC has as one of its goals to host one or more hackathons while implementing best practices in developed APIs and providing efficient tools to save time attracting developers. Furthermore, ALMANAC is releasing a set of component using the open source Apache License, Version 2.0 by the end of Y2 that will allow to interact with the developers' community continuously and progressively.

iOT 360 Hackathon

During the iOT360 Hackathon ALMANAC provided to the participants the necessary technical support and access to the existing software components, thus offering all the essential tools to develop one or more innovative applications for the management of waste collection, guaranteeing also the engagement of citizens in the Smart City governance processes.

Possible ideas included (but were not limited to) the conceptualization and development of:

- Mobile applications encouraging citizens to report waste issues (e.g., damaged bins);
- Systems and algorithms to optimize the waste collection process (e.g., plan routes for all waste collection trucks, suggest re-routing of trucks based on real-time data or signaled issues);
- Tools to visualize and make waste management issues more understandable;
- Applications prompting users to recycle more;
- Serious games using the data provided by the Smart City Platform or the City of Torino.

From ALMANAC's side, the components available for the Hackathon were:

- SCRAL
- Virtualization Layer
- Data Fusion Manager
- Storage Manager
- (Simulated) data sets as used by the project itself

More information on the conditions and rewards for the challenge, as well as extensive documentation of the developed technologies tutorial including a description of the available ALMANAC Tools and API and how to use them, can be found at the following link: <http://almanac-showcase.ismb.it:8000/>

Overall, the number of participants was lower than expected. However, a group of PhD students participated in the Hackathon using ALMANAC technology. The development product comprised prototyping on route optimization, semantic discovery and forecasting. All software and libraries developed during the hackathon are expected to be released open-source, according to the Hackathon Challenge rules, and are being integrated into the ALMANAC platform.

4. Application specification

4.1 Introduction

Following the IEEE 42010 methodology for architecture description, the citizen-centric application is specified according to the functional, informational and deployment view⁴. The developers' engagement scenario will not be described using this approach since an actual software application does not need to be developed

4.2 Functional view

This section gives an overview over the different components, their functionalities, interfaces (APIs) and interactions of the set of citizen-centric applications that are and will continue to be developed until the end of the project.

The Citizen-centric application promotes and enables citizen engagement. The ALMANAC Smart City Platform will receive measurements and observations from a range of sources, and the application will allow discovery and viewing of data.

In Figure 4 the three main use cases derived from the first co-design workshop are presented and then expanded into detail later in the following sections:

1. Recycling Support
2. Issue Reporting
3. Bike SHARING

These three use cases cover the overall set of features of the three citizen-centric scenarios described in section 3.5. As a general consideration, it is assumed that all the involved actors in these use cases are properly logged in and authenticated by the ALMANAC platform as described in D8.2 "Application Description – Waste Management" in section 4.2.1 regarding the Identification Package.

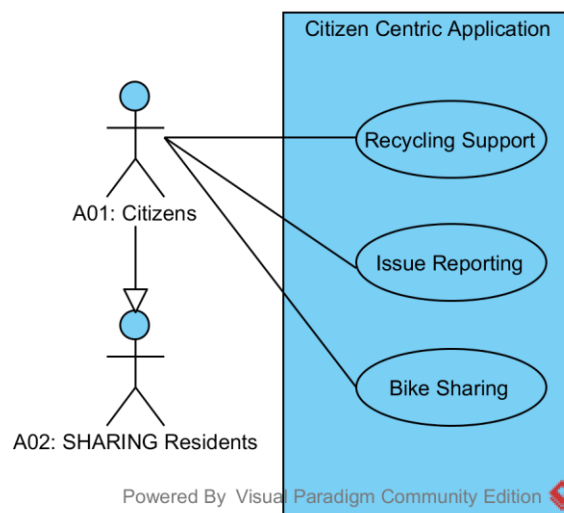


Figure 4. Citizen-centric application: Use Cases

Altogether the citizen-centric activities should implement the three above main use cases or scenarios. In the following, each use case will be extended and described into detail.

It is assumed that the following types of actors can interact with the system:

⁴ According to the methodology, a "view" represents one or more structural aspects of the architecture that illustrates how the architecture addresses one or more concerns of its stakeholders.

Table 2. Actors in the Citizen-centric application

ID	Actor Name	Description
A01	Citizen	Any citizen logged in into the ALMANAC platform interacting with the system, previously authenticated.
A02	SHARING Resident	A citizen which has been previously logged in into the platform and identified and authenticated as a SHARING resident
A03	SHARING Manager	A citizen which has been previously logged in into the platform and identified and authenticated as a SHARING staff member and has special privileges

4.2.1 Recycling Support

An overview of the recycling-related use cases is presented in Figure 5. This application offers the functionalities needed for supporting citizens in the recycling process by providing relevant information in a clear and simple way.

