Deliverable

Project Acronym:	ImmersiaTV
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D4.4. User evaluation

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Abstract: This report details, iteratively, the perception of the experience by the end- users, as well as the perception of professional content producers using the production tools from performance and service management perspectives. Usability aspects are also included in this report.

REVISION HISTORY

Revision	Date	Author	Organisation	Description
0.1	28/12/16	Wendy Van den Broeck	imec	First version of the deliverable
0.2	02/01/17	Touradj Ebrahimi	EPFL	Revision
0.3	11/01/17	Wendy Van den Broeck	imec	Revised version of the deliverable
0.4.	07/03/17	Joan Llobera	I2cat	Revision of the deliverable and open comments
1.0	31/05/17	Wendy Van den Broeck, Paulien Coppens	imec	Revision of the deliverable
1.1	28/08/17	Paulien Coppens, Wendy Van den Broeck	imec	Update of the deliverable
1.2	25/01/18	Paulien Coppens	imec	Second version of the deliverable
1.3	25/1/18	Touradj Ebrahimi	EPFL	Second version revision
1.4	26/01/18	Paulien Coppens	imec	Revised version of the deliverable

EXECUTIVE SUMMARY

This deliverable reports on the user evaluation of the different pilot activities.

This deliverable is split in three iterations, in line with the three pilots. A first version of D4.4. was foreseen in M11, a second version in M20 and the third version in M30. This document contains the first and second iteration of D4.4.

This deliverable is directly linked to D4.1. "Pilot evaluation and execution plan" in which all the planned evaluation activities are described in detail. This current deliverable reports on the results of these different activities. Furthermore, also the end-user and professional user requirements as listed in D2.1. and D2.2. are closely related to this deliverable.

In the first version of this deliverable (January 2017) all the evaluation activities related to pilot 1 were discussed. This includes both end-user evaluation and professional user evaluation of pilot 1. For the end-user evaluation, different evaluations of the developed documentary (Dragon Force) took place. For the professional user evaluation, focus is on the iterative development of the Immersia TV content creation toolkit.

In this second version of the deliverable, we describe the user and professional evaluation activities related to pilot 2. This second iteration was normally foreseen for M20. However, because of the postponement of the pilot 2 evaluation activities due to technical development delays, the submission of this deliverable was delayed to M25.

The third and final iteration of this deliverable is foreseen for M30.

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CONTENTS

LIST OF ACRONYMS

Acronym	Description
HMD	Head-Mounted Display
VR	Virtual Reality
Avg.	Average
CAPI	Computer Assisted Personal Interview
MOS	Mean Opinion Score
QoE	Quality of Experience

1. INTRODUCTION

1.1.   Purpose of this document

This deliverable will iteratively report on the different user evaluation activities related to each pilot phase. Focus is both on the user experience of the end-users while consuming the developed content as on the user experience of the professional users while using the different production tools to create content.

For each pilot, detailed evaluation activities are outlined in D4.1. - Pilot execution and evaluation plan. In this deliverable, focus is on the results of the user evaluation activities. After each pilot phase, a new version of the deliverable will be provided. This deliverable is complementary to D4.3., which discusses the execution of the pilots and D4.4., which addresses the technical evaluation of the pilot.

1.2.   Scope of this document

The first version of this deliverable (M12) reported on the results of the user evaluation activities for pilot 1. The document is outlined according the different defined evaluation activities in D4.1. These evaluation activities are clustered as follows:

1) Iterative development of the content creation toolkit (P1.1.)
2) Evaluation of the content creation toolkit (P1.8)
3) Evaluation of Premiere Pro plugin and the tutorial (P1.10)
4) Evaluation of the demonstrator at demo-booths (IBC and NEM- P1.2 and P1.9)
5) Closed pilot test (P1.3- P1.4 and P1.5)
6) Semi-open pilot (P1.6)
7) Open pilot (P1.7)

The second version of this deliverable (M25) reports on the results of the user evaluation activities for pilot 2. The document is outlined according the different defined evaluation activities in D4.1. These evaluation activities are clustered as follows:

1) Iterative development and evaluation of the live director's toolkit (P2.1)
2) Closed pilot test (P2.2)
3) Semi-open pilot test (P2.3)
4) Open pilot test (P2.4)

1.3.   Status of this document

This is a second intermediate version of D4.4. with delivery foreseen in M20. This document focuses on the end-user evaluation activities of the first pilot. Other versions of this document will be delivered in M25 (additional intermediate version related to pilot 2) and M30 (pilot 3).

