

# Resilience Information Portal

## Nicolas Serrano

Tecnun, University of Navarra  
nserrano@tecnun.es

## Josune Hernantes

Tecnun, University of Navarra  
jhernantes@tecnun.es

## Tim A. Majchrzak

CIEM, University of Agder  
timam@uia.no

## Mihoko Sakurai

CIEM, University of Agder  
mihoko.sakurai@uia.no

### ABSTRACT

The Smart Mature Resilience Project is a European research Project aimed at developing a Resilience Management Guideline. The guideline is composed of five tools developed in the project. They help to determine the level of resilience of a city and how to improve it.

The Resilience Information Portal, one of these five tools, must support and integrate the different tools. It is also used as an engagement and communication tool.

The tool had to be built before the finalization of the requirements, so a double approach was pursued in this project. First, a fast prototype was built based on a CMS, and second, a solution was built from scratch. The paper explains this process, compare both approaches, and how the long way can be more efficient. The final version has shown to be easy to use, and powerful enough to respond to the requirements of the users of the portal.

### Keywords

Resilience, portal, information system, CMS, software development.

### INTRODUCTION, THE SMART MATURE RESILIENCE PROJECT

The Resilience Information Portal presented in this paper is part of the Smart Mature Resilience Project (SMR). The SMR is a European research project funded by Horizon 2020, the largest research and innovation program in Europe, available from 2014 to 2020. The project is one of the 5 projects funded under Crisis management topic 7: “Crises and disaster resilience - operationalizing resilience concepts”. The projects in this topic should provide “the development of European Resilience Management Guideline and demonstration through pilot implementation.”

The SMR project addresses the objective of developing a Resilience Management Guideline with three pilot projects in the sectors of Critical Infrastructure security, climate change and social dynamics. The guideline will be supported by a set of five tools that will be developed in the project by the different partners. The guideline will increase the resilience of the cities. The concept of city resilience emphasizes the capacity of the city stakeholders to adapt not only to the shocks such as earthquakes, fires, and floods (Bruneau et al., 2003; O’Rourke, 2007; Fisher and Norman, 2010; Bakkensen et al., 2016) but also to the stresses that affect a city on a day-to-day basis such as climate change. By addressing both the shocks and the stresses, a city becomes able to respond to adverse events, and is overall better equipped to deliver basic functions in both good times and bad, to all populations (Spaans and Waterhoutd, 2016).

The project focuses on cities because nowadays, the majority of the world’s population live in cities and, according to projections, this number will increase over the coming decades (100 Resilient Cities, 2016). Accelerated globalization has dramatically increased the complexity and unpredictability of threats and hazards that affect cities (Bach et al 2010). As cities continue to grow, they face an increasing variety of challenges ranging from short-term shocks such as floods, droughts, and earthquakes, to long-term stresses such as climate change (Prior and Roth, 2013).

## Partners

The partners of the project are 7 cities, 4 Universities and 2 other organizations. The importance of the cities in this project is represented in the number of cities in the consortium. The cities are 1) Kristiansand (Norway), 2) Donostia/San Sebastian (Spain), 3) Glasgow (Scotland), 4) Vejle (Denmark), 5) Bristol (England), 6) Roma (Italy) and 7) Riga (Latvia).

Some of the cities belonged already to other resilient networks, so they have experience with the goal of the project and others are the city of one of the universities of the project that helps to implement the different tools.

The universities are: 1) TECNUN the School of Engineering of San Sebastian, of the University of Navarra, and leader of the project, 2) The Centre for Integrated Emergency Management (CIEM) of the University of Adger, 3) the University of Strathclyde in Scotland and 4) Linköping University in Sweden.

The two other organizations are 1) ICLEI with a wide experience supporting local and regional governments in sustainable development, and 2) DIN, the German institute for Standardization, because one of the goals of the project is establish the Guideline as a standard.

## Five Tools

The five tools (figure 1) that will form the Resilience Management Guideline are the following:

1) The Resilience Maturity Model is the foundation for the guideline. It defines the current resilience stage of a city and the path to go to the next level. These levels are: Starting, Moderate, Advanced, Robust, vertebrate. Its initials are the word SMART. Each stage has five dimensions: robustness, infrastructures and resources, cooperation, learning, preparation, and leadership and governance. The model defines policies for each stage and dimension. The description of the levels are:

**Starting:** the crisis management is based on risk assessment without having an integrated approach towards multi-hazard approach.

