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13. Implementation of a citizen-centric public service application in Danube Delta area for Flood-Serv Horizon2020 Project

NICHERSU I. Iuliana*, NICHERSU Iulian, BRATFANOF Edward, BALAICAN Dragoș

Danube Delta National Institute for Research and Development, 165 Babadag street, Tulcea 820112, Romania

**Address of author responsible for correspondence: NICHERSU I. Iuliana, Danube Delta National Institute for Research and Development, 165 Babadag street, Tulcea 820112, Romania, e-mail: iuliana.nichersu@ddni.ro*

Abstract: FLOOD-serv Horizon 2020 project developed a pro-active and personalized citizen-centric public service application that enhances the involvement of the citizen and harnesses the collaborative power of ICT networks (networks of people, of knowledge, of sensors) to raise awareness on flood risks and to enable collective risk mitigation solutions and response actions. For this, the project team implemented pilots, verified and validated the project solutions in different conditions and different areas of Europe.
The activities implemented by the team of the project enhanced the role of the user (the citizen) in the society. DDNI team members tested the Flood-Serv System using attractive participatory approaches by involving existing communities of people, public authorities, water management officials, planners, emergency services but also regular citizens and academia institutions.
Close collaboration with the end-users plays an important role in the transformation of public services. Given the high availability of data, through the knowledge base of Danube Delta National Institute (DDNI), users were provided more pro-active, higher quality and valuable flood risk management services. This made services more attractive and increased collaboration between all the parties, speeding up the information flow from citizen to public administrations in case of a flood event. The activities presented in the study enhanced also societal resilience towards an improved cooperation and collaboration of all stakeholders: government, private sector, NGOs and other civil society organizations as well as citizens.
Keywords: Floods, Flood risk management, Tulcea, ICT, Flood-Serv System

INTRODUCTION

FLOOD-serv Project (Public FLOOD Emergency and Awareness SERVice) was a project implemented under Horizon 2020 program between 2016-2019, by a team of 12 partners. The FLOOD-serv project aimed to enhance the role of the final user (the citizen) in the society. The proposed solution was user-driven, involving existing communities of people, public authorities, water management officials, planning officials, emergency services but also industry stakeholders and academia institutions.

We live in the age of Big Data, yet many areas of environmental management are still suffering from a lack of relevant data, information and knowledge that impedes sound decision making in the face of change and increasing challenges. A highly relevant phenomenon is therefore the so-called citizen observatories whereby the observations of ordinary citizens, and not just those of scientists and professionals, are included in earth observation and environmental management. The basic idea of involving the public in data gathering has been termed 'citizen science' by natural scientists [(Bhattacharjee, 2005), (Silvertown, 2009)], 'volunteered geographic information' (Goodchild, 2007) and 'crowdsourcing geospatial data' (Heipeke, 2010) by geographers and 'people-centric sensing' (Campbell AT, People-centric urban sensing, 2006) and 'participatory sensing' (Holler, et al., 2014) by computer scientists. Citizen observatories can have many 'shapes and sizes', often extending beyond 'mere' data collection and sensing to citizen participation in decision making. They vary, for example, in terms of their area of application (from observing the physical environment to human behaviour), involving implicit or explicit data provision, collecting objective or subjective measurements, from bottom

up to top down implementation, and using uni- or bi-directional communication paradigms between citizens and data ‘processors’. (When et al., 2015)
The importance of stakeholder participation in decision-making, and in flood risk management in particular, has been recognized by international and regional treaties such as the Aarhus Convention (1999), which promotes public participation in decision-making on environmental issues, and the European Flood Directive 2007/60/EC, which requires the establishment of public participation mechanisms to ensure citizens’ involvement in the flood management cycle. Yet questions can be raised as to how to achieve this goal and successfully translate these requirements into meaningful and effective participation. Innovative means, such as citizen observatories enabled by information and communication technologies (ICTs) (e.g. sensor technologies and social media), have the potential to provide new ways (and perhaps even new paradigms) of participation, whilst at the same time generating relevant information and promoting demand-driven policy responses [(Holden M. , 2006) (Rojas-Caldenas & Zambrano, 2008)].

