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History of a failure: dos and don'ts in planning a Smart City intervention

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ABSTRACT

In this paper we will analyse all the actions, especially during the planning and preparation of a project proposal, that could influence the success of a Smart City intervention.

In particular we will focus on a system of mobility sensors (traffic and Automatic Number Plate Recognition, ANPR) installed in Brescia (Italy) for the MoSoRe (Mobilità Sostenibile e Resiliente) project. The aim of this system was to provide data to test some evacuation algorithm upon a flooding hazard. We will go through all the steps that, in the writer's opinion, co-occurred to the overall failure of the main objective, i.e. data collection and usage. We will underline the main planning and operational complexities of a Smart Cities intervention, such as:

- *Localization: is the chosen site manageable? How many administrations insist on the specific site? Would a demo site provide the same validation for our aim? Are there already operating sensors on the specific site? Could we access or retrieve data from those sensors?*
- *Use cases: we believe that a detailed planning and sharing of use cases among the partners is fundamental to understand the goal of the system for every single actor involved in a specific intervention.*
- *Supply: are there any problems providing power or network to the sensors, and what could be the cost of providing such services? Is there a market scarcity problem on sensors and/or on electrical and electronic appliances?*

Finally, we share the lessons learnt from a failure: could a better plan help?

KEYWORDS: Urban planning, smart city management, proposals' planning

1 SHARING POSITIVE AND NEGATIVE OUTCOMES

It is a common habit among the scientific community to usually describe and highlight the positive outcomes of a project or a line of research, especially in the Smart City research community where we want to give back something tangible and valuable to citizens and public administrations. In this paper the main focus will be instead on sharing the possible negative outcomes, starting from real project carried on in Brescia (Italy), and how we can learn from negative outcomes in order to plan better project proposals and better interventions.

In fact, while we can learn and use for planning guidelines general principles and success story, concealing the “bad side” of a project could potentially expose the scientific community to repeating the same mistakes again and again. Moreover, we know how much a Smart City project is intertwined with the territory where it is developed: its positive and negative outcomes could potentially replicate in other territories, but we mostly highlight only the good ones.

Next on this paper we will introduce the specific intervention that we will discuss and then in each subparagraph we will focus on a different critical aspect: Localization, Use cases and supply.

2 OUR EXPERIENCE: GENERAL SETTINGS AND POSSIBLE MISTAKES

The MoSoRe@UniBS project, in the following MoSoRe, was one of the projects of the POR-FESR 2014-2020 Call Hub of Lombardy Region in Italy. MoSoRe stays for Infrastructures and Services for a Resilient and Sustainable Mobility, and it was a project lead by the University of Brescia and with other 7 partners (ENEA among these 7). The MoSoRe Project focused on resilience of the mobility as service paradigm, proposing solutions for road infrastructures, charging infrastructures for electric vehicles, ICT infrastructures, and front-end services that allow users to move around safely, calmly, and within expected times, even in the presence of events or emergency situations, whilst promoting also the use of e-bikes and other light electric vehicles (LEVs) presenting the health benefits and providing integrated charging stations [1].

Among the solutions for road infrastructures, the goal of one of the work packages was to test a new high performance smart concrete jacketing on pillars and beam of two bridges along the SP45 bis road, and to install on the bridge in the municipality of Bassano Bresciano (BS, Italy) a monitoring system with accelerometers and tiltmeters inside the jacketing, and a thermo-hygrometer and a traffic load sensor (smart eye) on a pole on one extremity of the bridge [2]. With the project effectively starting by the end of February 2020, with the beginning of lockdown for the COVID-19 pandemic in Lombardy from the 8th of March 2020, all the partners involved in the work package were trying to eventually come up with a Plan B solution, in particular for the traffic load monitoring as the jacketing intervention could not be modified. Most of the mistakes that will later be highlighted came from the planning of such Plan B.

Focusing on the resilience of roads in presence of emergency situations, in particular flooding, another place of interest for the MoSoRe project was the Mandolossa hydraulic confluence, an area on which traffic load monitoring could have been interesting in order to test algorithms for vehicles evacuation in case of a hydrogeological emergency. Unfortunately, the management of the installation of such a traffic load monitoring system was deemed too complicated, because the area is shared among three municipalities. Therefore, we finally decided to install a traffic load monitoring system on a demo area inside the University of Brescia Campus.