**Moderate:** The risk assessment with regard to hazards affecting Critical Infrastructures is operationalized in cooperation with Critical Infrastructure providers in order to deliver essential services in case of crisis.

**Advanced:** The city has developed an operational resilience action plan with holistic approach that integrates all sectors and relevant stakeholders.

**Robust:** All relevant stakeholders to be involved in the resilience action plan have been identified and engaged the majority of them.

**Vertebrate:** The city excels regarding its resilience as part of the regional, national and global system resilience, understanding that in order to become resilient the environment needs to be resilient as well. The city acts as a vertebra in the European resilience backbone.

2) The System Risk Assessment Questionnaire that helps identify the risk of a city and to determine the maturity level of the city.

3) The portfolio of Resilience Building Policies that defines the path to the next maturity level.

4) The System Dynamics Model, build based on the Resilience Maturity Model, that allows the government of the city to play with different policies and observe the result of the decisions in the different variables that defines the resilience of their city.

5) The Resilience Information Portal that is described in this paper.

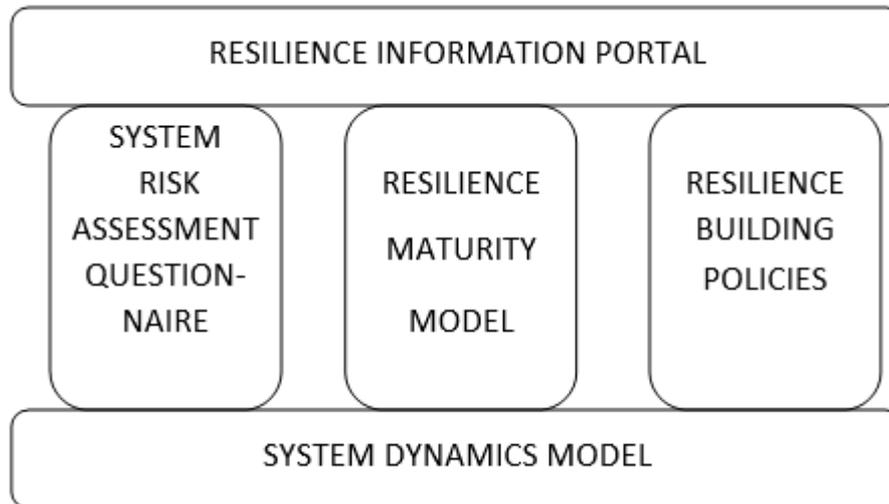


Figure 1. The 5 tools of the Resilience Management Guideline

### THE RESILIENCE INFORMATION PORTAL TOOL

The Resilience Information Portal aims to facilitate different levels of communication and engagement in resilience building activities. It describes the information system that is actually developed as a prototype for the project and that cities will implement. The Resilience Information Portal deals with a technological aspect of a communication tool for cities and stakeholders while cities also need to develop relevant processes and the required ecosystem as a non-technological perspective. The Resilience Information Portal is used in the project to align it terminologically with the other tools that are currently developed. The portal is supposed to be used to respond both short-term and long-term shocks and stresses that cities are facing. For instance, cities have to manage a disaster situation as a short-term shock. Responding actual incident requires a city's resilience in order to avoid harm and to mitigate negative consequences while a medium- to long-term development does not require immediate action. Likewise a refugee crisis, cities need to set up an efficient communication environment with citizens and stakeholders. As an example, cities could use the portal to keep the public updated with news on arriving refugees respectively the virus spread and how refugees are distributed to shelters. In this case the portal also serves as providing a backchannel where citizens can comment on the situation of the event as well as on consequences for themselves. The portal has several sets of functional requirements. For instance, the portal should employ social media integration, search functionality and data management and so on.

The portal is proposed as a toolbox with rather coarse, yet very versatile functionality that allows cities to try out ideas, share best practices, use the portal as a showcase, and to adapt successful practices to their own portals. After the project, the portal will be used as the Resilience Information Portal of each city.