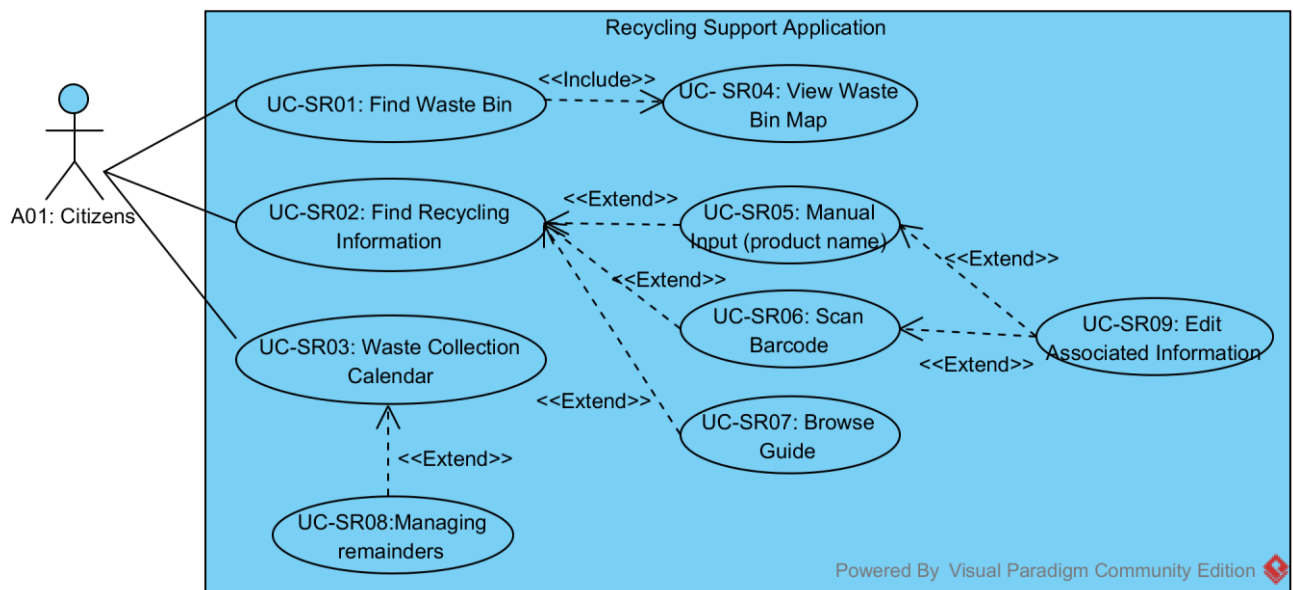


Figure 5. Recycling Support Use Case Diagram

UC-SR01: Find Waste Bin

This use case verifies when the user opens the application to find the nearest waste bin to him. The user obtains detailed information on the bins' positions based on his location and respectively categorized by type. The user is also offered the possibility to calculate the shortest path to the bin. This use case includes the UC.SR04 "View Waste Bin Map".

UC-SR02: Find Recycling Information

Use case that is triggered when the user needs to find information on how to recycle certain packaging. This use case is extended by UC-SR05, UC-SR06 and UC-SR07, which specify the different ways the user is able to interact with the application to find the needed information.

UC-SR03: Waste Collection Calendar

The user opens the application to access the collection calendar of his neighbourhood based on the day of the week. This use case is extended by UC-SR08 "Managing reminders".

UC- SR04: View Waste Bin Map

This use case is triggered when the user opens the waste bin map to search visually for the nearest bin by browsing through the map, even when location services are not enabled.

UC-SR05: Manual Input (product name)

This use case extends UC-SR02 "Find Recycling Information", and considers the situation in which the user finds the information by manually typing the name of a product/object and modifies the associated description and corresponding waste type. Once the user modifies the desired information the system is able to request feedback on the original information consulted.

UC-SR06: Scan Barcode

This use case extends UC-SR02 "Find Recycling Information", and considers the situation in which the user finds the information by scanning the bar code of a product packaging. Once the user finds the information needed the system is able to request feedback on the trustworthiness of the information consulted.

UC-SR07: Browse Guide

This use case extends UC-SR02 "Find Recycling Information", and considers the situation in which the user finds the information by browsing through the recycling guide until the needed information is found. Once the user finds the information needed the system is able to request feedback on the trustworthiness of the information consulted.