2. OVERVIEW OF EVALUATION ACTIVITIES

The pilot evaluation activities were detailed in D4.1. The overall methodological approach for the pilot evaluation is the living lab framework. This approach is detailed in D4.1. pg. 13-17. The main characteristics of the approach are the iterative approach, the importance of the natural setting of the use case and the central involvement of users (end-users as well as professional users). As mentioned in D4.1., the user research is a continuous activity throughout the entire development process. Our aim is to provide in-depth insights in the users via a multi-stakeholder approach in which different user research methods are combined in order to understand how the innovation fits within people's everyday practices. The following central questions were defined as part of D4.1.:

- How will the ImmersiaTV experience fit within viewers' current TV-practices?
- How will professional users integrate the developed ImmersiaTV toolchain in their current workflow?

The research findings are translated in direct actionable feedback on different layers including technical, business and usability aspects.

2.1. Overview evaluation activities pilot 1

The following table gives an overview of the foreseen evaluation activities as mentioned in D4.1. For each of the foreseen activities, we indicate the current status in M25.

N°	Activity	Timing (foreseen in D4.1)	Target group	Location	Status (in M25)
P1.1.	Evaluation of content creation toolkit (software evaluation)	June 15 2016 (1st SW release) - October	Professional users	VRT (Brussels) Lightbox (Porto)	100% Completed
P1.2.	IBC evaluation activities	September 8-12, 2016	Visitors IBC Immersia TV boot (professional users/end-users)	Amsterdam	100% completed
P1.3.	Pre-test of closed pilot action (lab setting)	September 2016	End-users	Brussels	NA (pretest took place in Porto during P1.5.)
P1.4.	Closed pilot test in lab setting	October 2016	End-users	Brussels	100% completed

P1.5.	Closed pilot test	October 2016	End-users/ professional users	Porto	100% completed
P1.6.	Semi-open pilot (online test)	November-December 2016	End-users	Brussels/ Barcelona	100% completed
P1.7.	Open pilot (open online test)	Jan-June 2017	End-users	Everywhere in Europe	Planned in February – March 2018

Table 1: Overview foreseen evaluation activities pilot 1

Three additional evaluation activities, not foreseen in D4.1, were executed as well:

N°	Activity	Timing	Target group	Location	Status (in M25)
P1.8.	Workshop on production tools	November 2016	Professional users	Porto	100% completed
P1.9.	Evaluation at NEM	November 2016	NEM visitors	Porto	100% completed
P1.10	Evaluation of Premiere Pro plugin and the tutorial	May 2017 – September 2017	Professional users	Barcelona	100% completed

Table 2: Overview additional evaluation activities pilot 1

For consistency in the reporting, we will report on the different evaluation activities in a clustered way:

1) Iterative development of the content creation toolkit (P1.1)
2) Evaluation of the production toolset (P1.8.)
3) Evaluation of Premiere Pro plugin and the tutorial (P1.10)
4) Evaluation of the demonstrator at demo-booths (IBC and NEM- P1.2 and P1.9)
5) Closed pilot test (P1.3- P1.4 and P1.5)
6) Semi-open pilot (P1.6)
7) Open pilot (P1.7)

For each of these activities, we will discuss the planned set-up, the detailed execution of the evaluation activity, the obtained results and insights and the next planned steps.

2.2. Overview evaluation activities pilot 2

The following table gives an overview of the foreseen evaluation activities as mentioned in D4.1. For each of the foreseen activities, we indicate the current status in M25.

N°	Activity	Timing (foreseen in D4.1)	Target group	Location	Status (in M25)
P2.1.	Evaluation of the live director's toolkit	March-July 2017	Professional users	VRT, Brussels	100% Completed
P2.2	Closed pilot test	Oct-Nov 2017	End-users/ professional users	Belgium	100% Completed
P2.3	Semi-open pilot test	Dec 2017 – January 2018	End-users	Belgium	Planned in February – March 2018
P2.4	Open pilot test	February 2018	End-users	Belgium	Planned in February – March 2018

Table 3: Overview evaluation activities pilot 2

For each of these activities, we will discuss the planned set-up, the detailed execution of the evaluation activity, the obtained results and insights and the next planned steps.

3. PILOT 1 - USER EVALUATION RESULTS

3.1. Iterative development of the content creation toolkit (P1.1.)

3.1.1. Planned set-up

The aim was to organise an iterative development of the Immersia TV content creation toolkit in which intermediate feedback of the professional users at Lightbox and VRT would be incorporated in new versions of the software.

Two central questions guided this activity:

1) Is the developed software in line with the formulated software requirements as part of WP2 research activities?

2) How can we maximize the user friendliness and satisfaction with the developed software?