The main outcome of FLOOD-serv project is an integrated multi-component platform, FLOOD-serv System, that is designed to serve public authorities, stakeholders and citizens in regard with various aspects of flood risk management such as coordination, management, missions, communication, citizens involvement and flood risk awareness.

Testing and piloting activities in FLOOD-serv Project were organized in three long-term piloting cycles that followed the research and development activities within the project. Detailed records were kept of all testing results for a full systematization, analysis and evaluation of each piloting cycle and on the functionality and perception of the System.

MATERIAL AND METHOD

Stakeholders involvement and System development participants

Flood-serv System distinguished three main end-user categories: pilot city testing teams, institutional stakeholders and citizens.
During FLOOD-serv Project, the system and its components were verified, piloted, evaluated and validated. Piloting (i.e. testing with a limited number of users before wide use) was performed by what we call in our Project: Pilot Cities. These are:

1. Municipality of Bilbao, Spain (in short Bilbao);
2. Self-Governing Region of Bratislava, Slovakia (in short Bratislava);
3. Municipality of Genova, Italy (in short Genova);
4. Prefecture of Tulcea, Romania (in short Tulcea);
5. Municipal Council of Villanova de Famalicao (in short Villanova)

Piloting/Testing Participants
As planned during the project, there were three types of participants in piloting/testing on the side of Pilot Cities:

1. Employees of Pilot Cities,
2. Representatives of stakeholders;
3. Citizens.

A fourth type of testing personnel were

4. Professional testers employed by technical partners.

The participants in piloting/testing sessions of Danube Delta pilot were:

- Employees of Tulcea Prefecture,
- Representatives of stakeholders - employees of the public administration of the 4 selected municipalities in the area of Danube Delta: Bestepe, Mahmudia, Isaccea, Tulcea; teachers from 3 high schools in Tulcea municipality
- Citizens: students from 3 high schools, regular citizen, colleagues

Piloting activities in Danube Delta, Romania

Tulcea Prefecture (IP Tulcea) together with Danube Delta National Institute for Research and Development (DDNI Tulcea), implemented, during the project, the piloting activities for Flood-Serv System, using 2 main approaches: internal and external testing.
The approach started with the internal testing, during the cycle 1 of piloting and continued with the external testing in the 2nd cycle of piloting. The 3rd cycle of piloting was conducted both internally and externally.

The testing sessions were organized at the administration's headquarters. The main stakeholders that tested the System were the actors from the exact flood event: mayors, main responsible of the flood event from the municipality and representatives of the main intervention's groups: volunteers, medical team, military, etc.

The first cycle of piloting was conducted mainly internally, as a first step in the testing of the components. The second cycle was a lot more complex, since for the testing were implicated also the stakeholders. At the end of the piloting activities, the 3rd cycle of piloting implicated even more testers, over 200 citizens completing the activities; stakeholders and employees.

For each piloting cycle, the teams from DDNI and IP Tulcea prepared the sessions by contacting individually each employee, stakeholder and citizen and sending the invitations to their institutions. After this step, the team organized the testing events, choosing the suitable location, depending on the testers: for the employees at IP Tulcea headquarters, for the stakeholders at the public administrations' headquarters and for the citizen, at different locations (DDNI headquarters, high schools).

The 3rd piloting cycle for Flood-Serv System, was implemented by DDNI Tulcea, and IP Tulcea using 2 main approaches: both internal (April and May 2019) and external testing (8th of April 2019- 8th of May 2019). The approach started with the external testing, as the first part of the piloting cycle (3A). At the end of 3A piloting cycle, DDNI conducted an internal testing session as well- scheduled for 22nd of May 2019.