### STANDARD TOOL OR CUSTOM TOOL

The Resilience Information Portal has two delivery dates in the project. The first one six months after the start and the second one 18 months after the start, in the middle of the three-year project.

#### First version

The first version of the portal had to be working six months after the start of the project. This time included the development of the first version of the requirements. Therefore, the time available to produce a version that the users could test weeks before the deadline was reduced. Due to this limitation, this first version was designed with a CMS (Content Management System). The CMS chosen was Typo3 because it is the same CMS used to develop the project web site (<http://smr-project.eu>). So, the tool was developed with the same CMS that hosts the web site. This makes it possible to maintain the same style and produce templates for the Resilience Information Portal more easily.

This version is available at <http://portal.smr-project.eu>. There are different templates for use by the cities and

partners in the project, or by other users who want to improve their resilience stage. The goal of this first version was to test the functionality of the tool by the cities.”

Figures 2 and 3 shows images of this first version. The home page (figure 2) shows the main news of the project, and a navigation menu to access the different sections of the portal. The City of Donostia page (figure 3) presents an example of information that the city can share with the tool, including subpages for citizens and stakeholders.



Figure 2. Home of the first version of the portal



Figure 3. City page with the first version of the portal

## Requirements

Together with the first version of the portal, the deliverable 4.1 of the project was delivered. This is the document that explains the process and results of defining the principles and requirements of the tool. The title of this document is “A communication platform that facilitates different levels of communication and engagement as a shared resource in the project,” available online at the project web site ([http://smr-project.eu/fileadmin/user\\_upload/Documents/Resources/WP\\_4/D4.1\\_Communication\\_platform.pdf](http://smr-project.eu/fileadmin/user_upload/Documents/Resources/WP_4/D4.1_Communication_platform.pdf)) (Grimes et al., 2017).

The result of this document is an initial set of requirements. It includes a definition of the product:

"The aim is to build a Resilience Information Portal. It will serve as a collaborative environment to facilitate awareness and engagement among key partners in resilience building activities. The portal aims to offer knowledge sharing and facilitate collective learning."

And some “Must” and “May” criteria. We include them here to understand the scope of the tool:

#### Must Criteria

- The portal must be a publicly available Web application.
- The portal must provide functionality to embed static content as well as dynamic content. In particular, it must be possible to have Newsfeeds, Weblogs, Wiki pages, and Forums.
- Users must be able to register themselves for portal usage and log in.
- Logged in users must be able to customize pages that are set to be customizable. In particular, the home page should be customizable.
- An adaptive role management must be realized.
- Logged in users with respective rights must be able to edit pages. This includes the upload of documents.
- Administrators or users with rights for sub-areas of the portal must be able to generate new pages as well as to remove pages from the portal.
- Page editing must be supported by WYSIWYG tools (i.e. easy editing tools that do not require programming or design knowledge).
- Accessibility standards as outlined by W3C must be followed.
- A search functionality must be provided that allows to sort information.

#### May Criteria

- The portal may support multiple languages.
- Mobile device support ought to be pursued.
- Accompanying Wiki pages, Frequently Asked Questions (FAQ) pages could be provided
- Tools for interactively measuring the resilience maturity level of a city could be provided.

With these requirements, we had to choose the way to develop the final version.

### Second version

For the final version, we selected a different approach due to the fact that the final requirements are going to be more demanding and although the CMS used allows a rapid prototype, it is probably going to be difficult to adapt to fulfill all the principles and requirements specified for the portal. This is the reason to start the development of the final version from scratch, taking into account the experience, design and content developed in the first version.

The pros and cons were weighed when making the decision of whether to continue with the CMS used in the first version or develop it from scratch. An “off-the-shelf” tool like the CMS used has the advantage of many features already tested and ready to be used, but it also means that the software must be used as it was designed, allowing only customizations supported by the designers of the CMS. In the case of Typo3, it can be argued that since it is an Open Source CMS, all the source code is available for customization, but due to the size of the work package and the size of the Typo3 project, this was not a feasible solution.

