



Proceedings

A methodology for using dynamic visualizations to enhance citizens engagement in mobility planning in Thessaloniki

Maria Konstantinidou^{1*} and Josep Maria Salanova Grau¹

¹ Centre for Research and Technology Hellas/CERTH-Hellenic Institute of Transport/HIT1; mariakon@certh.gr; JS: jose@certh.gr

* Correspondence: mariakon@certh.gr; Tel.: +30 2311 257629

Abstract: The purpose of this paper is to present how digital twins can be used as a tool for vulnerable citizen engagement, improving efficiency of co-creation in mobility planning. Through a 3-steps workshops' approach within Thessaloniki Smart Mobility Living Lab, the mobility needs set by vulnerable users are collected, prioritized and matched with policy plans. By combining citizens feedback with real time data incorporated in digital twins, citizens receive back visualized scenarios of the impact of specific mobility measures on their neighborhoods. By lifting the citizen engagement in mobility planning to the next participatory level, the results of the study create a bridge between participatory processes and digital twins.

Keywords: Digital Twin; citizens' engagement; co-creation; mobility planning; vulnerable users;

1. Introduction

Citizens' engagement is fundamental in planning process of forming an urban mobility strategy. End-users feedback is an important feature for policy makers to understand service's acceptance and improve the provided system. Traditional ways of receiving feedback, such as actual public consultation, are time consuming in terms of receiving and interpreting received information and quite generic in terms of geographical focus (Fitzgerald et al., 2016).

This paper aims at presenting extended opportunities of the use of digital twins as tools in engagement processes. Through the implementation of a 3-steps methodology presented in this paper, a twofold goal will be achieved; a higher level of engagement of the citizens that are typically under-represented in participatory processes by the use of digital twin models and validation of citizens input through visualizations in digital twins, contributing to a more effective and accurate incorporation of citizens feedback into policy plans. Section 2 presents the area of study including a literature review on the benefits of digital twins and how they could be used in citizens engagement processes. The methodological approach followed, and the results are described in sections 3 and 4 respectively. Last, a summary of the main conclusions is provided in section 5.

2. Area of study

A digital twin is a virtual model that replicates a real-world urban area/city, allowing the creator to determine the performance of its different systems (Furst et al., 2021). Therefore, digital twins are defined as virtual representations of a physical environment (Wan et al., 2019), consisting of all the systems included, supporting the purpose of a smart city to operate.

The element that distinguishes a digital twin from any other digital model, is its connection to the physical twin. Based on data from the physical system, a digital twin unlocks value by evaluating innovative mobility schemes under the current situation and

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future scenarios (Mohammadi and Taylor, 2017). The evaluation of a holistic system through a digital replica, is an accelerator key for decision makers to adopt targeted solutions for a resilient urban environment. Historical data stored in the smart cities, can be used to evaluate current situation in an urban environment, such as congestion, quality of air and evaluate future scenarios from the decision-making perspective.

This capability of conducting physical experimentation of services through simulation while optimizing their efficiency under real world complex conditions provide to policy makers a valuable benefit of prior implementation risk management, reducing the uncertainty of the investments (Wan et al., 2019). It is now possible to transfer the complicated system of a city to the digital world, enabling town planners to test solutions without taking too many risks.

Additionally, the users of the services can understand the importance of co-creation as they are able to see through visualizations how their feedback on mobility needs could be used and incorporated into policy plans. Communication between the interested parties can be enhanced since the flow of information is facilitated through new channels (Gao et al, 2021). The policy makers will regain the trust of the citizens, as the new tools will allow the integration of the information received in the real world in a quicker way (Fitzgerald et al, 2016).

3. Methodology

Thessaloniki pilot was implemented within Thessaloniki Smart Mobility Living Lab (THESSM@LL) that is a user-driven innovation environment where users and producers co-create innovation in a trusted, open ecosystem that enables business and societal innovation.

3.1. Selected neighborhood and target group

Thessaloniki's pilot focuses on pedestrians in the specific area of the Egnatia road. Due to high levels of congestion, the lack of parking slots and insufficient infrastructure (e.g inconsistencies in ramp corridors) it is one of the most challenging areas for pedestrians and vulnerable groups. The study area was the Egnatia Street's full length, but greater emphasis was given on the section of the road from Ethnikis Aminis to El. Venizelos Street, where most of the problems are appeared and largest flows of the pedestrians are observed.

3.2 . Ideation, Co-creation and Validation-evaluation Workshops

The ideation workshop took place with the presence of people from the Pedestrian association of Thessaloniki. The main objective of the ideation workshop was to discuss with the participants about the specific characteristics of the Egnatia road, the definition of their specific mobility needs and mobility related problems they face as pedestrians on this street. A detailed report including the main problems observed in the examined area as they identified in the field "scanning" by CERTH/hit team along with the related photos was used as the basis for the discussion with the workshop's participants. It was suggested to participants to write down their problems on post-it and put them on the specific location on printed maps. This approach would be helpful for the next step of the co-creation workshop.

The co-creation workshop took place with the same group of participants from the pedestrian association. The objective of this workshop was to conclude with the participants on a list of prioritized mobility related measures and discuss on the impact they could have on the mobility conditions of the examined area.

Considering the suggested interventions of the Sustainable Urban Mobility Plan in Thessaloniki and building on the problems discussed during the ideation workshop, participants were asked to propose specific measures they want to see in Egnatia corridor, to improve the safety and accessibility of the pedestrian network.