External testing approach

The two partners organized an extended testing activity, over the period of one month during 8th of April to 8th of May, in a number of 9 sessions.
The team established the piloting methodology based on the previous expertise of DDNI, on the implementation of other stakeholder approaches and from the experience in understanding stakeholder responses to scientific information and decision-making processes, combined with the administrative knowledge of IP Tulcea. For the good implementation of the testing sessions, DDNI and IP Tulcea teams prepared the piloting instruments and previously announced and simulated the testing sessions on all the System components.

The methodology for each testing session was to let all the stakeholders work and discover each component as it is. This approach was established after the training sessions, considering the state of the art for each component and for the System as a hole.

Internal testing approach

For Danube Delta pilot activities the team had two internal testing sessions. The first one was in April, during the simulation of the external testing sessions. The team reported directly to all the technical partners on the issues from each component, in order to have the bugs fixed by the implementation of the external sessions.

The second internal testing session was in May, for the checkup of the reported bugs, errors and completions. All the internal testing activities targeted employees in the Danube Delta pilot- IP Tulcea and DDNI.

Considering the number of participants that tested the System during the testing cycles (both internal and external testing), their category can be spilt as follows Table 1.

Table 1 Participants in Tulcea pilot

Nr. crt	Cycle	Employees	Stakeholders	Citizens	Total no of external participants
1	Cycle 2	7	23	0	30
2	Cycle 3A	2	36	122	160
	Total	9	59	122	190

The result of the testing sessions, considering the piloting instruments for Tulcea pilot were: 72 completed Template for reporting test results and 280 completed End of testing sessions questionnaire.

Piloting Key Performance Indicators (KPIs)

For the systematization of the results and for a better understanding on the use of Flood- Serv System, the project introduced a series of functional and non- functional KPIs.

Functional KPIs

The following indicators were considered KPIs as related to functional test results (they are reported as rows in the tables in this section): Requirements/Functionalities; Planned to be tested; Planned to be tested; Tested; Passed; Failed

On the columns one can observe the chronological evolution of indicators. The following columns are present:

1. ***Analysis*** – represents the analysis phase of the project during which user requirements elicitation and technical requirements specification was conducted. This column is only applicable for the Requirements/Functionalities (#) indicator.
2. ***Implementation*** – represents the implementation phase during which the Components of the FLOOD-serv System were developed and integrated. This column is only applicable for the Requirements/Functionalities (#) indicator.
3. ***Cycle 1***, ***Cycle 2***, ***Cycle 3A*** and ***Cycle 3B*** correspond to each Cycle of testing.
4. ***Cycle 3 Final*** is not a separate cycle but an aggregation based on the last available results as explained

Non- Functional KPIs

The aggregated results for the non-functional KPIs were processed by calculating the average values of the ‘End of testing session questionnaires’ collected during the entire project through the piloting activities. The results reveal important information for the follow-up and exploitation of the results of Flood-Serv project, offering the basis for the use of the system and its’ components.

‘End of testing session questionnaire’, asks two questions about each non-functional aspect reported per each Component, as follows:

- Overall perceived usefulness of Component;
- Overall perceived value added of the Component;
- Overall perceived ease of use of Component;
- Overall ease of understanding of Component’s features;
- Overall perceived intuitiveness of Component interface;
- Overall perceived pleasantness/enjoyment of Component interface.
- Overall perceived Connectivity citizen- public authorities

The first question has a standardized ordinal scale of answers (from 0 to 4, i.e. 0.Not at all useful, 1.A little useful, 2.Somewhat useful, 3.Useful, 4.Very useful), the second question had open, text answers (respondents had the option to answer it and were requested to answer especially if the answer to the standardized question had a low value).

The questionnaire was applied once per participant, per session of testing, per Component. Which means that usually participants in a testing session, first run the functional tests corresponding to a Component, then filled the End of testing session questionnaire, as pertaining to that Component. If the testing session continued with running functional tests for a different Component, then the End of testing session questionnaire was filled in again as pertaining to the second component, and so on.