Examining the principles and requirements of the portal, we analyzed that the amount of core functions that were going to be used from the standard tool was quite low compared to the specific requirements of the

Resilience Information Portal. Although starting from scratch implied some initial development of standard features, in a few weeks the prototype provided the same functionalities as the previous one, and the inclusion of new functionalities was easier due to the total control over the existing code.

Also, we must clarify that the expression “from scratch” must be considered in the scope of the project developed. The portal is a web application and most web applications are developed with technologies that provide solutions for most of the challenges affecting applications of this type. The next section explains the technologies selected for the development of the portal.

## Technologies

The first requirement of the portal is to be a web application: “The portal must be a publicly available Web application.” Requirement A01 of deliverable 4.2 (<http://smr-project.eu/papers/#c3650>).

It may seem obvious, since most of the current applications developed nowadays are web applications, but in this case, it is a written requirement. And this requirement defines the architecture of the application: a web application has a server side and a client side. On the client side, the HTML, CSS and JavaScript render the user interface for the final user showing the information requested and allowing that the user enter or update the information with the provided user interface. On the server side, the application programs manage this information, which is stored in a database on the server. In this case, it is necessary to decide which platform to use.

The deliverable 4.2 specifies that: “It should be a fully cloud-based information system.” A web application can be hosted on the cloud in three different ways: SaaS, PaaS and IaaS (Serrano et al., 2015). Typo3 is a SaaS (Software as a Service), which is the easiest to implement but not so easy to customize as we have discussed in the previous section. The choice is whether to use a PaaS (Platform as a Service) or an IaaS (Infrastructure as a Service). In this case a PaaS was chosen because there is no need for a SQL Database and it allows the automatic scaling of the platform without any specific management. The platform and language chosen was App Engine with Java due to experience in previous projects and because they are widely used.

### App Engine

Using a PaaS (Platform as a Service) is the most convenient way to develop a custom web application to prevent the overload of managing servers, load balancing, clusters, security packages and all the administrative tasks involved in maintaining a farm of servers. One of the most popular PaaS is Google App Engine, which we have selected for this prototype. App Engine allows to use different programming languages; for this project we selected Java, a well-known language for developing enterprise applications.

### Servlets

The basic element for developing web applications with Java is the servlet. The servlet is an application, written in Java, that runs on the server based on requests from the client side, processes the request, reading and storing, if needed, any incoming input, and produces a response that is send to the client to be rendered in the browser of the final user. Our portal will consist of a set of servlets that can produce all of the elements the end user needs to manage the portal and produce the final web pages, which is the ultimate goal of the Resilience Information Portal.

### Entities

While the above definition of the behavior of the application is complete, it is quite concise and therefore it is easy to confuse the elements for managing the portal with the final web pages themselves. The reason is that in a web application all the elements are web pages; see the pages shown in figure 4 for an example. But web pages are also the final goal of the Resilience Information Portal: the web pages that the city stakeholders are going to use to share information and engage the public use of the portal. To create these web pages, the users are going to use other web pages, the web pages in the application, to create their final web pages and the other elements needed to manage the portal, i.e.: users, organizations, data sets and the information and security of the web pages. These elements are known as “entities,” the name used in this paper.

For example, the entity “user.” To manage a user in the application, we must know the person’s username, password, email and name of organization. The final user edits this information with the application, as shown in figure 4.

**Figure 4. Page to edit a user**

To manage a user, fields (username, password, email, organization) are stored on the server and can be managed by the administrator of the application with a servlet that can perform different operations; for example: a) show the user information of the different users in a list, b) show the information of user allowing the field values to be modified and sending this information to the server, c) read the information modified by the administrator and store it on the server, etc. These operations can be performed by one or several servlets. In the portal architecture we have decided that one servlet will perform all the operations related to a specified entity. In this case, the “Users\_Action” servlet performs all user-related operations.

Now that the concept of entity is clear with the example of a “user,” we will see how the entity “UserPage” (pages generated by the user) is managed with the application. The same way we create or modify a user, we can create or modify “UserPages”. In this case, the servlet that is going to perform these operations is the “UserPage\_Action” servlet. You can follow their activities in the browser URL when you create or edit user pages.