UC-SR08: Managing remainders

This use case extends UC-SR03 "Waste Collection Calendar", and is triggered when the user configures the application settings to receive (or stop receiving) daily notifications/reminders related to the waste collection calendar of his neighbourhood.

UC-SR09: Edit Associated Information

This use case extends UC-SR05 "Manual Input (product name)" and UC-SR06 "Scan Barcode" allowing the user to either edit or add new information related to a specific packaging on the recycling guide or evaluate the available information (e.g. through a star-based evaluation feedback)

4.2.2 Issue Reporting

An overview of the Issue management application use cases is presented in Figure 6. This application offers the functionalities needed for supporting citizens reporting issues that could be linked either to their city or neighbourhood through a simple user-friendly interface.

In this application, a new actor is involved called the "SHARING Manager". This actor represents the employees of the SHARING project which have an administrator role, enabling them to see and update the status of all issues reported and edited by the residents regarding the individual and general problems of this particular community.

UC-IM01: Create Issue

This use case describes the need of the user to create a new issue in the system

UC-IM02: Find Issue

This use case is general and is triggered when a user needs to find an existing issue, avoiding generation of repeated issues and providing follow-up information when available.

UC-IM03: Update Issue

The user needs to use the application to update or add new information related to a personal or public issue that has been already created in the system. This use case extends the UC-IM01 "Find Issue".

UC-IM04: Close Issue

In this use case, the SHARING management needs to use the application to close an existing issue, while providing information concerning whether the issue has been solved or cannot be remedied. This use case extends the UC-IM01 "Find Issue".

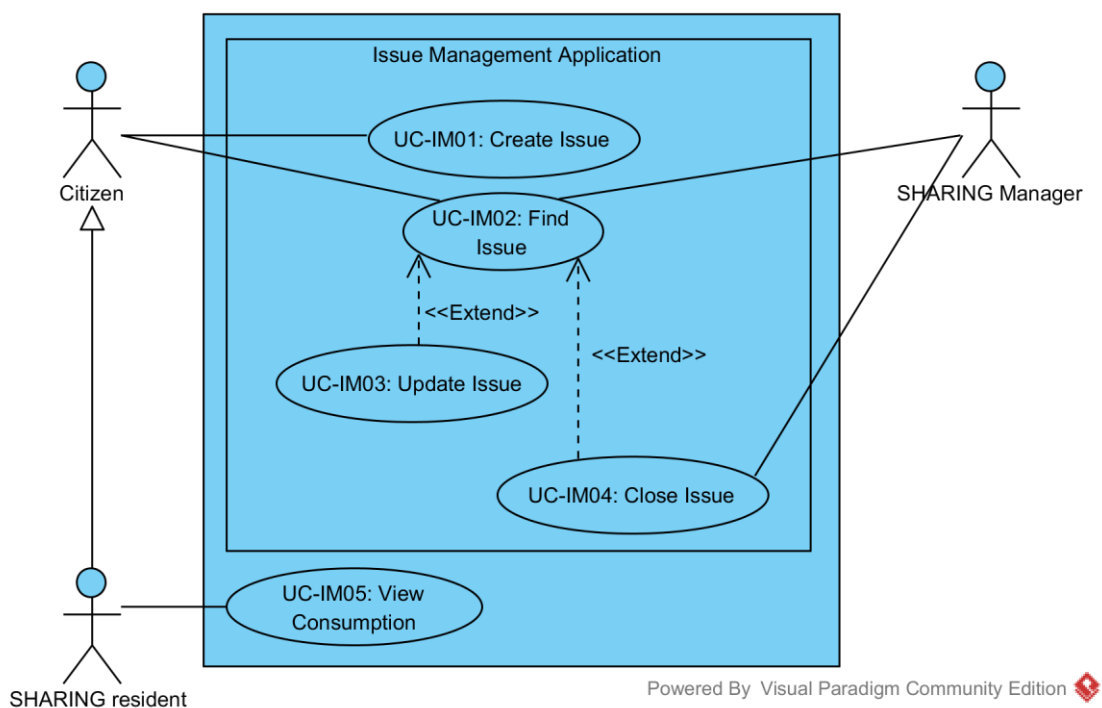


Figure 6. Issue Management application Use Case Diagram

UC-IM05: View Consumption

This use case is outside the boundaries of the issue management application, and is triggered when a SHARING resident wants to access his consumption data (i.e. electricity, water, gas) in order to check for possible issues or malfunctioning, or simply to monitor/regulate his monthly expenses.

4.2.3 Bike SHARING

An overview of the Bike Sharing application use cases is presented in Figure 7. This application provides the integration of different bike sharing services and other relevant open data from the city of Turin aiming to improve the efficiency of these types of services through the use of a unified application.

