



## Deliverable

### D6.3 Pilot Testing Cycle Report 1

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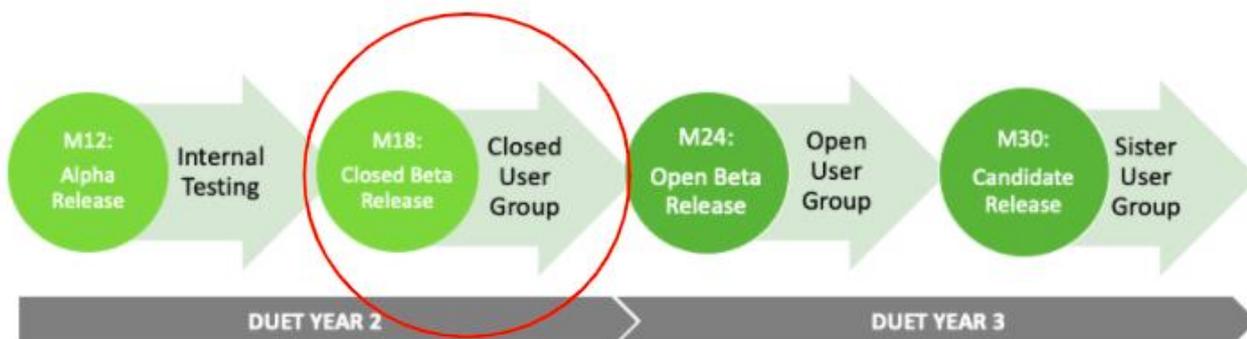
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# 1. Executive Summary

This report provides an overview of the first DUET Testing Cycle that aimed at testing the DUET Digital Twin Closed Beta Version (see Figure 1). It contains specific action items derived from qualitative and quantitative testing approaches to improve the DUET Digital Twin and provide a more stable and user-friendly Open Beta Version.



**Figure 1: Overview of DUET Testing Cycles**

The results of the first testing cycles were insightful and helped in focusing the efforts towards improving content and guidance, user-friendliness of the Beta Version for both expert and non-expert users, as well as identifying potential bugs in the current version.

A key finding from this testing cycle is that an additional interface for non-expert users should be created that allows for simple “before/after” simulations matching the skills and interests of non-expert users.

We have furthermore identified key areas for testing in the following testing cycle. These include the discussions with focus groups on gamification and specific user needs in this regard. Furthermore, more thorough testing of the features for registered users will be conducted. Overall, the number of testers will be increased beyond project partners and employees of project partner organisations - ensuring the inclusion of subject-matter experts (e.g. in mobility or environment) in public administrations in the three pilot cities and regions, as well as the inclusion of non-expert users (especially interested citizens).

Overall, the development of the DUET Digital Twin is well underway and it became evident during this first testing cycle that - while the user experience is to be improved - testers recognised the importance of the digital twin for policy-making. Testers have furthermore stated that the digital twin is a tool where finally data from the city becomes available at a central repository and that - with improvements to the usability of the tool - it can become a substantial aid in day-to-day activities in public administrations.

## 2. Introduction

The DUET Pilot Testing Cycles are an integral pillar for the successful delivery of a digital urban twin that is operational and user friendly. Following the launch of the DUET Alpha Version and the efforts to personalise the twins with data and simulation models for each DUET pilot region and cities - Athens, Pilsen, and Flanders (See D6.2), DUET launched the Closed Beta Version of the digital twin, which is accessible online<sup>1</sup>. This launch marked the starting of the first of three testing cycles with the ambition to elicit user feedback to improve the user experience and drive further development towards the Open Beta Version, which will be launched in M24, i.e. in November 2021.

This report provides an overview of

- The methodology applied for the user testing of the closed beta version;
- The results of the user testing of the prototype and their analysis;
- Specific recommendations for the development of user-friendly digital twins;
- An outlook for the upcoming second pilot testing cycle.

The overall ambition of this first pilot testing report is to provide our development team with the necessary insights to create a user-friendly digital urban twin. We want to create a solution that helps policy-makers, city administrators and in general, all citizens who have access to the digital twin, to get insights into how the city works. By combining the relevant data, empowering it by applying calculation models for traffic and air quality, as well as noise pollution, we want the DUET Digital Twin to be a useful visual aid supporting experts in making decisions and informing / communicating to the public the reasons behind selected policies.

## 3. Methodology

The methodology for this first pilot testing cycle combines a qualitative as well as quantitative approach. The combination of both approaches has allowed us to get a detailed understanding of how the DUET Closed Beta Version is currently perceived by a selected group of potential users and where improvements are necessary.

### 3.1. Qualitative Approach

The qualitative approach for the first testing cycle followed the general principles of usability testing. A selected group of users tested the DUET Closed Beta Version prototype in a one-on-one setting with the facilitator of the testing. The users were provided with a specific scenario and a range of tasks, which they were asked to complete. While completing the tasks, users were invited to share their thoughts, expectations and challenges during the interaction with the prototype. The benefits of this approach are clear: usability testing helps to identify problems with the design and development in the stage where features can easily be added, changed, fixed or improved. As explained by the Interaction Design Foundation, usability tests specifically allow us to<sup>2</sup>:

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<sup>1</sup> <https://citytwin.eu/close-general-pattons-bridge/>

<sup>2</sup> <https://www.interaction-design.org/literature/topics/usability-testing>

- 1) Determine whether testers can complete tasks successfully and independently;
- 2) Assess their performance and mental state as they try to complete tasks, to see how well your design works;
- 3) See how much users enjoy using it;
- 4) Identify problems and their severity;
- 5) Find solutions.

For this first usability testing cycle, we have selected five testers, whereby 3 testers work in city/regional administration of each pilot site (Athens, Pilsen and Flanders) - specifically in smart city/innovation units - and 2 testers have been selected from the staff of the DUET partner organisation Open & Agile Smart Smart Cities. In this first stage, we have chosen deliberately to test with users who have already heard about the DUET project but are yet unfamiliar with the Closed Beta (and previously the Alpha) Version. The reasons for this approach are simple: The DUET Digital Twin is still in an early stage of development, with one use case (Pilsen traffic simulation; at the time of the testing) publicly available. Furthermore, the twin did not yet operate at full capacity in terms of speed. Four of the five testers were women and all testers were between the ages of 30 and 50.