When you create or edit a user page, one of the fields on the user page is the content of the web page. In the application, it is edited with an online web editor. See Figure 5.

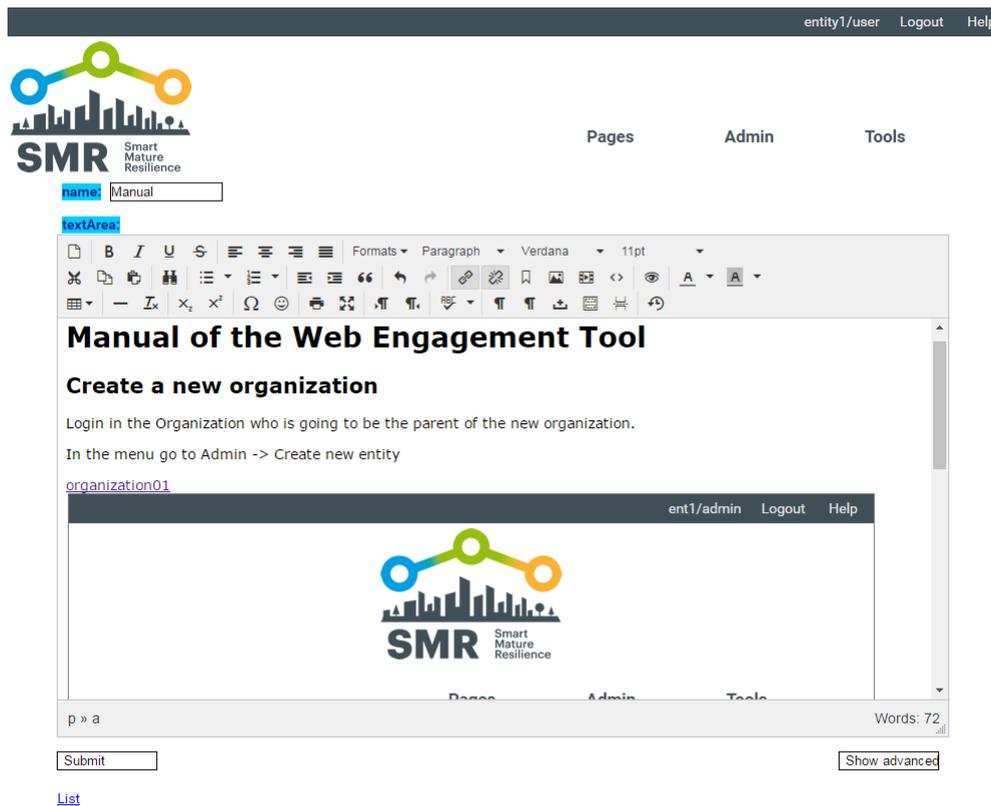


Figure 5. Page to edit a User Page

Although the field for editing the content of the web page is more complex than the field for editing the name, internally they are stored very similarly on the server.

In this case of the “UserPages” we have an additional servlet that renders the final page. For example, to render the manual of the application we use the servlet `UserPage` with the url:

<http://smr-project-test.appspot.com/UserPage?PageKey=5193646789885952> This servlet reads the information on the web page and produces the output of the final page for other users of the application.

### Data structures

One of the requirements that led to deciding to build from scratch was “The portal must provide the functionality to provide existing dynamic content”. (Requirement A05).

As explained in the previous section, the application needs to manage information of different entities (users, organizations, pages, etc.). But this requirement states that it must provide dynamic content. Traditionally, the information provided by an application is organized in tables or objects in a database, like the entities of the portal. These tables are defined with the design of the application and each one has its own application (servlets in our case) to manage them. However, this requirement talks about dynamic content, that is, content that was not predicted in design time. This adds great flexibility to the use of the portal because it can include elements that were not predicted when the tool was being built. But it also involves a challenge to provide this functionality.

To address this question, the portal uses the concept of data structure. A data structure is a type of content, organized similarly to the information in a table. It can have different records and each record has a set of fields. The portal must be able to define and use these data structures.