The detailed set-up of this activity was defined in D4.1., pg. 18-19. An online questionnaire was developed applying a USE questionnaire as developed by Lund (2001) in which generic topics as usefulness, ease of use, ease of learning and satisfaction were incorporated. Professional users could also give feedback on specific software functionalities. For the functional evaluation, the requirements as defined in D2.2.and D2.3. were used as a starting point (see D4.1. pg. 19-22). In a second phase, also a think-aloud evaluative method was planned.

The expected outcome of the software evaluation activities was a validated toolset that integrates well within editors' workflow, has a high-perceived usefulness and is intuitive and user friendly.

3.1.2. Detailed execution of the activity

The plan was to have 12 professional users iteratively testing and evaluating the software, 6 at Lightbox and 6 at VRT. However, only professional users directly involved in the Immersia TV project evaluated the software, leading to a total of 6 professional users evaluating the software. This was due to time constraints and more specifically the need for quick iterations to develop the software in combination with the fact that the evaluation took place in summer.

The participants completed the developed online survey (see D4.1., annex 1). Besides the survey, also conference calls were set up to discuss the necessary improvements in the software toolkit.

In total 7 releases of the software were iteratively tested. Only after two releases (0.2. and 0.4) the survey was used, afterwards feedback was provided in dedicated meetings on the topic. This because only 5 users tested the software and experiences could be shared and discussed more easily in a meeting.

In annex I, an overview of the different screenshots of the evaluated software version can be found. These screenshots were also used in the survey, to show the different features that were evaluated.

3.1.3. Obtained results

Based on the first version of the survey after release 0.2., the main feedbacks on individual functions of the Premiere Pro plugin were:

1) It was considered too complex to use the software, because it included too many functionalities. The main suggestion here was to "keep it simple" and group or even leave out some of the functions.
2) For specific functions such as the reference snippet, there was no visual reference on the output screen, which made it difficult to understand what it actually does.
3) For the longitude and latitude snippet, this was considered counter-intuitive and difficult to use. Here the professional users prefer the use of width and height or position in pixels.
4) The size snippet should be presented in percentages instead of in absolute numbers.
5) The Luma Matte snippet was considered not useful, since the users did not understand its specific function. Also here a visual representation was highly recommended.
6) For the Render Mode, the nomenclature (naming of the different items) was considered being unintuitive and unclear.
7) The Immersia TV export panel was considered very useful. Here users would prefer an indication that the export has started. The function of the transition tick box was also unclear.

Concerning the overall feedback on the integration of the tools in the current production flow, the following comments were made:

"1) In general: Think we have to work on the UX, make clear what it does: transition portal interaction. Don't copy code ideas (longitude, latitude) to the plug in, maybe work with X-Y-Z. The output screen: all the setting changes we make in the portal effect, are not seen in the output sceen.

2) The whole system and method should be made more intuitive and easily understandable. This also changes our style of workflow, directing it into a NEST oriented type of workflow due to the fact that we can only use one sequence to proceed to the final output.

3) They integrate fine, apart from some install issues. As of right now, it's very clunky and non-intuitive to use, except for the export panel. Though in the 2015.3 version of Premiere it did not export correctly (no image output)."

This indicates that the User Interface is very important and that the use should be more intuitive. Also the integration with existing tools is considered important. "*We should try to integrate it with the new version of Premiere, especially since now it supports a live preview of 360 footage (which before required plugins such as Kolor Eyes). And see how the portals behave in the 3D space."*

After version 0.4., evaluation on most of the functions of the Premiere pro plugin was positive, since the suggested improvements were integrated in the new versions. Remaining issues were:

"1) Render mode: "*Needs clarification and visual feedback on what we are doing. Having it on or off shows the same result in the preview window, as well as switching between the numerous options on the dropdown menu. Tried using it in the third tutorial, but since it doesn't offer any visual feedback and (as of now) I have no way of testing the final output, I have no idea if it works or not. Also, if it includes interactivity, it should feature some form of possible preview, since each option grants the same end result. Should include a prompt that lets the user know what its possible uses are, and what each option does visually, for each of the options (or on the manual)."*

2) Immersia TV export panel: "*The refresh could use a bit of work, since it works sometimes and other times it doesn't. I noticed it working mostly after quitting premiere and leaving only a single sequence open, when it refreshes. Seems a bit random. Tested it with multiple video tracks and seemed to respond nicely, though when using multiple video files it tends to behave a bit randomly in showing more tracks than there actually are. Also, when exporting, the output files tend to have their names switched: it outputs some video files with some other names. Finally, it should offer some sort of explanation of what one should expected from the options, i.e, number of files it will export and the sort - that way we'll know if it did or didn't do its job properly - a bit in the same fashion as exporting files from Premiere, when something goes wrong, the program sends a prompt letting us know it didn't export correctly - though in here it would be more simple, such as having a number of set paths below the export button that would show, based on the options selected, the number of files it will produce.*"

In terms of integration, a main issue was the **work speed**, as the plugin tended to load the images very slowly. Having a preview option was also considered important: "*Also, I would suggest that the immersia player should be integrated with the plugin so that we could preview each format we're outputting, to have a final preview before outputting the final clips.*"

During conference calls on the software evaluation, several suggestions for improvements were discussed. In addition, the practical usage by Lightbox, at i2CAT and PSNC also showed several bugs which needed to be corrected.