Each one-on-one usability test was conducted remotely via the Zoom platform and lasted between 45 and 60 minutes - including the time for the briefing of the testers. As part of the usability testing, testers were invited to share their screens while carrying out the task, so that the facilitator could follow the actions in real-time. Furthermore, the testers were asked to share their video, so that the facilitator also had the chance to notice facial expressions or gestures by the participants. Additionally, the users were encouraged to “think aloud” while working on the task. This has the benefit that the user explains what s/he is doing and every step that is taken, every doubt, every challenge and every expectation of a potential click is comprehensible for the facilitator and therefore also for the design and development teams. And lastly, each session was recorded for the subsequent analysis of the results to take place.

### Usability Testing Scenario

As mentioned before, at the time of the testing, one use case was fully available on the DUET Closed Beta for interaction with potential users: The traffic and noise simulation for the City of Pilsen, with the particular focus on the impact of the closure of a central and important bridge close to the centre of the city. This scenario is related to the epic G1, which was jointly identified as a high priority epic for all three pilot regions and cities.

#	Description
G1	<p><b>As a</b> public servant of a relevant department (mobility, spatial planning and environmental department,...)  <b>I want to</b> see the difference in density of traffic in the area of interest of a scenario where I closed traffic in a set of roads versus the base density,  <b>so I can</b> assess the impact of changes to the local situation on the traffic in my area of interest</p>
G2	<p><b>As a</b> public servant of the mobility or environmental protection department,  <b>I want to know</b> the level and impact on air pollution when certain roads would be closed  <b>so I can</b> discover causes of air pollution and the impact on citizens well-being in the city</p>

**Table 1: Epics that served as a baseline for the usability testing scenario**

Before starting the usability tests as described above, every tester received the same briefing (see Figure 2). They were invited to take the view of a citizen who read about the road works and the subsequent closure in the local newspaper. From there, they are invited to explore how the closure potentially affects their neighbourhood, which is located in the vicinity of the bridge. They start exploring the case from the landing page [www.citytwin.eu](http://www.citytwin.eu)

The goal for this scenario was specifically to receive feedback on the:

- 1) <https://citytwin.eu/> landing page;
- 2) <https://citytwin.eu/> use case page;
- 3) Digital Twin - DUET Closed Beta Version.

In all cases, we strived to find out more about the usability of the software as well as the functionality. And while it was not a primary objective, in one case the user also tested the registration to create their own “DUET” as well as the available data catalogue on the citytwin.eu website. As a result, insightful feedback on these two additional interfaces was provided.

## Briefing





- You are a citizen of Pilsen, a medium-sized European city.
- You're a keen reader of the local newspaper and you read there that the General Patton bridge, an important traffic node in Pilsen, will be closed for construction work soon for 3 months.
- You live 15 minutes on foot away from the bridge in a calm residential area.
- The article also said that traffic will be redirected and that you can digitally explore how the closure will likely affect traffic in surrounding neighborhood with the DUET Digital Twin tool.
- You go online to explore this new tool because you're interested in how the closure might affect you personally.
- You arrive at [www.citytwin.eu](http://www.citytwin.eu)

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**Figure 2: Briefing as presented to Closed Beta Version testers**

In the following section we outline the approach for the quantitative testing, which complements the qualitative usability testing.

## 3.2. Quantitative Approach

In order to evaluate the overall progress of the development of DUET and its application in each pilot region, four sets of criteria are put forward in the D6.1 Pilot Operations Plan, Section 5.2 on the Evaluation Criteria. These criteria relate to how a digital twin fits in the policymaking process; how stakeholders interact with DUET; how results are transferred to other cities and regions; and the business potential of the solution. These criteria were used as a starting point to perform the quantitative evaluation of the pilots. In this stage of the evaluation, the focus was put on the acceptance of DUET as a solution, the usability of DUET and the impact of DUET, especially whether it has an added value over existing solutions (see Table 2).

ID	Outcome	Description/question	Method	Goal	Obj.	Survey
<b>Digital Twins in the policymaking process</b>						
D1	Acceptance of DUET as a solution	Is DUET perceived as tackling a real problem and providing a sufficient solution?	S/I	90%	2.1	Yes
D2	Usability of DUET	Is DUET easy to use for its target audience? (User experience)	S/I	80%	1.3	Yes
<b>Business value</b>						
B1	Measure the impact of DUET	What is the added value of DUET over existing solutions, and how does it fit in existing policy processes? (Acceptance, satisfaction)	S/I	80%	2.1	Yes

**Table 2: Selected Evaluation Criteria for the pilot testing cycle**

To evaluate the feedback, a survey was developed based on questions regarding:

- 1) The profile of the participants (3 questions);
- 2) The acceptance and usefulness of DUET (5 questions);
- 3) The usability of DUET (2 questions);
- 4) The impact of DUET (1 question).

At the end of the survey, an open-ended question invited testers to provide suggestions to make the DUET solution better. The survey was based on a Likert scale of 5. After each question, participants were asked to explain if an answer was given on the 1 and 2 points of the Likert-scale. An example of a question is the following:

*“How easy is DUET to use?”*

- 1- Very difficult - 2- difficult - 3- neither easy, nor difficult - 4-easy - 5-very easy”

To determine if the goal (in Table 2) was reached, the researchers calculated how many people rated a question on Likert scale 3 or higher. Thus in the example of “how easy is DUET to use?”, this included people answering 3 - (neither easy nor difficult), 4- (easy) or 5 - (very easy) . The full questionnaire and results from the survey can be found in the annex of this report.

# 4. Results & Analysis of User Testing

This chapter provides a detailed account and analysis of the results from the testing cycle. Overall, it can be summarised that the combined approach of quantitative and qualitative usability testing has provided the DUET development team with a wealth of actionable insights to improve the user interface of the DUET Digital Twin in line with the project ambition to provide a tool that helps non-technical users - from city decision-makers, to domain experts in mobility, environment, etc, as well as the regular citizen - to get a better understanding of their city.

All these results have been immediately communicated with project partners leveraging the well-established bi-weekly pilot calls (see D6.1) as well as the regular technical meetings. The recommendations for improvement are already being implemented in an agile way by the technical team.