#### The Data Structure entity

To define a data structure, the portal uses the concept of Data Structure entity. A Data Structure is defined by a name and a set of fields. We are going to see it with one of the required criterion for data structures: a contact list (A04). The name of this data structure is “contacts” and the fields or items of a record are: name, phone, email, address, skype. The portal uses two servlets to manage these elements: `RegisterType_Action` and

RegisterTypeItem\_Action. With these servlets the final user is able to define new Data Structures and their items. An item is composed of a name, the order of this item in the set of items and the type item (string, number, date, etc.). The user can also modify an existing Data Structure, changing its name, or the different items of the Data Structure.

When the Data Structure is defined, the user or other users with the defined permission can insert and see the content of the Data Structure.

### Using a Data Structure

The users can define different data structures with very different purposes; one, for example, to be used as an address directory and another to register levels of floods. However, all of them are managed by the portal in the same way: each entry is a record of the defined data structure that is stored on the server.

The user can therefore interact with a defined data structure to see the content, add a new record, or modify an existing record. The application could provide different forms for these operations, but instead, a more flexible approach was chosen to allow the integration of external data as described in requirement A05. For this purpose, the application uses a JSON format to provide the data. Very briefly, JSON (JavaScript Object Notation) is a lightweight human-readable data-interchange format. That means that it is very easy to use on the server and especially on the client, where JavaScript is the language to manage web pages.

The client in the browser can read the JSON data and format it however the application requires. The example in Figure 6 shows a standard table.

View	id	order	name	phone	email	adress	skype
<a href="#">view</a>	4860816083910656	3	Municipal Guard	092	udaltzaingoa@donostia.org	Calle Easo, 41 20015 Donostia, Gipuzkoa	MunicipalGuard
<a href="#">view</a>	4865814888972288	4	Hospital	943007000	hdo.sapuar@osakidetza.net	Begiristain Doktorea Pasealekua,117, 20015 Donostia, Gipuzkoa	Hospital

[New register](#)

Figure 6. Data from JSON in table format

To create a new record, the application generates a form with the structure of the data structure (figure 7), and for editing an existing record, it creates the same form but populated with the values of the fields (figure 8).

[Log in](#)   [Log out](#)   [Sign up](#)   [Status page](#)


Donostia

[Home](#)   [Cities](#)   [Contacts](#)   [News](#)   [Information](#)   [Forum](#)   [Language](#)

## General Edit Form

name

phone

email

adress

skype

Order

Figure 7. Form to create a new contact register

Log in   Log out   Sign up   Status page

Donostia



Home   Cities   Contacts   News   Information   Forum   Language

## General Edit Form

name  
Hospital

phone  
943007000

email  
hdo.sapuar@osakidetza.net

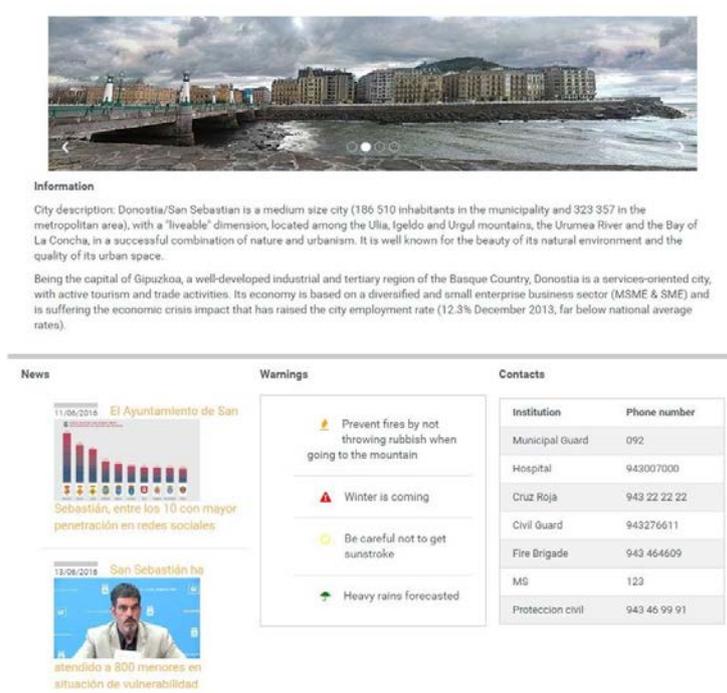
address  
Begiristain Doktorea Pasealekua,117, 20015 Donostia, Gipuzkoa

skype  
Hospital

Order  
4

**Figure 8. Form to edit an existing contact**

With this architecture, the final user can edit web pages in which the data can be used in different ways. For example, the web page of a city (figure 9) uses the News data structure, the Warnings data structure and the Contact data. A user can record this type of information with forms similar to the forms shown in figure 7 and figure 8. The web page of the city integrates these data.