As shown in Figure 7, the use cases UC-BS01 to UC-BS05 are general for all Turin Citizens, while the use cases UC-BS06 to UC-BS09 are specific to SHARING residents.

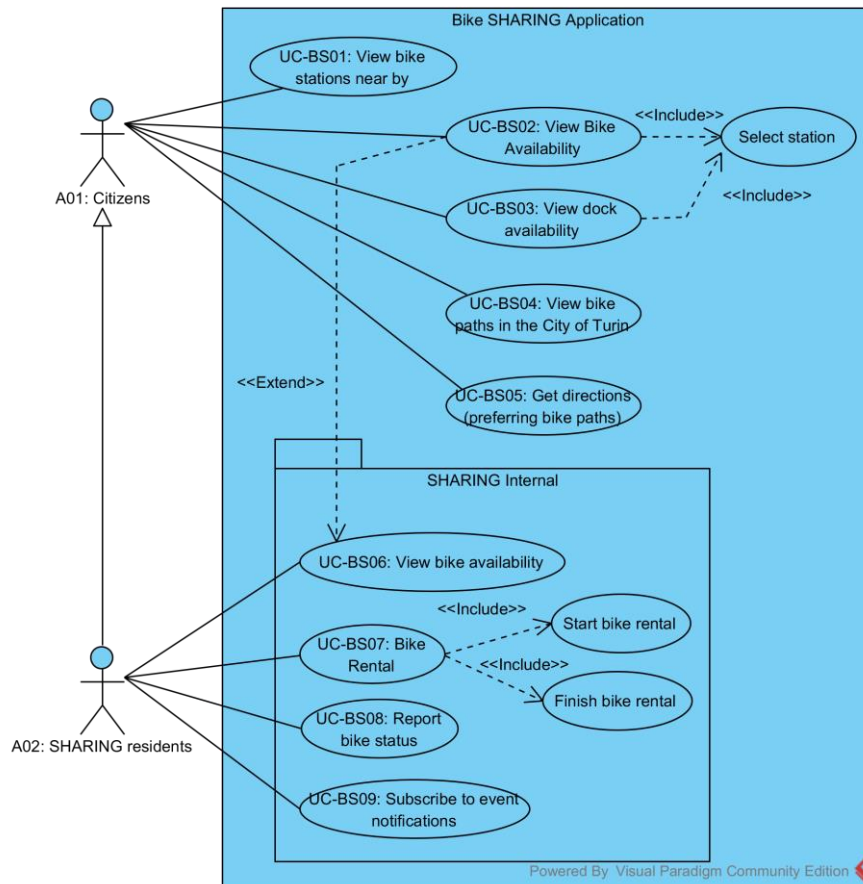


Figure 7. Bike SHARING Application Use Case Diagram

UC-BS01: View bike stations near by

The user opens the application to find the bike sharing stations near by, based on his location. It is possible to configure the settings applications to adjust the radius of the considered area. Furthermore, when location services are not available the user is able to browse using the bike sharing map in order to find stations of interest.

UC-BS02: View Bike Availability

Using the application, and when available the location services, the user is able to check the number of bikes available in a particular area or station.

UC-BS03: View dock availability

Using the application, and when available the location services, the user is able to check the number of free docking spaces available in a particular area or station.

UC-BS04: View bike paths in the City of Turin

This use case reflects the user need to view the bike paths in the city of Turin. Using the application the user is able to browse a city map with the bike paths represented in it.

UC-BS05: Get directions (preferring bike paths)

The user is able to get directions to go from one location to another preferring routes that include bike paths, whenever these are available in the city.

UC-BS06: View bike availability (SHARING)

This use case extends UC-BS02 "View Bike Availability" to the particular case of the SHARING residents in which the availability is updated by the residents themselves.

UC-BS07: Bike Rental (SHARING)

This use case extends UC-BS03 “View dock availability” to the particular case of the SHARING residents in which the available bikes for renting and the free docking spaces are updated by the residents themselves.

UC-BS08: Report bike status (SHARING)

This use case is triggered when a particular type of users (SHARING residents) need to report a generic problem with one of the bikes from the internal bike sharing service.

UC-BS09: Subscribe to event notifications (SHARING)

Users (SHARING residents) can subscribe to event notifications informing them whether when an issue related to the bike sharing service has been solved or other relevant events, such as when a bike or a free docking space becomes available in a particular station.

4.3 Information view

This chapter shows the concepts of the Citizen-centric Application. It shows the types of information needed by the application, and how they are stored.