## 4.1. Qualitative Results

First of all, the results from the one-on-one usability testing are summarised and presented. To arrive at the results, the remote testing sessions were recorded and analysed with the help of the online whiteboard tool Miro. After distilling the key feedback - in form of direct quotes as well as summarised observations - from each of the five usability tests (see Figure 3), the results were translated into an actionable feedback shared with the project team. From there, the feedback has been shared with the technical partners using the already established feedback form to report bugs and file requests<sup>3</sup>.

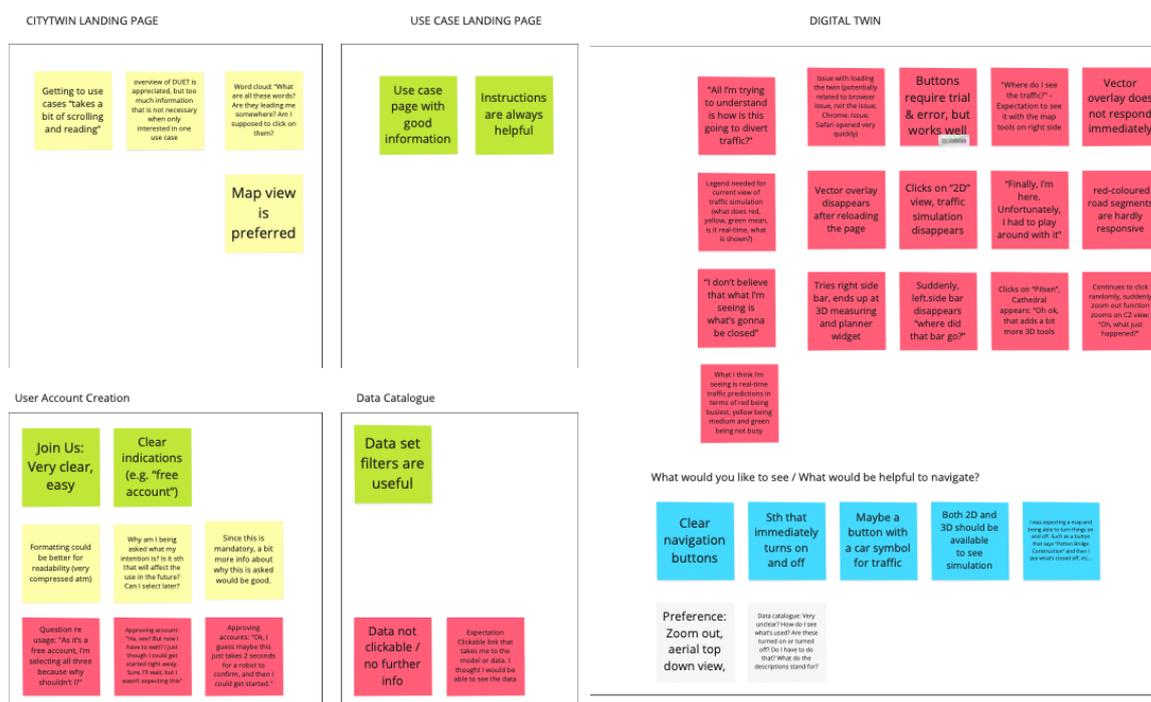


Figure 3: Summary of key feedback of one of the qualitative testing sessions in Miro

<sup>3</sup>[https://docs.google.com/forms/d/e/1FAIpQLSeQC0K7geb0bdIRgXX4R0s-zQgmLNjD4iE1\\_M\\_I0RLHkWPnRQ/viewform?usp=sf\\_link](https://docs.google.com/forms/d/e/1FAIpQLSeQC0K7geb0bdIRgXX4R0s-zQgmLNjD4iE1_M_I0RLHkWPnRQ/viewform?usp=sf_link)

In order to provide the best possible overview of the results from the first qualitative user testing, the feedback will be presented according to the main focus areas of the usability testing (i.e. digital twin, <https://citytwin.eu/> landing pages and <https://citytwin.eu/> use case pages). Additionally, we have received feedback on the data catalogue and registration process, which was not the focus of this first testing activity, but will nevertheless be shared in order to support the continuous and agile process of improving the DUET Digital Twin.

Before diving into the more detailed feedback, we highlight that the perceived usefulness of the DUET Digital Twin solution is high (see Table 3). Overall, the testers acknowledged that specifically, the integration of diverse data sets of the public administration in one place is potentially highly useful for city operations and day-to-day activities going forward. In addition, the testers lauded the interface of the <https://citytwin.eu/> landing page and use case landing page for the displayed information and the attractive and well manageable interface of the platform.

What	Description	Location
Data	Data sets used are interesting and useful	Data Catalogue
Data	Amount of data sets integrated	Data Catalogue
Data	Option to filter data sets is good	Data Catalogue
Interface	The citytwin.eu landing page looks appealing	Landing Page
Interface	Users access use cases very fast from the landing page	Landing Page
Interface	The banner of the landing page looks appealing	Landing Page
Registration process	Join us and the first steps are clear (also about the costs of registrations, i.e. "free account")	Registration
Data	Big step forward in connecting data and making it useful	Twin
Map	Ability to switch between 2D & 3D	Twin
Interface	Descriptions of use cases on the landing page are good and helpful	Use Case Landing Page

**Table 3: General feedback with a positive tone**

Going forward, we will provide more detailed feedback based on the five qualitative usability tests conducted according to the focus areas of the testing. Each subsection contains recommendations along the categorisation of Fix, Add, Improve, Remove as set out in D6.1 (see Table 4).

RECOMMEN DATION	ADD	REMOVE	IMPROVE	FIX
<b>Description</b>	Features and functionalities which have been identified by the user groups during the testing and feedback phase as relevant for a successful digital twin, but are not yet part of the release or the roadmap for upcoming roadmaps and therefore should be added.	Features and functionalities of the respective release which have been identified by the user groups during the testing and feedback phase as irrelevant or unnecessary - contrary to previous assumptions - and therefore should be removed.	Features and functionalities which have been identified by the user groups during the testing and feedback phase as unclear, confusing or otherwise insufficient. These features are nevertheless critical for the success of the Digital Twins and therefore need to be improved according to user needs.	Available features and functionalities which have been identified by the user groups during the testing and feedback phase as broken/not working, but are considered relevant for the Digital Twin and therefore need to be fixed.