**Information**

City description: Donostia/San Sebastian is a medium size city (186 510 inhabitants in the municipality and 323 357 in the metropolitan area), with a "liveable" dimension, located among the Ullia, Igeldo and Urgul mountains, the Urumea River and the Bay of La Concha, in a successful combination of nature and urbanism. It is well known for the beauty of its natural environment and the quality of its urban space.

Being the capital of Gipuzkoa, a well-developed industrial and tertiary region of the Basque Country, Donostia is a services-oriented city, with active tourism and trade activities. Its economy is based on a diversified and small enterprise business sector (MSME & SME) and is suffering the economic crisis impact that has raised the city employment rate (12.3% December 2013, far below national average rates).

**News**

11/06/2014 **El Ayuntamiento de San Sebastián, entre los 10 con mayor penetración en redes sociales.**

13/06/2014 **San Sebastián ha atendido a 800 menores en situación de vulnerabilidad**

**Warnings**

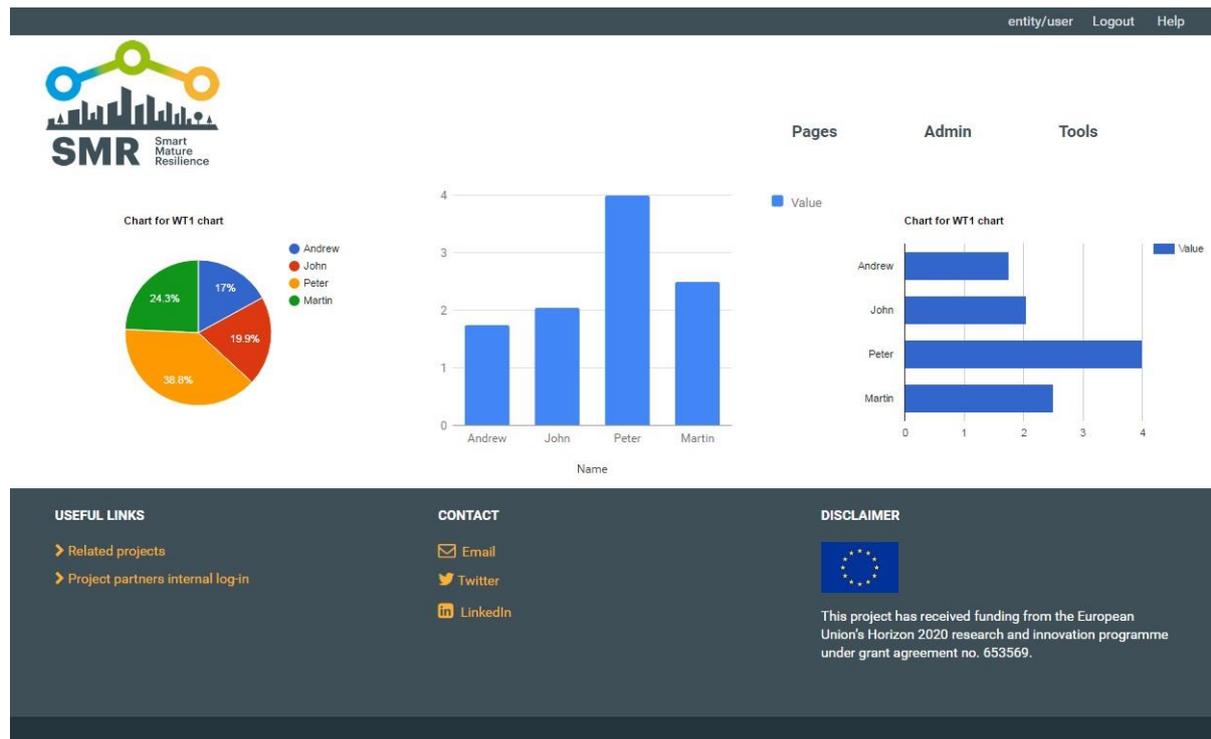
-  Prevent fires by not throwing rubbish when going to the mountain
-  Winter is coming
-  Be careful not to get sunstroke
-  Heavy rains forecasted