RESULTS AND DISCUSSIONS

The results obtained for Tulcea Pilot functional KPIs are presented in the tables bellow (Table 2,Table 3,Table 4,Table 5,Table 6,Table 7):

Table 2. FLOOD-serv Portal Functional KPIs

Portal	Analysis	Implementation	Cycle 3 Final
Requirements/Functionalities (#)	19	19	32
Planned to be tested (#)	-	-	32
Planned to be tested (%)	-	-	100.0 %
Tested (#)	-	-	32
Tested (%)	-	-	100.0 %
Passed (#)	-	-	32
Passed (%)	-	-	100.0 %
Failed (#)	-	-	0
Failed (%)	-	-	0.0%

Table 3. EMC Functional KPIs

EMC	Analysis	Implementation	Cycle 3 Final
Requirements/Functionalities (#)			22
Planned to be tested (#)	-	-	22
Planned to be tested (%)	-	-	100.0%
Tested (#)	-	-	22
Tested (%)	-	-	100.0%
Passed (#)	-	-	22
Passed (%)	-	-	100.0%
Failed (#)	-	-	0
Failed (%)	-	-	0.0%

Table 4. EMC Functional KPIs

SMC	Analysis	Implementation	Cycle 3 Final
Requirements/Functionalities (#)	NA	NA	NA
Planned to be tested (#)	-	-	34
Planned to be tested (%)	-	-	NA
Tested (#)	-	-	34
Tested (%)	-	-	100.0 %
Passed (#)	-	-	23
Passed (%)	-	-	67.6 %
Failed (#)	-	-	11
Failed (%)	-	-	32.4 %

Table 5. CDF Functional KPIs

CDF	Analysis	Implementation	Cycle 3 Final
Requirements/Functionalities (#)	8	8	8
Planned to be tested (#)	-	-	8
Planned to be tested (%)	-	-	100.0 %
Tested (#)	-	-	8
Tested (%)	-	-	100.0 %
Passed (#)	-	-	6
Passed (%)	-	-	75.0 %
Failed (#)	-	-	2
Failed (%)	-	-	25.0 %

Table 6. TMS Functional KPIs

TMS	Analysis	Implementation	Cycle 3 Final
Requirements/Functionalities (#)	4	4	4
Planned to be tested (#)	-	-	4
Planned to be tested (%)	-	-	100.0 %
Tested (#)	-	-	4

Table 7. SW Functional KPIs

SW	Analysis	Implementation	Cycle 3 Final
Requirements/Functionalities (#)	10	6	6
Planned to be tested (#)	-	-	6
Planned to be tested (%)	-	-	100.0 %
Tested (#)	-	-	6

Tested (%)	-	-	100.0 %
Passed (#)	-	-	3
Passed (%)	-	-	75.0 %
Failed (#)	-	-	1
Failed (%)	-	-	25.0 %

Tested (%)	-	-	100.0 %
Passed (#)	-	-	6
Passed (%)	-	-	100.0 %
Failed (#)	-	-	0
Failed (%)	-	-	0.0%

The average values of the 'End of testing session questionnaires' collected during the entire project for Tulcea pilot gathered through all the testing cycles are presented in the next tables(Table 8,Table 9,**Error! Reference source not found.**,**Error! Reference source not found.**,Table 12,Table 13,Table 14):

Table 8. Average Perceived Usefulness

	Tulcea			
Component	Cycle 1	Cycle 2	Cycle 3A	Cycle 3B
CDF	NA	NA	3.3	4.0
EMC	NA	NA	3.6	4.0
Portal	NA	NA	3.3	4.0
SMC	NA	NA	NA	3.0
SW	NA	NA	3.3	4.0
TMS	NA	NA	NC	4.0
Average total	NA	3.2	3.4	3.8

Table 9. Average Perceived Value added by Component

	Tulcea			
Component	Cycle 1	Cycle 2	Cycle 3A	Cycle 3B
CDF	NA	NA	2.7	3.0
EMC	NA	NA	2.8	3.0
Portal	NA	NA	2.7	3.0
SMC	NA	NA	NA	2.7
SW	NA	NA	2.7	3.0
TMS	NA	NA	NC	3
Average total	NA	2.4	2.7	2.9