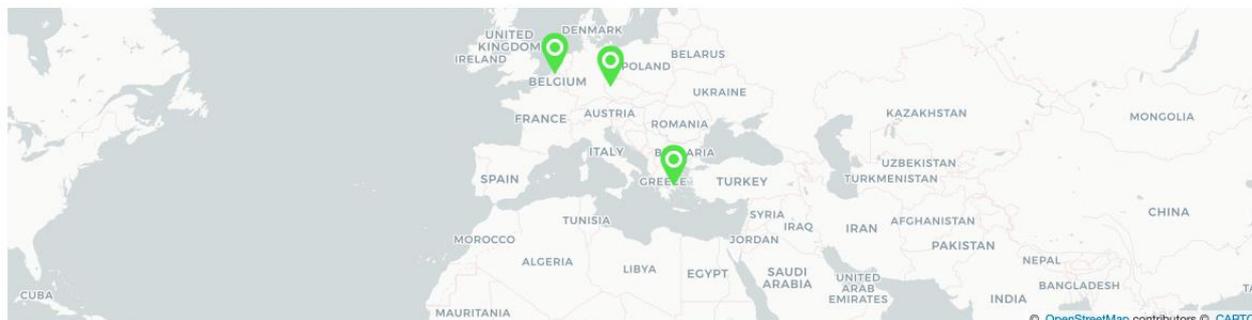
**Table 4: Feedback categories for pilot testing cycle reports**

#### 4.1.1. Citytwin.eu Landing Page

The <https://citytwin.eu/> landing page is most likely the first entry point for non-expert users (i.e. citizens) to the DUET project and the DUET digital twin. Therefore, this landing page is of great importance to explain what digital twins are and do, but also to lead visitors quickly to the use cases that are interesting and relevant to them. Because of this, we have started each testing session at this landing page and generated useful insights to make the current landing page even better.

Overall, the feedback on the landing page was positive and testers were at ease navigating from the landing page to the use case that was explained in the scenario. The main action items for DUET are now to improve readability by increasing text size on the website and by reducing the amount of information that is displayed on the homepage. Use cases should be brought into focus by moving them higher up on the landing page. The map has been used by 4 out of 5 testers to access the use cases and is therefore a highly relevant feature that should receive more focused attention (see Figure 4). On the other hand, the word cloud that is currently in place was rather confusing to most testers. The usability of the word cloud should be re-evaluated and potentially removed - also in an effort to reduce the information overload which was identified by the testers.

### DUET Case locations



**Figure 4: Map on Citytwin.eu landing page**

The table below shows the relevant feedback received from the testers on the <https://citytwin.eu/> landing page with recommendations for action.

What	Description	Location	Recommendation
Word cloud	Users don't seem to use the cloud, they are rather confused by it	Landing Page	Remove
Text size	Increase text size	Landing Page	Improve
Information overload	The landing page contains a lot of information and does not directly refer to the twin and the use cases. Recommendation to highlight the use cases on the top of the page	Landing Page	Improve

**Table 5: Feedback Overview for Citytwin.eu Landing Page**

#### 4.1.2. Citytwin.eu Use Case Page

The three <https://citytwin.eu/> use case pages provide an important introduction to each use case, explaining the background and ambition of each digital twin. Additionally, each page provides an overview of “how to use” the digital twin, as well as the data and data models that have been integrated for the respective use case. This overview was rated by all testers as highly relevant and helpful (see Figure 5).



How to use
Used data
Used models

Open the case, select the traffic layer.  
Then close the block the street on top of the bridge and see the impact on traffic and air. Below image shows the traffic and air pollution that is generated from the rerouted traffic.



See this case live on DUET

**Figure 5: Use case description on Citytwin.eu use case page**

As this description is the last information that users see before opening the Digital Twin tool, it is of utmost importance to:

- 1) Improve the content that is currently displayed for the Pilsen use case;
- 2) Ensure that the descriptions and explanations for future use cases are accurate, descriptive and complete.

This was the main point of criticism from the testers and should therefore be a high priority of the DUET team going forward (see Table 6).

What	Description	Location	Recommendation
Improve description of how to use	Use case Pilsen: The information is not complete, could be more detailed	Use Case Landing Page	Improve
Improve description of data used	Information is incomplete	Use Case Landing Page	Improve
Improve description of data used	Better explain what data models do and how they work	Use Case Landing Page	Improve

**Table 6: DUET Digital Twin - Closed Beta Version**

Following the testing of the landing page, which leads directly to the DUET Digital Twin tool, we are now focusing on the latter. As this is the heart of the testing, naturally, it received more attention and more feedback than the other parts that complete the digital twin experience.

As mentioned earlier, the ambition of DUET has been rated as highly useful. We have, however, identified issues with the user experience of the DUET Digital Twin, specifically with non-expert users who have not yet been involved in exploring the DUET Digital Twin, but who have a certain background in digital and data analysis.

A main point of critique was that the simulation was not available in the 2D view of the map, which leads to confusion. Overall, the simulation was hardly accessible for any of the testers as it is too complicated to navigate for non-experts. Testers were not able to identify certain features such as the ability to click on roadblocks to start the simulation.

One finding from the testing is that it might be relevant to consider two interfaces - one for expert users and one for non-expert users. The interface for experts should have all features to create simulations including a detailed guide, while the version for non-experts should only contain a prepared simulation that shows the "Before/After" situation and an explanation of the results.

Overall, the testers have made several suggestions to improve the guidance on the DUET Digital Twin page (see Table 7).

Another point of attention is the loading speed of the solution. As calculations are heavy and take more time, users quickly become impatient and delay the calculation process by starting to click on other buttons. This process leads to additional confusion and frustration. Therefore, a specific focus should be put on increasing the speed in the upcoming version of DUET leveraging HPC and cloud.