The validation/evaluation workshop took place with a wider group of participants including representatives from the Municipality of Thessaloniki, the Major Development Agency Thessaloniki, the Pedestrian association, transport operators (shared bike operators and taxi association) and Thessaloniki Transport Authority.

The main purpose of the third workshop was the validation and evaluation of the visualized measures by the participants. Some of the suggested measures were visualized through Digital Twin and presented along with their impacts on pedestrians' moving (e.g. decrease of waiting time and near misses' incidents) during the validation/evaluation workshop to both the target group of pedestrians and to policy makers and other mobility related stakeholders that joined the event.

4. Results

The key output of the ideation workshop was a list of problems in the examined area that created a clear image of where the suggested measures of the second co-creation workshop should be focused on. The main problems as summarized through the discussion were clustered in five groups related to pedestrian crossings (e.g. absence of a 4th pedestrian crossing at some intersection), pavement condition and geometric characteristics, obstructions and illegal parking, infrastructure for disabled people (e.g. absence of tactile paving and acoustic traffic signal for Visually Impaired) and insufficient signing.

During the co-creation workshop specific measures of high importance were suggested to improve the safety and accessibility of the pedestrian network of Egnatia road and were clustered on measures related to intersections (e.g. addition of a 4th crossing where missing in some intersections and longer green interval of traffic lights for pedestrians), policy measures (e.g. reduction of the speed limit for vehicles from 50 km/h to 30 km/h and low speed/emission zone), infrastructure related measures (e.g. separation of the two traffic streams with a planted divided median strip) and multimodality measures.

Some of the suggested measures were presented to the participants of the validation/evaluation workshop through visualization in Digital twin and their impacts were captured in related charts. One of the main interventions simulated was the addition of a 4th crossing at intersections (e.g. Iasonidou and Egnatia intersection) (Figure 1a). This intervention has important impacts on the decrease of near missed incidents as shown in Figure 1b.

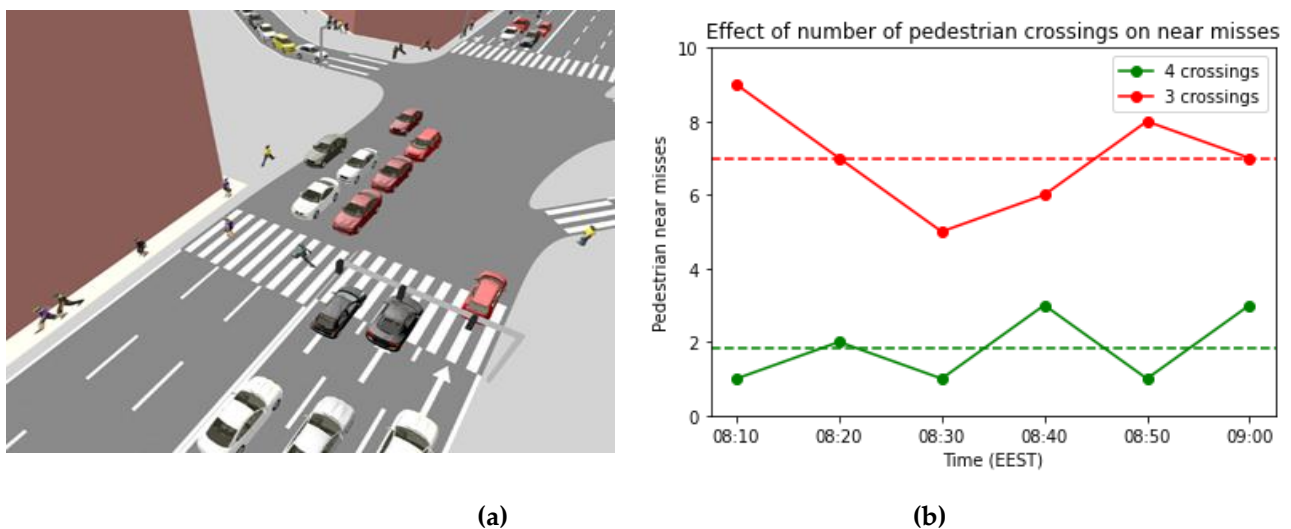


Figure 1. (a) Addition of a 4th crossing at Iasonidou and Egnatia intersection and (b) effect of the suggested measure on near misses.

5. Conclusion

The study proposes an innovative methodological approach of using the digital twins, by transforming them from real time data-driven replicas, targeted to the facilitation of the decision-making process for the public authorities to a tool for enhancing citizen engagement in the mobility context. Since the advances in technologies has resulted in a new efficient representation of the transportation systems in the real world, new digital tools are available creating a digital environment in which citizens and policy makers can collaborate to provide better solutions (Kaur et al. 2020). Collaboration with the end users of a mobility service could reveal handy visualization of a subjective point of view of the services. Thus, the digital twins can function as an accelerator tool of the traditional time-consuming assessment activities of mobility services.

The extraction and the creation of knowledge resulted from the fusion and the processing of the information received from the participants of the workshops within Thesaloniki Smart Mobility Living Lab fed dialogues and debates between the participants. The use of digital twin created common understanding on the real needs of the pedestrians in Egnatia road, the mobility issues and the measures that need to be implemented facilitating the communication between the interested parties and keeping them engaged during the whole process.

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