Based on the detailed feedback by professional users, we released several software revisions. These are detailed in deliverable D3.8.

3.2. Workshop on production tools (P1.8)

3.2.1. Detailed execution of the activity

A second evaluation activity was a workshop on production tools that took place in Porto on November 21[st.] This activity was not planned in Deliverable 4.1., since it was an opportunity that emerged after the delivery of D4.1. The workshop was organised in cooperation with the UCP (Universidade Catolica Portuguesa) – School of Arts, as part of the Science and Technology Week 2016 in Porto. The workshop consisted of a lecture explaining the different tools and a hands-on session in which participants could test the software.

Figure 1: Production tools workshop at UCP

The workshop was divided into two parts. During the first part VideoStitch explained how video content can be acquired and stitched. Here different cameras and rigs were presented and the

post-production stitching workflow was explained. During the second part, Lightbox discussed how to edit and add metadata. The use of the Adobe Premiere Pro plug-in was demonstrated and the required actions to set-up a project and add timelines was described. Participants could then test and experiment with different tools.

10 participants took part in the workshop, consisting of a mix of university staff, PhD researchers and master students. 8 respondents gave their feedback via our evaluation form after the workshop.

An overview of the participants can be found in the table below:

Participant	Gender	Occupation	Field of study
1	Male	PhD researcher	Sound
2	Male	PhD researcher	Audio and machine learning + video games
3	Male	PhD researcher	Digital media
4	Male	Student	Documentary
5	Female	PhD researcher	Digital media
6	Male	Professor	/
7	Male	Professor	Digital video
8	Male	Professor	Computer- music-multimedia

Table 4: Overview participants production tools workshop

3.2.2. Obtained results

Overall rating of the workshop

Overall, the workshop was very positively perceived. A first question in the evaluation form was to rate the workshop with a score of 1= poor to 5 = excellent. The following table shows the different criteria, the mean opinion score and the minimum and maximum scores that were given. (N=8)

	Avg.	Minimum	Maximum
Overall quality of the Immersia TV workshop	**4.1**	3	5
Relevance of the workshop for you personally	**4**	3	5
Part1. Acquiring videos and stitching them – explanation	**4.4**	3	5
Hands-on session on video stitching	**3.9**	3	5

Part 2 editing and metadata explanation	**4.7**	4	5
Practical exercises on editing and metadata	**4.3**	3	5
Usefulness of the content	**4.3**	4	5

Table 5: Production tools workshop evaluation

This table shows that participants were overall very satisfied with the workshop. The parts in which the workflow was explained received very high average scores, respectively 4.4. and 4.7. The hands-on part on video stitching was scored the lowest, but still scored an average of 3.9. The overall usefulness of 4.3. indicates that the workshop attracted the right audience.

Appropriateness of workshop in relation to skill level

A second evaluation question was whether the level of the workshop was appropriate to the current skill level of the respondents. Respondents could choose between too advanced, about right and too basic. All 8 respondents indicated 'about right'.

Evaluation of the workshop

Respondents liked the overview of the developed solutions and the better understanding of the 360° production tools, getting to know the software and their different capabilities, the possibility to learn new skills and ways to display content, as well as the practical exercises and the hands-on approach of the workshop.

Only three respondents made suggestions for improvements. Mentioned points for improvement were: the use of video examples on how the streaming works instead of just pictures, a small presentation of the final results of the video processing and the adding of 3D sounds.

Evaluation of the developed tools

The workflow was evaluated in a positive way. Respondents thought it was easy to follow, also for beginners, and relatively easy to apply in the exercises. Showing the final result of the editing would improve the understanding of the impact of what participants did in the exercises. Overall they evaluated it as a promising toolset.

The Premiere Pro Plugin was seen as a flexible solution, very useful and complete. Participants liked the overview of the possibilities.

Future expectations

Two final questions in the evaluation related to whether participants would consider creating immersive content themselves and whether they would recommend the workshop to a colleague.

7 out of 8 respondents would create content themselves. The one person that would not create content says that he is not a content creator, but would definitely recommend it to other people.