What	Description	Location	Recommendation
Simulation (General)	Enable simulation also 2D. Simulations are currently not available in 2D.	Twin	Improve
Simulation (General)	Show simulation / what-if selection with one click. Add a "button" that automatically blocks the desired area (like the bridge), add a before / after button.	Twin	Add
Traffic simulation	Traffic layer is hard to select / barely responsive	Twin	Improve
Traffic simulation	Improve navigation for traffic simulation: currently, the information is too specific /not understood by testers (i.e. choose simulation "KUL, Plan4All, CityFlows"; users do not understand these terms)	Twin	Improve
Traffic simulation	It is not immediately clear what the change is after a segment is blocked (see before / after suggestion). Improve explanation / interpretation of results.	Twin	Improve
Traffic simulation	Reloading the page makes simulation disappear	Twin	Fix

Traffic simulation	Colour code of visualisation is intuitive, but additional legend could be useful (red, yellow, green lines).	Twin	Improve
Traffic simulation	Data displayed (when clicking on traffic overlay) is barely relevant for normal citizens and hard to understand. Either remove or improve.	Twin	Improve
Map	Map keeps rotating after clicking on the top right map navigation button.	Twin	Fix
3D view	The 3D view is very flat. Can a bird-view for 3D be enabled? (users seem to prefer the 2D view; street names are not very legible in 3D).	Twin	Improve
Clearer instructions	Add pop-up windows.	Twin	Add
Clearer instructions	Add text (when hovering over a button) to inform users of the function of a button.	Twin	Add
Clearer instructions	Add tutorials (for example a video or short guide).	Twin	Add
Speed	Improve reaction / loading speed of the twin.	Twin	Improve
Improve data catalogue	Users are not sure if they need to "turn on data" to make simulation work; Potential solutions: disable data catalogue for public users or be more specific / clear about the functionalities.	Twin	Improve
Improve data catalogue	It is not clear if data is already activated or not.	Twin	Improve
Ad-block	Potential effect of ad-block on data visualisation.	Twin	Improve
Improve content	Explain what POI means (left hand side).	Twin	Improve

**Table 7: Feedback Overview for DUET Digital Twin - Closed Beta Version**

### 4.1.3. Additional User Feedback

During the qualitative usability testing, some users have gone further than others and therefore were able to share certain insights on the registration process on the citytwin.eu landing page and data catalogue.

The DUET Registration page, which is accessible through the "Join Us" button on the citytwin.eu landing page, was identified as clear and straightforward (See Figure 6). However, the testers identified certain aspects that can improve the registration process (see Table 8). First and foremost, this relates to the speed of the registration. As a physical person needs to approve the registration, this can take a certain amount of working days. The user was expecting a captcha/confirmation link and to be able to start immediately as a registered user.

In addition, there is no confirmation email that announces the registration and explains the process (for example: "Registration can take up to 3 working days to be completed"). Tackling these two aspects - increasing the speed of registrations and informing users clearly about the process - will greatly improve the user experience.



## Create a free DUET account

Use the DUET solution for free.

Use the DUET maps, data layers, models and dashboards to project DUET cases to your region. Upload your own dataset and combine it with the DUET data to gain more insights. Make simulation images and movies to document policy questions or decisions. Manage and store your work. Share it with the world to help others. To keep the bandwidth in control and to avoid abuse of the DUET solution, we ask you to apply for a personal account.

Full name \*

**Figure 6: DUET Registration Page to create simulations using the DUET tool**

Furthermore, the user has highlighted that the indication of “intention” (see Figure 7) which is required to complete the registration, causes some doubt about whether or not the experience / features might change depending on the answer. A short explanation as to why this information is collected would be helpful to remove any doubts on the user's side.

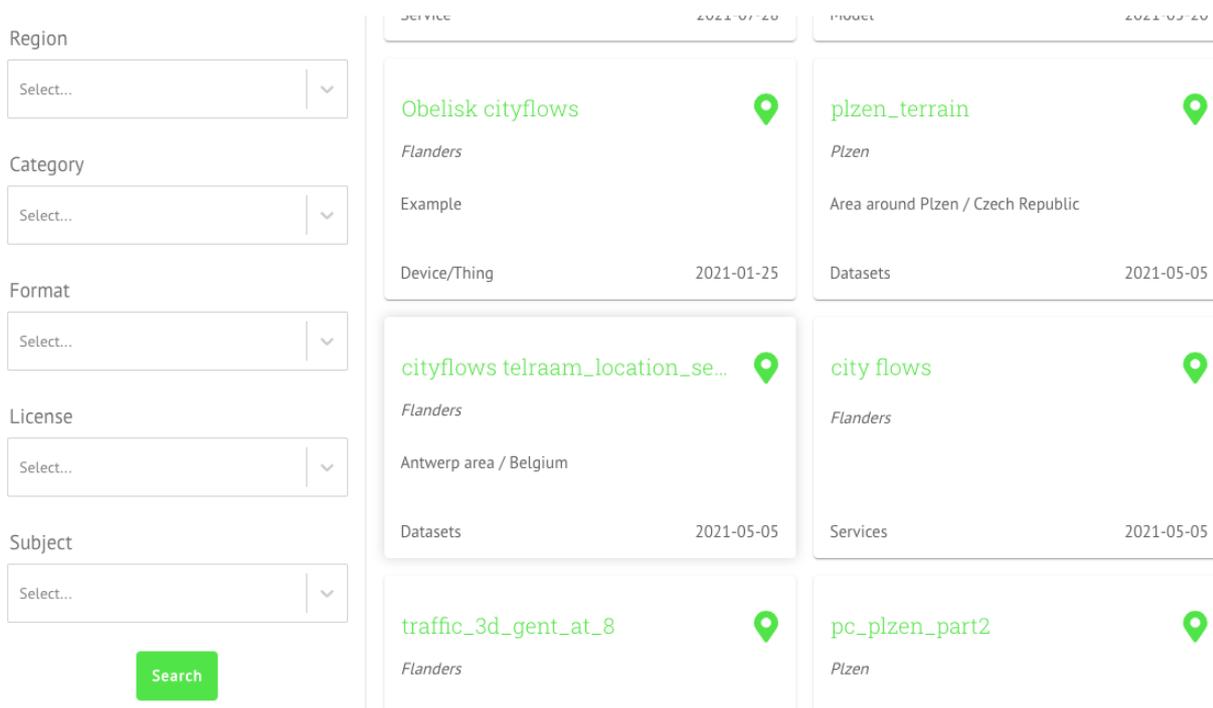
Your intention \*

- I want to create a view with the existing data layers
- I want to make simulation using the available data
- I want to combine my own uploaded dataset

Region \*

**Figure 7: Question to indicate “intention” when registering for DUET Digital Twin**

Secondly, testers have also shared feedback on the DUET Data Catalogue that is accessible via the citytwin.eu landing page (see Figure 8) but also through the DUET Digital Twin. Users are generally appreciative of the overview that is provided by the data catalogue with regards to the data that is featured in the digital twin. However, testers have identified the need to improve the titles and short descriptions to be clearer and more descriptive. The current overview is only clear to “insiders” to the project or data owners. Improved descriptions are needed to make it clear to people who are not already involved in the project about the purpose and use of these data sets.