For each scenario, a class diagram product of object-oriented analysis, showing conceptual classes, their associations and relevant attributes has been created.

As mentioned before in section 4.2 it is assumed that all the involved actors in these use cases are properly logged in and authenticated by the ALMANAC platform prior to any of the use cases described in the following, as depicted in D8.2 “Application Description – Waste Management” in section 4.2.1 regarding the Identification Package.

4.3.1 Recycling Support

The information view associated to the Recycling support scenario is shown in Figure 8. In the following table a name and description for each class considered in Figure 8 is provided.

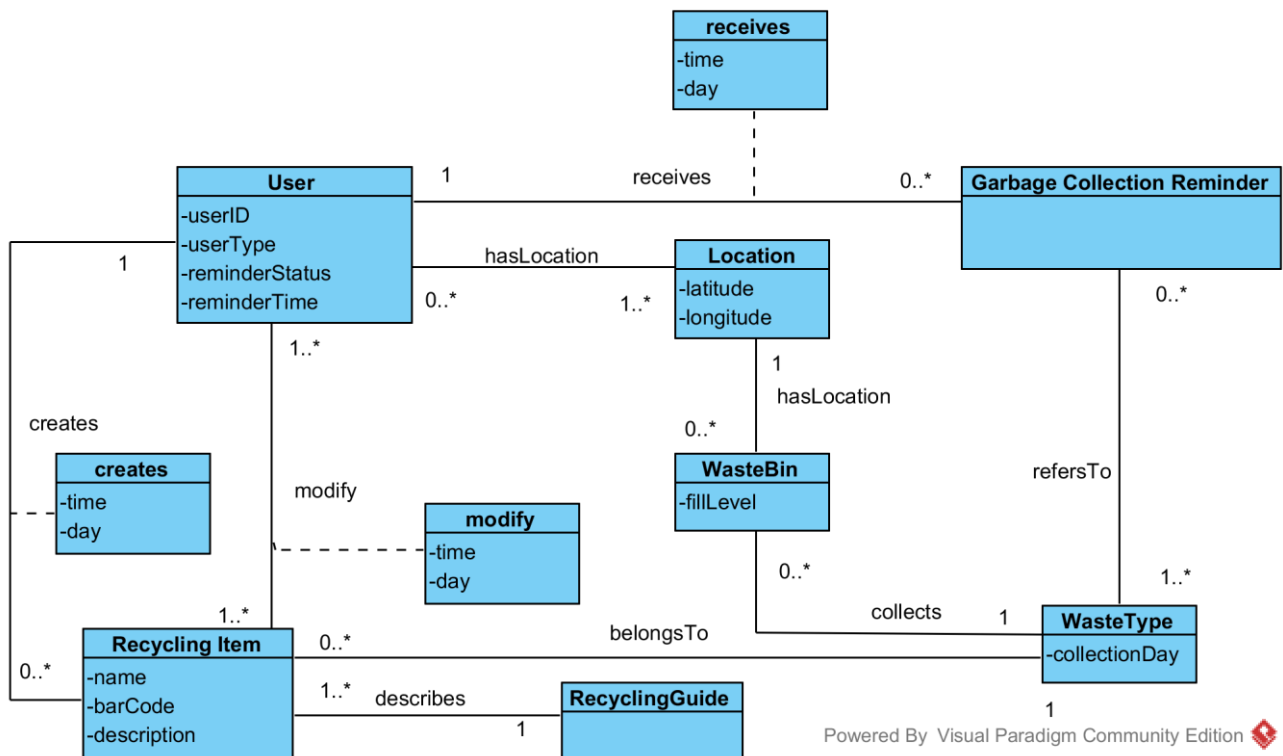


Figure 8. Information view – Recycling Support Scenario

Class Name	Description
<i>creates</i>	Action taken by a user to create a new Recycling Item belonging to the Recycling Guide. Every <i>create</i> action is associated to a time and a day.
<i>Garbage Collection Reminder</i>	A notification message indicating the type of waste (based on the week day) that is sent to a user, whenever the user <i>reminderStatus</i> attribute is set to be subscribed to collection reminders. Garbage Collection Reminders are associated to a specific Waste Type according to the week day in which the reminder is sent.
<i>Location</i>	A set of coordinates indicating a certain location that can associated to either a user or a Waste Bin. Waste Bin locations are provided by the ALMANAC platform.
<i>modify</i>	Action taken by a user to modify the information associated to a certain Recycling Item belonging to the <i>Recycling Guide</i> . Every <i>modify</i> action is associated to a time and a day.
<i>receives</i>	Action associated to the reception of a <i>Garbage Collection Reminder</i> , in concordance with the user attributes.
<i>Recycling Guide</i>	Containing a list of different Recycling Items which have an associated waste type and that can be created and modified by the users.
<i>Recycling Item</i>	A recycling item is define by a name, a barcode and an associated description of the item. Recycling Items can be created/modified by users.
<i>User</i>	Any user which is allowed to interact with the system. A user has associated locations (depending on time and day) and can subscribe to receive notifications form the platform regarding the Garbage Collection schedule. Users can create or modify existing Recycling Items from the Recycling Guide.
<i>Waste Bin</i>	A waste bin with its corresponding fill-level is used to collect a particular waste type and has an associated location. Fill-levels associated to waste bins in the city are fetched from the ALMANAC platform.
<i>Waste Type</i>	List of all waste types, and their association with the day of the week in which a certain waste type is collected.