One other respondent remarks that it will depend on the content he or she would be working on. Using the tool would have to make sense in the storyline. Two respondents name specific projects they would want to work on, one is an educational project and another one is a VR documentary.

All respondents would recommend the workshop to a colleague. They see it as a good way for them to learn how to create new ways of sharing stories and content, and to get familiar with the 360° production workflow.

3.2.3. Next steps in toolkit evaluation

The toolkit will be further developed and tested for pilot 2 and 3. The planned think- aloud evaluation with staff of Lightbox and VRT will take place as part of the second pilot activities.

3.3.   Evaluation of Premiere Pro plugin and the tutorial (P1.10)

3.3.1. Planned set-up

In this evaluation activity, the usability of the production tool was tested through a tutorial. 3 professional content producers in Spain were asked to first familiarize with Adobe Premiere Pro using a tutorial and then use the plugin to edit content. This activity was not planned in Deliverable 4.1., but organized to create and test the tutorial.

3.3.2. Detailed execution of the activity

A tutorial was created in order to enable the testing of the usability of the production tool by professional test users. Three tests were organized with 3 different professional video editors, and in between each test the editing tool and the tutorial were iteratively improved.

The tutorial first introduced the main components of the Premiere Pro plugin and then consisted of three exercises, designed to cover the main functionality in the plugin.

1. In the first exercise, the professional user was asked to create one omnidirectional scene with two directive inserts. More specifically, he/she could:
   - Learn how to introduce video inserts with the Portal Effect
   - Add two video inserts in an omnidirectional scene (one user referenced, one world referenced).
   - Learn how to use the preview. Try it both in tablet and HMD mode.
   - Learn how to export content using the Export panel, and include different tracks in the exports for   tablet, HMD and TV
2. In the second exercise, the professional user learnt to create scenes where the end-user could trigger a transition between two omnidirectional videos by pressing a (user-referenced) directive video insert. Then, once it was working with one transition, he/she learnt how to introduce a second insert to be able to go back and forth between the 2 omnidirectional videos.

3. In the third exercise, the professional user further explored the use of nested sequences. In particular, he/she learnt how nested sequences could be used to allow a content consumer using a tablet to select between an edit based on multi- camera capture and an omnidirectional video.

An observer was present to take notes, observe difficult points and to address usability problems. The test users were helped when they could not progress further due to a bug or if the tutorial wasn't clear.

The three selected test users had at least three years of experience as a professional video editor. An overview of the interviews can be found in the table below:

Participant	Gender	Date and location interview
1	Male	11/05/17, Barcelona
2	Male	20/09/17, Barcelona
3	Male	27/09/17, Madrid

Table 6: Overview participants evaluation tutorial Premiere Pro Plugin

All participants were rewarded with a 50 euro gift card as incentive for participation.

3.3.3. Obtained results

The professional users feedback was used to make the tutorial more usable and better understandable and to address discovered bugs in the software. After each test, the tutorial and the Adobe Premiere Pro were improved, but the overall experience and exercises remained the same.

In two hours the video editors learned how to work with the Adobe Premiere Pro and it's different features and perform the tasks in the tutorial with no major difficulties. The final created plugin can be founded in Annex II.

In general, the tool was considered intuitive and effective. The design of the the plugin followed the basic assumption of video editing (i.e., a common timeline across tracks), while at the same time introducing additional creative possibilities. The edition process was kept simple though, and the professional users could still use it easily. Especially the preview possibility in in low-cost devices such as mobile phones was considered very useful. The possibility to rapidly see the scene composed on a mobile phone, and trigger the transitions, is very useful to understand the created video composition.

3.4.   Evaluation of the demonstrator at demo booths IBC and NEM (P1.2. + P1.9)

3.4.1. Planned set-up

Only the IBC activity was planned in D4.1., pg. 23-24. The aim was to validate the ImmersiaTV concept and gather some **ad-hoc feedback** on the visitors' experience with the ImmersiaTV demonstrators. The expected outcome of the IBC activity was to generate interest for the ImmersiaTV project in the broader community of professionals and researchers, identification of possible synergies with other projects and services and gather some specific feedback on the project in general and on the first pilot. Since a formal evaluation would be difficult, we choose for a combination of video testimonials and an evaluation form with some feedback questions.

3.4.2. Detailed execution of the activity

The Immersia TV project had the opportunity to be present with a demo booth at both IBC 2016 and NEM 2016.

IBC 2016[1] is the International Broadcasting Convention, a yearly event consisting of a conference and an exhibition, attracting over 50'000 visitors. The audience is a mix of industry representatives and academia. IBC 2016 took place in Amsterdam, the Netherlands from September 9-13.