**Figure 8: The Data Catalogue on the citytwin.eu website**

Additionally, the data sets on the citytwin.eu data catalogue appear to be clickable and thereby raising the expectation that datasets are available for download (or at least provide further information or lead to the source of the data). As the data is not available for download, the interface should be tweaked or additional information should be provided in order to not give the impression that datasets are downloadable. The overview of feedback is provided in the table below.

What	Description	Location	Category
Data descriptions	Details and titles of data in the data catalogue are not self-explanatory. Should be improved so that persons who are not involved in the project can understand what the data set is about.	Data Catalogue	Improve
Data download	Data catalogue (on the landing page) gives the impression that data is downloadable, which is not the case. Remove the hover effect or explain that the catalogue only provides info, not the data itself.	Data Catalogue	Improve
Improve registration process	Registration takes too long (due to the approval process).	Registration	Improve
Improve registration process	Create a confirmation email with a note about the approval process.	Registration	Improve
Improve registration process	Add an explanation about "intention" and why this information is needed. Users are confused as to how the intention will affect their use.	Registration	Improve

**Table 8: Feedback Overview for Data Catalogue & Registration Process**

## 4.2. Quantitative Results

The results from the quantitative testing are summarised and presented below.

### 4.2.1. Profile respondents

The testing group for the quantitative analysis consisted of 13 respondents: 3 GIS specialists, 1 director, 1 Open Data Manager, 1 product owner, 1 consultant, two head of EU Projects Sector, a business analyst, a project assistant, an innovation expert and an intern. 69% uses data regularly (daily, weekly or monthly) for policy making in the day-to-day job, while 31% seldom or ever. Therefore, some caution needs to be made, as for some participants the use of DUET will not be that useful by definition. 77% have average or high skills in using data for policy making, while 23% consider their skills low or very low.

### 4.2.2. Acceptance of DUET

Illustrated in Table 9 are the results on the perceived acceptance and usefulness of DUET as a solution. Different users perceive DUET as a useful tool, where the interpretation of the data, access to real-time data sources and the help in what-if analysis showed potential if the user friendliness of the tool would improve. The **interpretation of the data** could be improved by displaying broader connections between different data and by involving modelling options and by including more metadata, a legend and labels. The **access to real-time data sources** makes it possible to simulate designs and to get closer to the real situation. There was doubt in the respondents whether the data in the use case was real-time, though. The **what-if analysis** is seen as a powerful tool in theory. It is by some respondents seen as the most important functionality of DUET. However, respondents indicate that this functionality is not yet sufficiently developed or sufficiently user friendly in order to be useful.

Acceptance & Usefulness	Percentage of Respondents (Likert scale 3-5)	Objective Reached
How well does DUET improve the interpretation of data?	76,9%	No
How well does DUET improve access to real-time data sources?	84,6%	Yes
How well does the what-if analysis help to make decisions?	69,2%	No
How well does DUET improve decision making in your day-to-day job?	46%	No
How helpful is DUET in your day-to-day job?	69,2%	No

**Table 9: Survey Results on the Users' Acceptance of DUET as a Solution**

In its current state, DUET will not improve decision making in the day-to-day job due to key limitations already identified. More **metadata** needs to be included and a **legend** needs to be made, and the presentation of the tool needs to be made easier. The slow loading time of the current demo created some frustration for some of the users, but if the tool becomes **more user friendly and faster**, respondents believe it will improve the

decision making. Additionally, in order to be more impactful it is crucial to determine **use case descriptions** and to define markets and beneficiaries more clearly.

### 4.2.3. Usability of DUET

Illustrated in Table 10 are the results on the perceived usability of DUET. A key finding is that the user interface (UI) and user experience (UE) need to be improved as some functionalities are not yet sufficiently clear and intuitive to the user. One participant mentioned *“DUET should be more intuitive and easier to use, the program has high potential and everyone should have the opportunity to take advantage of its features”*. Therefore, there are several points of improvement.

In particular, the performance of the platform should be optimized by improving the **load time**. Additionally, the UI should be improved to be more intuitive and user-friendly. The use of different buttons/ functionalities should be clarified, particularly the interface on the map, how to process and add data and how to obtain data, and what “sending changes” means. Testers also suggested including a legend on the data layers and to provide a short **video tutorial** or a guided tour, part of the UI experience.

Some participants mentioned they liked the option to control the movement of the map with the mouse and the elevation profile works well. But other functions need improvement, as no changes in the data occurred when one respondent wanted to close off a street block.

Usability	Percentage of Respondents (Likert scale 3-5)	Objective Reached
How easy is DUET to use?	46%	No
How clear is the DUET platform?	61,5%	No

**Table 10: Survey Results on the Usability of DUET**

### 4.2.4. Usefulness and Impact of DUET

As illustrated in Table 11, the usefulness and impact of DUET scored below the goal, but this needs to be nuanced as some respondents do not have a job which requires the use of DUET in their day-to-day job.

Additionally, the usefulness and impact would increase if the user-friendliness of the DUET impact would increase. Some respondents indicated the DUET platform is a significant step forward to present and prepare data resources for decision makers. The **use of 3D might show benefits** for some use cases, but for other use cases 2D visualizations might be sufficient as it **3D slows down the program**. Some users indicated also that they already have tools and visualizations which do exactly the same, without the 3D factor.

The usefulness and impact of DUET	Percentage of Respondents (Likert scale 3-5)	Objective Reached
To what extent does DUET complement your current tools for decision making?	69%	No (Nuance: some respondents do not have a job which requires the use of DUET)

**Table 11: Survey Results on the Usefulness and Impact of DUET**

## 5. Conclusion

The first testing cycle of DUET was a success as we have identified important action points based on user feedback to make the DUET Digital Twin more relevant and user-friendly. Overall the testing cycle has proven its value, revealing improvements which are necessary in order to ensure DUET will be a helpful tool for expert and non-expert users.

The Digital Twin was perceived as a potentially very useful tool in day-to-day work and policy-making with its capability to visualise data and connect datasets, which previously were held in silos across the administrations and beyond.

However, we have also identified shortcomings, particularly in user experience. This applies to both expert and non-expert users.