4.3.2 Issue Reporting

The information view associated to the issue reporting scenario is shown in Figure 9. In the following table a name and description for each class considered in Figure 9 is provided.

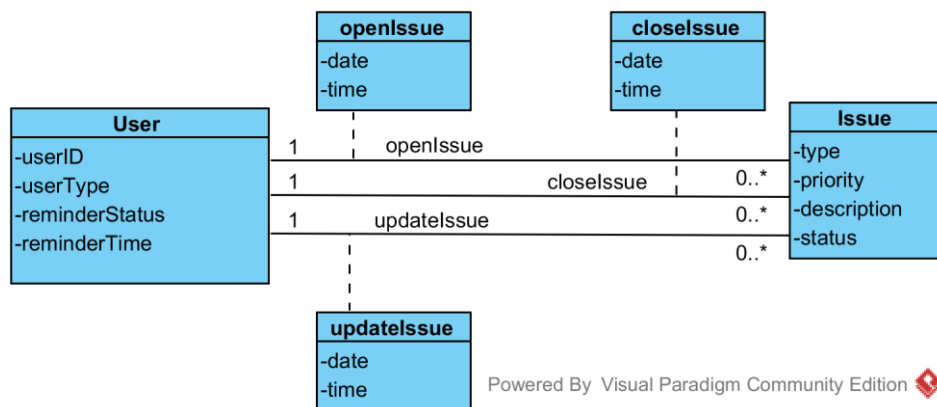


Figure 9. Information view – Issue Reporting Scenario

Class Name	Description
<i>closeIssue</i>	Action taken by a specific user to close an existing issue. Every <i>closeIssue</i> action is associated to a date and a time. <i>closeIssue</i> is an action that requires the user to have a specific <i>userType</i> , which in this case corresponds to a SHARING staff member.
<i>Issue</i>	The representation of a problem which a User reported to the system. Issues have an associated type, different levels of priority depending on their importance, a description and a status indicating their stage in the issue lifecycle ⁵ .
<i>openIssue</i>	Action taken by a specific user to create a new issue. Every <i>openIssue</i> action is associated to a date and time and a user.
<i>updateIssue</i>	Action taken by a specific user to update an existing issue. Every <i>updateIssue</i> action is associated to a date and time and a user.
<i>User</i>	Any user which is allowed to interact with the system. A user can create, update or close existing issues depending on the <i>userType</i> .

4.3.3 Bike SHARING

The information view associated to the bike SHARING scenario is shown in Figure 10. In the following table a name and description for each class considered in Figure 10 is provided.