Table 10 Average Perceived Ease of Use by Component

	Tulcea			
Component	Cycle 1	Cycle 2	Cycle 3A	Cycle 3B
CDF	NA	NA	3.3	3.0
EMC	NA	NA	3.3	3.0
Portal	NA	NA	3.3	3.0
SMC	NA	NA	NA	2.7
SW	NA	NA	3.2	3.0
TMS	NA	NA	NC	3.0
Average total	NA	3.1	3.3	3.0

Table 11 Average Perceived Ease of Understanding by Component

	Tulcea			
Component	Cycle 1	Cycle 2	Cycle 3A	Cycle 3B
CDF	NA	NA	3.2	3.0
EMC	NA	NA	3.2	3.0
Portal	NA	NA	3.4	3.0
SMC	NA	NA	NA	3.0
SW	NA	NA	3.3	3.0
TMS	NA	NA	NA	3.0
Average total	NA	3.1	3.3	3.0

Table 12 Average Perceived Intuitiveness by Component

	Tulcea			
Component	Cycle 1	Cycle 2	Cycle 3A	Cycle 3B
CDF	NA	NA	3.3	4.0
EMC	NA	NA	3.3	4.0
Portal	NA	NA	3.3	3.0
SMC	NA	NA	NA	3.0

Table 13 Average Perceived Pleasantness of Interface by Component

	Tulcea			
Component	Cycle 1	Cycle 2	Cycle 3A	Cycle 3B
CDF	NA	NA	3.3	4.0
EMC	NA	NA	3.3	3.0
Portal	NA	NA	3.2	3.5
SMC	NA	NA	NA	2.7

SW	NA	NA	3.2	3.0
TMS	NA	NA	NC	4.0
Average total	NA	3.2	3.3	3.5

SW	NA	NA	3.2	3.0
TMS	NA	NA	NC	4.0
Average total	NA	3.0	3.2	3.4

Table 14. Average Perceived Connectivity citizens- public authorities by Component

	Tulcea	
Component	Cycle 3A	Cycle 3B
CDF	3.4	4.0
EMC	3.3	4.0
Portal	3.3	4.0
SMC	NA	3.0
SW	3.2	3.0
TMS	NC	4.0
Average total	3.3	3.7

CONCLUSIONS

Good cooperation process was assured with different stakeholders and citizen through the use of piloting methodology for the test of Flood-Serv System. The method proved also successfully in raising stakeholder’s awareness regarding flood event management. The success of this approach was ensured by the combination of the qualitative scientific knowledge for flood risk with the administrative management of the flood event and also the high number of testers.

The final changes recommendations took into consideration all the suggestions mentioned by stakeholders and citizens, according to their point of view and interest, giving in this way, the possibility of an improved flood risk management process. It is important that the interest for the Flood-Serv System rose among the participants during the piloting sessions to continue beyond the project for a better flood risk management procedure. This sustainability of the System will be achieved with the aspiration of IP Tulcea to include the System in the regular flood risk management procedures.

Results present that during the final cycle of piloting, in response with the Functional KPIs, all the System components have successfully passed. The ‘End of testing session questionnaires’ collected during the piloting campaigns in Tulcea show that, from a piloting cycle to another, the general interest of the stakeholders has gradually increased making the System a success. The general perceived connectivity between citizens and authorities has gradually increased from one piloting cycle to another proving that, through the adjustments made, the System achieved its purpose of connecting stakeholders.

The piloting cycles participants considered the System components’ more useful and more pleasant from one test to the next one, and with added value by every adjustment and upgrade made from one pilot cycle to another. The components interfaces have undertaken various improvements every cycle reaching participants’ expectations, perceiving them as more attractive. From the end user point of view, the stakeholders considered the System components easy to use, easy to understand and more intuitive as the System reached its’ final shape.

Given the above results we can conclude that Flood-Serv System has an important role in the context of flood risk management and the implication of the citizens in the case of a flood event.

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