The installed traffic load monitoring system (see Figure 1) installed on Via Branze (Brescia) was made of: 5 ANPR sensor with onboard AI algorithm specifically modified in order to store only encrypted plate numbers, 3 traffic sensors to monitor and categorize the traffic on each Origin-Destination pair on each roundabout at the ends of Via Branze (2 for the roundabout at the Viale Europa/Via Branze crossing, 1 for the roundabout at the Via Branze/Via Trumplina crossing). All the sensors had to be positioned on the public lighting poles (see Figure 2), requiring a dedicated IP68 power supply.

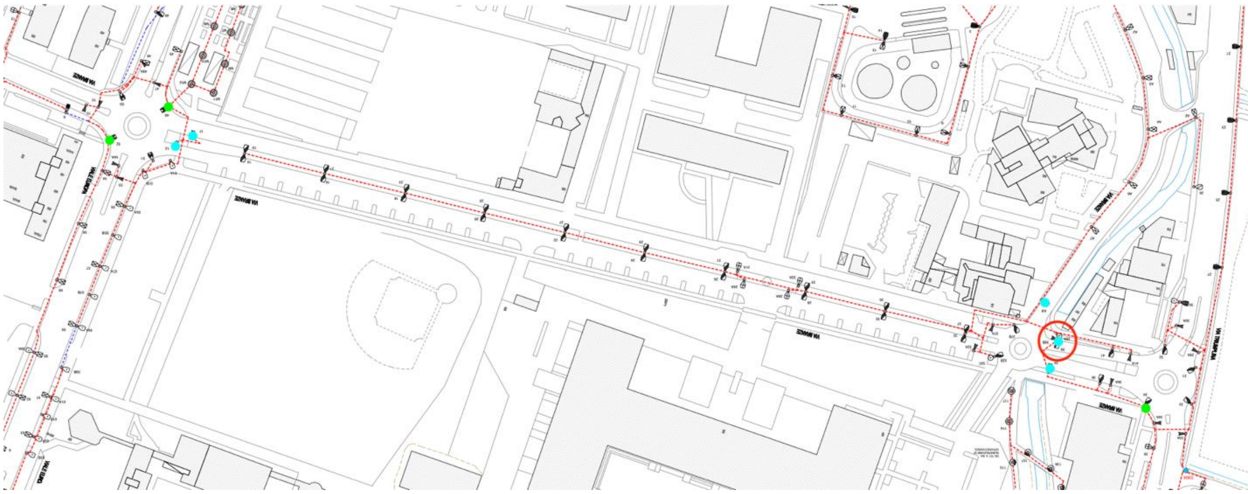

Figure 1: Layout of the monitoring system in Via Branze, traffic sensors in green, ANPR sensors in sky blue

Figure 2: Ttraffic load sensor on a lighting pole

The aim of the whole system in via Branze was to detect how many vehicles were passing through via Branze and how many vehicles were instead parked in the University premises and for how much time (thus the need for ANPR sensors). These data were to be used to feed and test the vehicles evacuation algorithms. The traffic load sensors instead collected traffic flows on the roundabouts in 10 mins intervals, giving some insights to design the fastest evacuation routes. Unfortunately, the system failed to provide reliable data, mostly for power supply and positioning issues.

Instead, the original system on the SP45 bis bridge was finally installed, together with a backup traffic load monitoring sensor placed 1 km far from the bridge on the same road. The back up sensor has proven to be a really good choice, because all the sensors on the bridge were affected by power supply issues.

In the next subparagraph we will analyse in detail three different aspects where mistakes could be avoided with a better planning.

2.1 Localization

When we plan a Smart city intervention one of the most crucial aspects is its localization. The answer to the *where* question must take into consideration:

- What is the best setting from a synergic point of view (in case of multiple systems) or from an observational point of view (what we want to measure/describe/infer).
- How many municipalities or public administrations insist on the candidate location.
- If there are other sensors collecting the same data and if such data are accessible via an interoperability platform.

Point 1 underlines the importance to collect data as close as possible to the phenomenon we want to observe: in our example originally, we want to observe the traffic load of different kind of vehicles on the bridge, in order to evaluate the quality of the jacketing intervention and to plan for maintenance. To work together with the sensors' system inside the jacketing, the most natural localization was the bridge itself. However, a backup localization not far from the bridge has provided some benefits and robustness to the system. Point 2 is a recommendation to avoid too many policy and regulatory issues regarding installations, data collection and GDPR compliance.