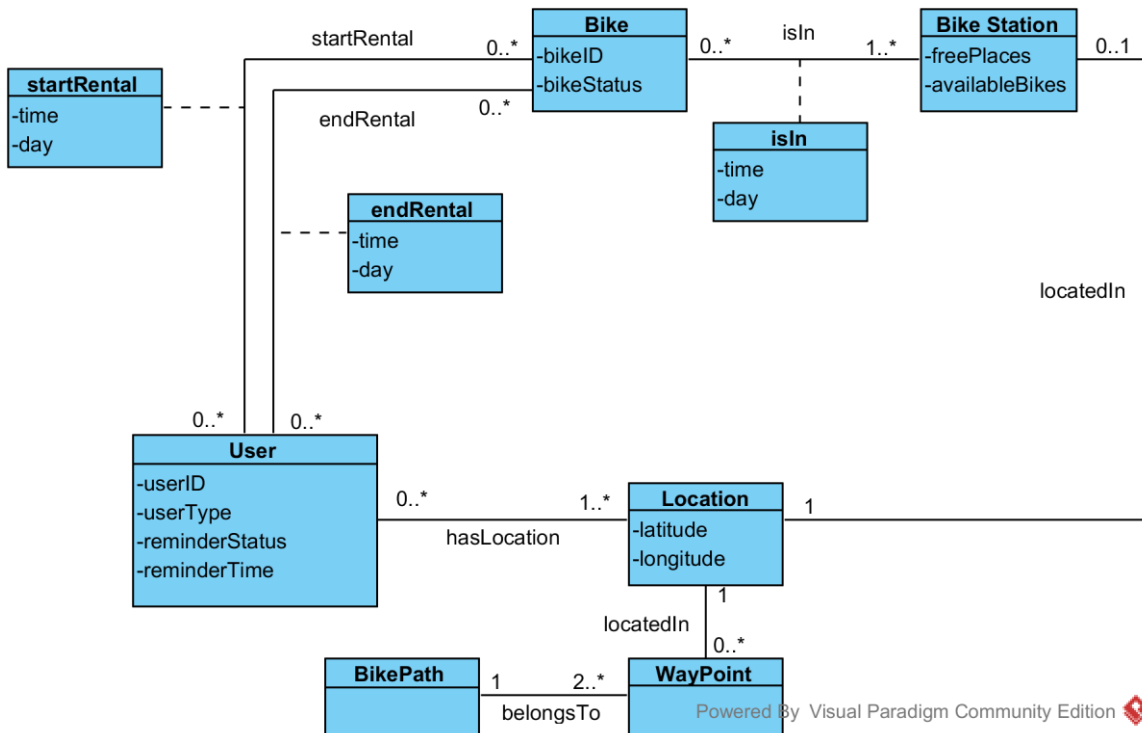


Figure 10. Information view – Bike SHARING Scenario

Class Name	Description
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⁵ For implementation purposes this document will consider the issue lifecycle defined in section 4.4 of the “D8.4 Application Definition - Waste Management”.

<i>Bike</i>	A bicycle belonging to a specific Bike Sharing service providing open APIs (European level) for its integration, or from the internal bike sharing service of the SHARING community in the city of Turin.
<i>Bike Path</i>	Cycling route infrastructure available in the city of Turin (or any other city providing this information as open data). A bike path is formed by a collection of waypoints.
<i>Bike Station</i>	Structure designed for use as a bicycle parking facility belonging to a Bike Sharing service offering open APIs (European level)
<i>endRental</i>	Action taken by a specific type of user (i.e. SHARING resident) through which the end of a bike rental is signalled in the system.
<i>isIn</i>	Relationship existing between a bike and the bike station it is located at a certain date and time.
<i>Location</i>	Set of coordinates (latitude, longitude) indicating a location. Users, bike stations have associated locations. When considering waypoints, the same location (lat, lon) can be considered to correspond to one or more waypoints in different bike paths.
<i>startRental</i>	Action taken by a specific type of user (i.e. SHARING resident) through which the beginning of a bike rental is signalled in the system.
<i>User</i>	Any user which is allowed to interact with the system. A user can create, update or close existing issues depending on the userType.
<i>WayPoint</i>	A waypoint is sets of coordinates that identify a point in physical space and belongs to a unique bike path. Different waypoints can correspond to the same location.

4.4 Deployment view

This view describes how and where the system will be deployed and what dependencies exist, considering hardware requirements and physical constraints.

The following table summarizes the deployment of software (services) required to implement the overall citizen-centric application:

Hardware	
Mobile Device	The mobile devices allows to access the set of citizen-centric application defined to engage citizens in more sustainable behaviours, and enables the user to receive notification on events the user is subscribed to.
Software	
Recycling support Application	Mobile application providing support to the citizens throughout the recycling process.
Issue Reporting Application	Mobile application enabling the citizens to signal different issue types while promoting more sustainable consumption behaviours.
Bike SHARING application	Mobile application enabling the citizens to have access to a more efficient European integrated bike sharing service (including also private bike sharing services from the SHARING community in the city of Turin)
ALMANAC Platform	The ALMANAC platform handles the integration of sensors, issuing and filtering of events, and forwarding of messages. In the case of the citizen-centric application, the ALMANAC platform is

	responsible for the proper authentication of the users (enabling federation services), and is also in charge of providing access to Open data resources (e.g. bike sharing services) and relevant data placed in context (e.g. recycling support), with the aim of promoting more sustainable and collaborative behaviours in the citizens of a Smart City.
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5. Conclusions

In this deliverable we have presented the specification of the citizen-centric application, to be implemented in two iterations during the development of the ALMANAC project. The results presented in this document are target of refinement based on the lessons learnt over the first year of the activities (M7-M24)

We introduced four main scenarios to be addressed by the set of citizen-centric applications that will be developed within T8.4 activities, and defined in detail the use cases to be handled by them:

- Recycling support
- Issue Management
- Bike sharing
- Developers' engagement

To support the realization of these scenarios main use cases were introduced, and later analysed by breaking them down into a larger set of simpler use cases and involved actors. A detailed explanation was provided for each one of them and finally, an information view was provided.