### 5.1. Recommendations

Following the first DUET Testing Cycle it has become clear that the consortium should focus on improving the user experience as a next step. After successful application of open standards for the DUET architecture (see D3.1 and D3.2) as well as the integration of datasets and data models, the user experience should now be the top priority for DUET to become a successful tool that is widely adopted not only in the three pilot cities and regions, but also in cities and communities across Europe and the globe.

The most specific recommendation to create a user-friendly experience is to evaluate if interfaces can be developed for both expert users (with a main focus on creating new maps and visualizations) and for non-expert users (with a main focus to show before/after visualizations). It could also help to establish a comment function for all users so that they are able to share feedback on the use cases.

In addition to the above, the following actions are recommended from this first testing cycle:

- Improve functionality for activating / deactivating scenarios for what-if analysis and visualization/explanation of the consequences of a scenario. Since the main objective of the DUET platform is to support such what-if analysis and exploration of scenarios, improving this functionality is key;

- Improve the current content of the Digital Twin and the citytwin.eu website with a specific focus on:
  1. the descriptions of the use cases on the citytwin.eu page;
  2. clarifying the purpose of the DUET platform and its use;
  3. information about the data used and whether it is real-time or model data.The ambition should be to have clear and descriptive content that is self-explanatory to both expert and non-expert users.
- Improve speed / response of the platform;
- Confirm and fix potential bugs that have been identified during the testing.

## 5.2. Outlook for Testing Cycle #2

The first testing cycle was conducted with a closed user group that was very closely linked to DUET and partner organizations. The next testing cycle will open up to more expert testers, as well as to non-experts (ie. citizens) who will test the functionalities relevant for this user group.

Therefore, preparations and talks are ongoing as part of the bi-weekly pilot calls to prepare for the next testing cycle and to elaborate a clear action plan to involve citizens as well as domain experts in each of the pilot sites for focus group user testing as part of the second testing cycle.

The consortium has already identified the testing focus for Cycle #2. It will include the following:

- 1) Testing the functionality and usability of the registered user backend / Interface to create new maps and simulations;
- 2) Focus Groups with non-expert users to define user needs for gamification tools;
- 3) Quantitative testing leveraging the survey infrastructure created.

## 6. Annex: Quantitative survey questions & results

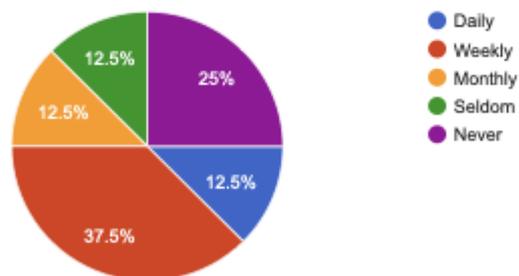
What is your role in your organisation?

8 responses

- GIS Specialist
- GIS specialist
- consultant
- Head of GIS department
- Open Data Manager
- Stagiaire
- product owner
- Head of EU Projects Sector

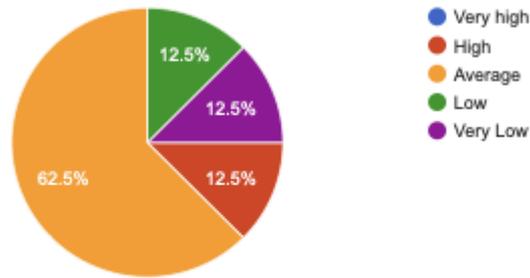
To which extent do you use and process data for policy making in your day-to-day job?

8 responses



### How would you rate your personal skills to use data in policy making?

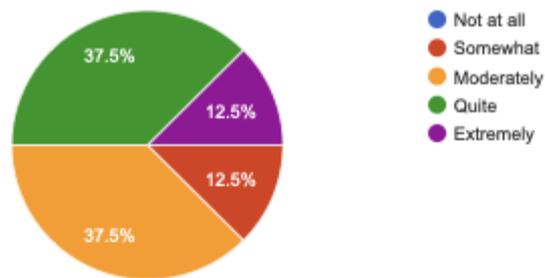
8 responses



### DUET Digital Urban Twins

#### How well does DUET improve interpretation of data?

8 responses



Please explain the reason for your choice

6 responses

Displaying broader connections between different data and involving modeling options.

To interpret the data correctly, it is necessary to add a more detailed description of the data (metadata) and a legend.

Add labels/tooltips to layers

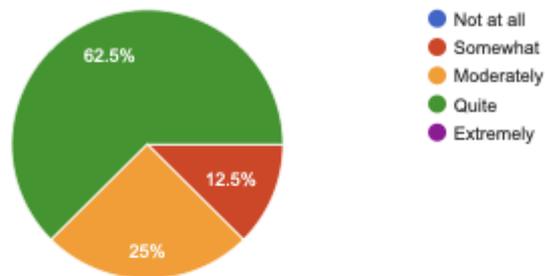
Due to the long loading times in the demo, it is not easy to interpret the data more easily. In the demo, I didn't notice any changes in the data when 'closing' a streetblock. I'm not even sure if I did anything at all. (The UI is not very easy to understand/use at all, which does not help the overall experience.)

interface on the map not 100% clear, usability makes it hard to see where you can simulate your case

The visualization of data on a map is highly usable on a city environment. Also the creation of what-if scenarios

How well does DUET improve access to real-time data sources?

8 responses



Please explain the reason for your choice

6 responses

It takes into account the direct use of data from sensors (traffic loops, air and noise measurements).

In fact, I'm not even sure if the "traffic\_plzen" data is real time data or if it's model data. It is not mentioned anywhere. The traffic model in the app is out of date and the displayed situations do not correspond to reality.

If any real-time data (from sensors, from mobile operators or float data from cars) can be connected, it will be beneficial to simulate designs. In addition, we will get closer to the real situation.

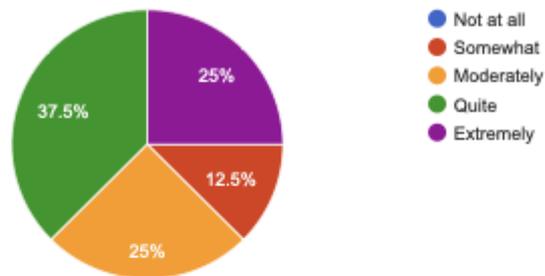
I can not say. I don't have the feeling that there is real-time data in this demo? And again, what will happen with the speed if you add more data sources?

not call clear what is the real-time data in the metadata

The access to data depend on their availability

How well does the what-if analysis help to make decisions?