Point 3 instead focuses on two general Smart City themes: lean data and interoperability. Lean data [3] is a principle used to obtain quality datasets enhancing existing resources, thus avoiding duplications and redundancy in data collection and sensors. Interoperability is also a widespread principle in Smart City services design, where a single city vertical should provide data in a common format defined by a horizontal interoperability layer [4]. In our case the interoperability platform was developed by one of the project partners, but interoperability was only among MoSoRe verticals.

2.2 Use cases

When setting up a new system of sensors or a new service we should focus on:

- The aim and the target (citizens, researchers, administrators).
- The actors involved in the realization.
- The actions in charge to every actor and the flow of information throughout parallel or subsequent actions.

We could comprehend and share all these things with the collaborative design of use cases for all the services and systems. A use case can be designed as a document, as a table or multiple tables (see Figure), or as a flow chart or an UML diagram, and can include time and milestones with Gannt charts. Use cases are handy inside the project partnership: they highlight every partner micro-task, they help visualization of input and output of every micro-task (in terms of data, infrastructures, supply), they help a clear communication between the partner involved in a common process. Use cases also help clarity towards the target of the common action, thus avoiding the phenomenon also known as data colonization, where smart city systems do not really provide a service considered valuable by the community. Finally, a carefully designed use case can facilitate negotiations with third party suppliers.

ID	Use case name
Alphanumeric string	A concise text name (ex: Sensor output to project platform)
Aim	
Brief description of the aim of the very specific use case (ex: definition of the virtual path and of the communication protocols involved from the data source to the project platform)	
Description	

Stakeholder	Description	CONSTRAINT
Ex1: Owner of a data source	Brief description of the stakeholder	Any constraint to the action of the stakeholder regarding the specific use case (ex: policy, specific software or protocol use)
Ex2: Manager of the project platform		
Ex3: Third party user of data		

Information	Owner	User	Recipient system	Recipient system outside the specific management area
Data type or other specifications	Who or what owns or generates the information		Where the information lands for the specific use case	Where the information could further land out of this specific use case

Figure 3: An example of multiple tables to describe a use case

In our experience we have learned that, whenever we are dealing with an alternative plan, we immediately proceed on the collaborative design of use cases with all the partners involved: sometimes some subactions or the interaction between a subset of partners stays as it is (and in general it could be considered a best practice to promote such similarities) as in our example the communication between the sensors and the project platform. But in other instances, the aim and the actors involved along all stages are very different and if not clearly analysed, stated and shared among the partners, they can cause a lot of confusion and potentially expose the whole operation to failure.

2.3 Supply

A crucial aspect that all the Smart city community has learned the hard way during the COVID-19 pandemic is the supply of services and goods. In our example, whilst the shortage of electric and electronic appliances was impossible to forecast in a short time frame (therefore could not be included at the planning stage), the supply of power and electricity was crucial in all the settings.

In particular on the bridge along the SP45 bis road all the project partnership had to ask for a dedicated electrical line and cabinet in order to power all the sensor inside and outside the jacketing and a pole for the traffic sensor and the thermo-hygrometer, whilst in via Branze we needed dedicated IP68 power suppliers and electrical network (sensors cannot use the same electrical line of public lighting lamps). In both scenarios small photovoltaic panels with an associated battery were considered, but scarcity on the market made the solution non-viable.

A guideline for planning, from the supply point of view should then consider:

- Supply of goods: electrical and electronic devices, sensors, raw materials.
- Supply and reliability of services: electricity, water, connectivity (optical fiber, ethernet, Wi-Fi, 3G or 4G or 5G).
- Reliability of suppliers of goods and services outside the project partnership and compliance with the quality standards imposed by partners.

The last two bullets are the most important to consider in an early planning stage (ideally during the project proposal) because of the time factor and the involvement of third parties.

3 CONCLUSION

In this paper we have outlined what we consider the most relevant barriers for the success of a Smart City intervention. Most of those barriers can be avoided with a careful planning, starting from a project proposal level, which can boost also the overall robustness of the project against unpredictable events (such as scarcity of goods on the market). It is important to understand that the same planning principles should be followed also for back up plans when facing unpredictable events. In particular we should never lose focus on the aim of data collection and on the idea of giving back some added value to the community. We hope that this concise list of most common errors and counteracting best practices could help other researcher to design, develop and deliver more efficient and effective Smart City projects.

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