After the completion of ID8.7.1 – Citizen-centric Application Prototype due on M24 (August 2015) Appendix of this document will be updated with an extract of the most important information reported in the same.

6. References

- [1] Stephen L. Vargo, Paul P. Maglio, Melissa Archpru Akaka, On value and value co-creation: A service systems and service logic perspective, *European Management Journal*, Volume 26, Issue 3, June 2008, Pages 145-152, ISSN 0263-2373, <http://dx.doi.org/10.1016/j.emj.2008.04.003>
- [2] C.K. Prahalad, Venkat Ramaswamy, Co-creation experiences: The next practice in value creation, *Journal of Interactive Marketing*, Volume 18, Issue 3, 2004, Pages 5-14, ISSN 1094-9968, <http://dx.doi.org/10.1002/dir.20015>

Appendix I: Co-design workshop

During the first co-design workshop the following needs were collected and further developed together with the SHARING residents involved in the activities.

A list of the identified needs and a very high-level requirements related to them is reported in the following.

- **Bike sharing service (internal)**
 - o Habitants would like to have near real-time information related to the availability and status of the bikes
 - o Currently, there are 10 dedicated bikes for this service, although only 5 of them are working properly
 - o Users of the service would also like to have the possibility to report malfunctioning or problems with the bikes in an automated way
- **Events and common spaces**
 - o Habitants would like to have information related to the availability of the building's common spaces (restaurant, bar, living rooms, etc)
 - o Availability of information related to events organized by the SHARING community (and in the neighborhood) would also be appreciated
 - o Weekly/daily notifications on internal and city-wide events
- **Wi-Fi (internal)**
 - o Data limit for each person (to have an overall better quality of the service)
 - o Real-time information on the availability and quality of the service (the Wi-Fi service does not work very well within the building installations)
- **Periodic and extraordinary maintenance**
 - o Availability of information related to the maintenance interventions, more specifically habitants would like to get notifications when the administrator/plumber is entering their rooms/apartments, and when the issue has been solved
 - o Habitants would also like to have the possibility to indicate, in an automated way, when there are issues or malfunctioning problems in their homes
- **Nightlife**
 - o Information on the "near-me" buses and shops opened during the night
- **Individual Consumptions**
 - o Habitants would like to have access to their consumption data (electricity, water and gas) more frequently, and not on a monthly-basis; possibility to have consumption data represented as graphs
 - o Possibility to set a threshold for individual consumptions and get alerts when it is exceeded
- **Sharing Economy**
 - o The community would like to have a tool that enables the exchange of products and services, e.g. they need a clothes horse ("stendino") which is not provided by default by the structure, nonetheless the facilities have some of these frames that lend to the guests. A similar situation occurs when the guests leave the structure (or the city) and they leave behind some of their things (rice cookers, books, etc.) or they simply want to exchange them temporarily

- **Controlled Access during the night**
 - o Currently, the access to the building is controlled manually during night hours. Guests have to ring the bell and wait for the staff to open the door. They would like to have an application that allows them to open the door using their smartphones or in some other automated way
- **Automated payments and renewal of access-credentials**
 - o Habitants would like to have the possibility to make monthly payments of the utilities and the rooms and have their access credentials (RFID cards) renewed automatically
- **Waste Collection**
 - o The community would like to have a waste collection calendar indicating the type of waste that will be collected depending on the day of the week
 - o Habitants would also appreciate information on the actual presence of the waste bins inside the building (the staff takes out the corresponding waste bin the night before the collection)
 - o Waste collection support information is something the community would also like to have. Sometimes foreign citizens do not have the information or the tools to recycle the waste, they need information on the available recycling points and how to perform the recycling of different types of material
 - o At a city level, the community would like to have information regarding the closest (empty) bin "near-me" when the corresponding bins are full

Note: during the discussion, habitants expressed their interest in receiving some information through proper asynchronous notifications. At the same time, it was clearly stated that too many notifications could be counterproductive: the possibility to use filters on the received notifications would be highly appreciated.

Appendix II: Recycling Support Application Prototype

As part of the development activities of T8.4 Citizen-centric application, a first prototype of the citizen-centric application referring to the recycling support scenarios is being developed. In this Appendix a first preview of the application developed is provided through a collection of screen shots from the developed mobile application.