NEM[2] (New European Media) has a yearly summit. This year the NEM summit was held in Porto on November 23-25. The ImmersiaTV demo, shown in Figure 3 has **won the NEM award for best exhibition booth at the NEM summit**.

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[1] Ibc.org

[2] https://nem-initiative.org/
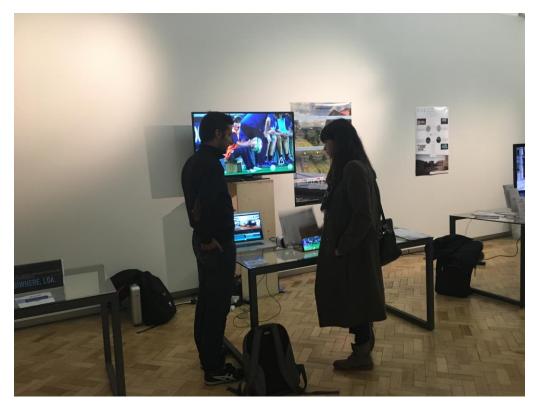
Figure 2: Immersia TV demo booth at NEM

In both events, Immersia TV had a demo booth in which pilot 1 was demonstrated, including the developed toolkit and the immersive documentary. Participants could try out the documentary on the HMD and tablet in combination with the television set and could also try out the developed software plug-in.

At IBC informal evaluations took place including discussions with participants and the recording of some video testimonials[3]. At NEM, participants that visited the demo booth were asked to answer some questions on their experience. A Computer Assisted Personal Interview (CAPI) via tablet was used to generate feedback. In total 20 people shared their experience with the pilot demo at NEM. This group consisted of academics, representatives of media companies and broadcasters (e.g. Nokia, BBC) and people working in governmental institutions.

3.4.3. Obtained results

Overall evaluation of the experience

A first question was "How do you evaluate the experience of watching the Immersia TV documentary?"

Overall the demonstrator was evaluated in a positive way. Visitors at the booth liked the concept and the combination of the different devices. They found it particularly positive that the the viewer is not isolated in the experience, but that he or she can explore the different options. Visitors also liked the degree of freedom offered to the viewers to explore certain scenes. Visitors who worked in different media domains also were inspired and saw potential for their own field of study, for example in video conferencing tools, interactive travel documentaries

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[3] See immersia TV website

and educational programs. Also the concept of the portals that was demonstrated for the first time at NEM was positively evaluated.

Negative aspects of the experience were the visual quality of the HMD. Although visitors of the booth saw it as something linked to the specific devices (HMD), they would prefer to have a better quality. One visitor also thought the set-up might lead to a too individual experience, particularly when the HMD would be used in a home setting. For one other visitor, the experience could also be a bit more intuitive, for this person it wasn't really clear how to navigate in the tablet.

Suggestions for improvement

A second question was on possible suggestions for improvement the booth visitors might have.

VR triggers and content flow

Since the audience was a mix of media professionals and academics, some gave very specific suggestions based on their own experience. For example, someone from the TV broadcasting sector suggested to use specific triggers and to not allow viewers to look around all the time. By using specific triggers at certain moments in time, the directors can still tell the story they want to tell.

The portal was particularly found suited for football and other live events, where viewers would be able not to miss out on the goals. This person also was aware of previous 360° experiments related to Eurosong, but one issue that was experienced in that context was the fact that you could see all the other cameras and technical equipment in the 360° experience. This might disturb the content flow. Other participants also mentioned the selective use of VR triggers.

Of course this is also closely linked to the type of content. Particularly in content with a storyline, the trick is not to get people distracted from the storyline. For sports they do see other options.

While some visitors would like to limit the interactions, other would like to see even more interactive modes. For example being able to select between different camera viewpoints or explore different alternative scenes depending on the audience's interest. Sometimes it might also be necessary to guide the audience in a certain direction, so that they know where to focus on so they won't miss any of the action.

Improved quality

Other suggestions related to the quality aspect. Almost all respondents referred to an improvement of the visual quality. Since the audio was disabled in the demonstrator, there were no comments about this in the evaluation. One respondent did mention the use of subtitles and dubbing. Now the subtitles are in English on the TV-set, but it might also be good to have subtitles on the HMD and the tablet. While the use of portals was seen as very innovative, the size and positioning of these portals also needs some improvement. It should also be very clear how people can interact with the portal.