8 responses



### Please explain the reason for your choice

5 responses

It is a very powerful tool when used. Usability depends on the quality of data and models and implemented functions.

In the tested project I was not able to create my own analysis. But according to the presentations at the meetings, these are interesting analyzes.

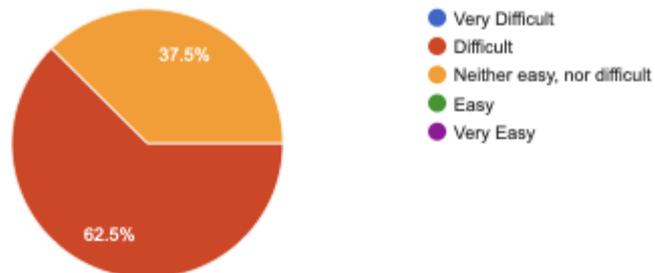
I don't know how to display those analyzes. This should be the benefit of the duet

I can imagine that what-if analyses can help to make decisions. However, I did not found this functionality or it was not clearly indicated. (As stated in the first question.)

Forecasting the outputs of a decision is a proactive process that can optimize the process

### How easy is DUET to use?

8 responses



### Please explain the reason for your choice

7 responses

It requires knowledge of the researched issues and possible contexts.

The process of adding data to the map is quite complicated.

In one project, data from multiple cities are combined, which can be again confusing.

Some labels (buttons) are in German.

It is not clear at first glance what data it is possible to obtain additional information in the map window (ie they are clickable).

I appreciate the control of movement in the map with the mouse.

Elevation profil works well

Camera flight - some grey window in the dialog box

Drawing - I wasnt able to move with selected object and edit and its shape.

The user loses a lot of time before understanding what the application can do.

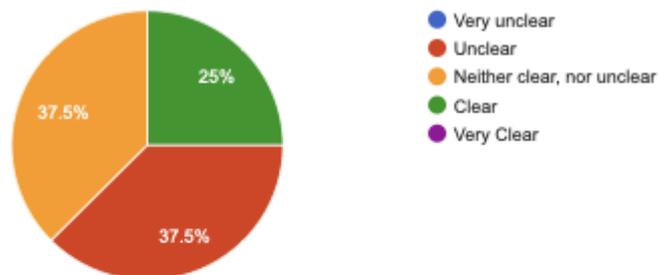
The help is done well.

Maybe a few basic short video tutorials would help.

At first sight, it looks fairly easy to use. However, when trying more things out and 'closing' street blocks, I did not see anything happen or change?

### How clear is the DUET platform?

8 responses



Please explain the reason for your choice

6 responses

I am not a decision maker, but only a specialist preparing data. Using may cause requests for additional data outputs.

I think there are still a lot to improve. First, the right, up-to-date and reliable data must be available. The data must contain a description (metadata) and a legend in the map. To create analyzes, it is necessary to create a simple procedure and make instructions.

The user must feel that the analyzes will help him to better assess the situation and make better decisions.

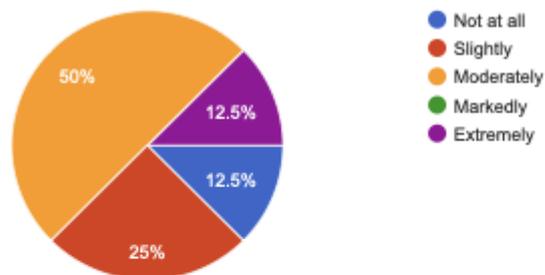
For me, personally, in this stage and in this demo, not at all. Again, the speed and the bugs of the system don't help the experience, at all. By using DUET, I will only lose time and gain frustrations. At this time there are plenty of other, faster, tools that are able to help me/us for our decision making.

I have a job that doesn't expect day-to-day decision making on traffic for the moment.

Decision making is not on my daily responsibilities, but the potentiality of DUET is

How helpful is DUET in your day-to-day job?

8 responses



**Please explain the reason for your choice**

6 responses

I am not a decision maker, but only a specialist preparing data. For real decision makers is, without a doubt, helpful.

See answers above. + I was not able to load some cases and create own analysis...

The application should be easy to use, clear, what data is used there.

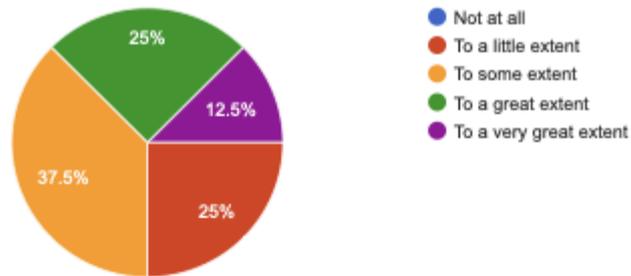
See previous question.

I have a job that doesn't expect day-to-day decision making on traffic for the moment.

As above

**To what extent does DUET complement your current tools for decision making?**

8 responses



### Please explain the reason for your choice

6 responses

I am not a decision maker, but only a specialist preparing data. But it is a significant step forward in presenting data and prepare resources for decision making.

Traffic model with current traffic situation. Noise and air pollutions.

Traffic model, noise pollution, air pollution

I can imagine that if the tool works faster, that this can help in certain policy areas. However, I do not see the advantage of the added 3D models in this use-case. (In the demo, you can not use the traffic layer in the 2D view, only in the (slower) 3D view; why?

Currently we have tools and visualisations that do exactly the same, without the 3D factor added.

I have a job that doesn't expect day-to-day decision making on traffic for the moment.

My city does not have enough decision making tools

### Do you have any suggestions to make the DUET solution better?

6 responses

Implementation of the possibility of temporary insertion / replacement of one's own 3D object (new building, noise barrier, design and architectural design). Visualization of the impacts of planned constructions is, after all, the basic principle of modeling and planning and the most necessary option for decision making.

Base map when viewed from the side is not legible (blurred). There may be an option to enlarge the map window to full screen.

The user must know which parts of the DUET he needs and can use. And after turning on the application, it doesn't know much.

I know that this is still a demo, but an improvement of the loading speeds would help this solution a lot.

Also, a guided introduction within the tool; or a video or something can help to understand the solution much better. When testing the demo, I did not have any idea if what I was doing, was right.

And like I said in the previous question, I'm not sure if the 3D-visuals add that much