**Contacts**

Institution	Phone number
Municipal Guard	092
Hospital	943007000
Cruz Roja	943 22 22 22
Civil Guard	943276611
Fire Brigade	943 464609
MS	123
Proteccion civil	943 46 99 91

**Figure 9. Page with data to show news, warnings and contacts**

Another example of using the data structure is to show the different values of the records of the data structure in a graph. In figure 10 you can see how the editor of the page has used a graphics library to show graphically the values of the records, without modifying the portal code.



**Figure 10. Chart with values from a data structure**

The protocol to interact with the server to read or write the values of the records of the different data structures is quite simple as can be seen in the different examples of the portal.

The JSON values obtained from the request can be used on the application in different ways, as we have explained in this section (tables, forms, graphs, custom templates) and can be read with different tools (plain JavaScript, as in the example of the table, or with JavaScript frameworks as AppML or Angular JS).

## USES OF THE RESILIENCE INFORMATION PORTAL

The tool presented in this paper is the Resilience Information Portal of the SMR project. Therefore, it will be used as the collaborative and engagement tool between projects partners and in the cities to improve communication between cities, citizens and stakeholders.

In the project there is a work package (WP5) that integrates the different tools of the project. The portal is one of the tools; it is, indeed, the tool that allows the integration of all the tools, so the use of the portal is basic for the fulfillment of the goals of the project.

The portal has been used in different workshops, first to understand its functionality, because although it is quite basic, a user does not use a new tool without the appropriate support. For this purpose, the portal has several tools to facilitate use of the portal. Here are some of these tools:

- Status page (<http://smr-project-test.appspot.com/status.page>). Explains the basics concepts of the portal.
- Tutorial (<http://smr-project-test.appspot.com/tutorial.page>). Explains, step by step, the main functionalities of the portal.
- Video tutorial (<http://smr-project-test.appspot.com/videotutorial.page>). Explains the main functionalities of the portal with videos.

<http://smr-project-test.appspot.com/tutorial.page>

There are specific workshops to practice using the portal with guided instructions. With this support the cities will be able to use the portal to collaborate with the different stakeholders and citizens. To manage this collaboration, the city can create a hierarchy structure with the complexity and depth needed for each specific city. The different nodes of this hierarchy can create new nodes if the parent node has allowed permission. Hence, the structure can accommodate the needs of every city and department or stakeholder.

The tools have a list of predefined templates that can be used directly from the cities or can be used as models to

create custom templates for different purposes, departments, citizen organizations, stockholders or entities.

Although a user can be trained to use all the roles on the portal, usually there will be a specialization based on the different skills. One or several users will be in charge of managing the different users and organizations, another will be responsible for defining new templates and providing the basic support to be used by their organization, another will have the skills to create structures of data and integrate this information in different views on the portal, and so on.

Finally, the portal can be extended with new features, without the need to change its source code or making a new installation. The new features can be added with the inclusion of new pages for new purposes.

## CONCLUSION

The portal created as part of the project has attained the goal of being an easy-to-use tool while meeting the requirements described in the deliverables.

It can be tested with the different examples presented in this paper and has been used as the platform to integrate the different tools of the project to achieve the goal of the project.

The portal has been shown to be able to support requirements arising after the development of the portal, as in the case of the System Dynamic model, another one of the project tools. The System Dynamic model was initially conceived as a model that needed to be integrated with the different tools. But when discussing how to develop it and based on the functionalities of the Resilience Information Portal, we started to build it directly on the portal. Therefore, there is no need to make a future integration and it is developed with an existing tool, making the learning curve easier for the authors.

The portal is a support tool for the project which has shown to be easy to use, and powerful enough to respond to the requirements of the different users of the portal.

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