Evaluation of the software plug-in

Also the software plug-in was demonstrated at NEM and a short demo was provided for viewers that were interested in knowing about the software toolkit. Here only five visitors evaluated the toolkit. The plug-in was seen as a very good idea to work with. People who are working in a similar domain thought the toolset was well designed and that it is good that it interacts with existing software (such as Adobe). The visual representation of the synchronity of the content

was found very relevant. One respondent thought it would require some expertise to work with the tool. Suggestions for improvement here were to identify, detect and annotate moving objects, since this is a new research domain and then to automate this procedure. A second suggestion was to have a plug-and-play version of the plugin online, so people can experiment with it. A last suggestion was to develop an end-user version, so also non-experts could work with it.

3.4.4. Next steps in demo booth evaluation

The evaluation activities will be continued in future demo events. The feedback via CAPI will be complemented with an evaluative quantitative score of the demonstrator.

3.5. Closed pilot test (P1.3-P1.7)

In the first iteration of D4.4, the results of the closed pilot test in Porto were described. The second iteration of D4.4 decribes the results of the closed pilot test in Brussels. As set-ups of the tests in Porto and Brussels were very similar, the results of both tests are discussed in section 3.4. Differences in set-ups and results are indicated in every section.

3.5.1. Planned set-up

3.5.1.1. First iteration

The closed pilot test is the first user test with the developed demonstrator. This test fits within the first phase of the living lab approach, in which the demonstrator is tested under controlled circumstances. By organising a lab-test, all parameters related to the set-up could be controlled and the researchers can interfere if necessary. The aim was to have 20 respondents testing the documentary.

The detailed technical set-up as described in D4.1. included a TV-set, 2 HMD devices and 2 tablets.

For the user evaluation, we planned the following activities in D4.1. pg. 25-32: *"The test procedure will consist of a combination of observations while people are watching the documentary, objective measures and a qualitative interview immediately after the experience. The questionnaire for the interview will include questions about the overall experience as well as more detailed questions to check the end-user requirements as defined in D2.1. Each lab test will take approximately 1 hour:*

- *Briefing + informed consent: +- 7 minutes*
- *Drop-off questionnaire: +- 8 minutes*
- *Documentary + observation: +-15 minutes*
- *Qualitative interview: +- 30 minutes"*

In the planned set-up, we've foreseen three possible user scenarios for the test: free usage, directed usage and directed group usage. Eventually, scenario A (free usage) was selected for the test, because our main interest was in how people would make use of the multi-device set-up, both as individuals and in a group setting (teams of 2). Scenario A was described as follows in D4.1.: "*Respondents **watch** the documentary and they can **freely** decide which devices they would like to use during viewing. The advantage of letting people choose how they consume the documentary is that we will be able to observe the natural flow of the usage and can see what*

triggers the users to switch devices or to explore certain aspects of the content more in-depth. The disadvantage is that it is possible that users will not make use of all the devices to watch the documentary and/or will miss certain cues (for example portals) on which we aim to get feedback during the trial."

While participants watch the documentary, the researcher observes how the individual respondents or teams of respondents watch the documentary, following the observation protocol. The observation will focus on:

- Usage of different devices (when do users switch to another device?)
- Body and head movements (do they sit down/stand up? Head movement or not?)
- Feedback (do they say anything when watching the content)
- Social interaction (do they talk with others while watching the documentary? What do they say? What different devices do they use?)

Immediately after the experience, a short interview took place. Seven topics were discussed during these interviews:

- Topic 1. Overall user experience
- Topic 2. Multi-device usage
- Topic 3. Usability
- Topic 4. Interaction + level of control
- Topic 5. Content
- Topic 6. Social viewing
- Topic 7. Future expectations

The expected outcome of this closed lab-test is detailed insights in user experience and user attitude towards the setting of the documentary. By combining logging, observation and qualitative interviews, an in-depth analysis of the user practices, user expectations and social aspects can be acquired.

3.5.1.2. Second iteration

The set-up of the labtest in Brussels was identical to the one in Porto. For a detailed description of the set-ups we refer to 3.5.1.1. In the drop-off questionnaire for the Brussels tests, an extra question was added with an QoE scale in which the respondents were asked to rate the visual quality of the video on the TV, the smartphone and tablet (see annex III for full questionnaire).

The topiclist for the in-depth interviews was similar to the topiclist used for the interviews after the closed lab test in Porto, with slight changes based on the results of the test in Porto. The same seven topics were discussed:

- Topic 1. Overall user experience
- Topic 2. Multi-device usage
- Topic 3. Usability
- Topic 4. Interaction + level of control
- Topic 5. Content
- Topic 6. Social viewing
- Topic 7. Future expectations

During the interviews we also used two scales to indicate the Quality of Experience (QoE) in terms of image quality on the different devices. Based on these scales, a MOS (mean opinion score) could be calculated for each parameter.

3.5.2. Detailed execution of the activity

3.5.2.1. First Iteration

The closed lab test took place in cooperation with the **Universidade Catolica Portuguesa (UCP),** School of Arts - Digital Creativity Centre in Porto, Portugal in their MOCAP room. The activity took place on November 21st and 22nd, 2016.

Technical set-up

The demo in the pilot has been set up trying to reproduce a standard living room: with a number of chairs/sofas (3 in the UCP experiment), a flat TV screen (40'' or higher), an Android tablet and a HMD (Samsung Gear VR). As shown in the image below (see figure 4), the demo is a compound of two main parts, a first one, and invisible for the user where all content is stored and distributed. The second one the content is displayed and the user manipulates different devices and interacts with the content being displayed.

As said, the first part, is build of two devices, a computer, and a router, with different functionalities each one. The computer has different roles: i) acts as a server (storing, distributing and streaming the content using MPEG-DASH), ii) it runs the Session Manager which facilitates that all devices connected to the same network play the same content synchronously, iii) it can also be used as a Windows player for the TV. This functionality (iii) can be alternatively be performed by an Android TV device, since the player has been built with the Unity framework. Finally, a router creates a network that distributes the content from the server to the different displays, all this done through a WLAN and a client App installed in the different devices.

The second part is the one with which the user interacts (TV, Table, HMD). Once users are connected to the WLAN and the ImmersiaTV App is up and running, they can select the content and watch and explore it on any display.
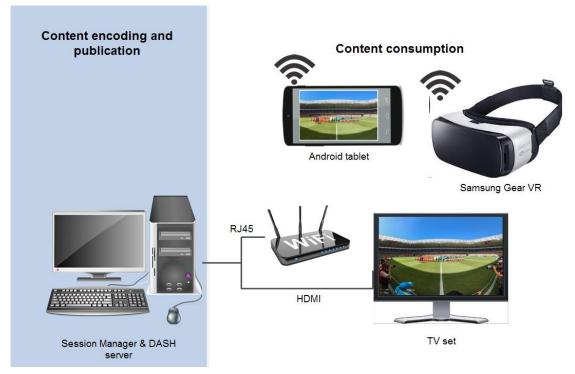
Figure 3: Demonstrator set-up Porto

Devices used during the demo were:

- Gigabyte i5, 32Gb RAM, Windows10 working as server / session manager / TV player

- Samsung Gear VR with a Samsung Galaxy S6

- Tablet Samsung Galaxy TAB S

- Samsung TV model LE40A856S1M

For practical reasons, only one Samsung tablet and one Samsung Gear was used instead of two as was originally foreseen in the set-up of the test.

User evaluation test

Figure 4: User evaluation test Porto

The user evaluation was executed as planned. After a brief introduction and completion of the profile questionnaire and informed consent, viewers were invited to watch the documentary, individually or in teams of two. When in teams of two, participants were invited to bring a friend, so they would know each other. The session was observed using the observation protocol. After the observation a brief interview took place. This was recorded on audio. Each session took around 40 minutes in total. All interviews were fully transcribed and analysed afterwards.

In total **18 sessions** took place:

- **11 individual sessions** and

- **7 group sessions**

6 of the group sessions consisted of 2 members, 1 session consisted of a group of 4 respondents.

The total number of participants was **27**. This was 7 more than originally planned.

18 respondents were male, 9 female. The average age was 27. 16 Respondents had no prior experience with VR, 11 experienced some form of VR before, for example on a Cardboard, Playstation or Samsung Gear.

An overview of the different sessions and participants is listed in the table below.

Session nr.	# participants	Gender	Age	Previous VR experience
1	2	Male	39	No
		Male	23	No
2	1	Male	41	Demo on oculus rift
3	1	Male	32	No
4	2	Male	29	Cardboard and Samsung VR
		Male	26	360° videos online via cardboard
5	1	Male	33	Some visuals on oculus rift
6	2	Female	25	Playstation VR and Oculus Rift
		Male	26	No
7	1	Male	47	No
8	1	Male	48	No
9	2	Male	24	Samsung Gear
		Male	17	No
10	1	Male	31	360° video, oculus rift, 3D virtual worlds
11	1	Male	34	C++ demo
12	2	Male	25	No
		Male	18	No
13	1	Female	19	Six flags VR rollercoaster
14	2	Female	21	No
		Female	21	/ (did not participate in conversation – no English skills)
15	1	Male	18	Oculus rift
16	1	Male	19	No

17	1	Female	28	No
18	4	Female	19	No
		Female	19	No
		Female	20	Cardboard
		Female	20	No
	27	*18M, 9F*	*Avg. 27*	*16 no experience, 11 experience*

Table 7: Overview participants labtests Porto

3.5.2.2. Second iteration

The closed lab test took place in the imec offices in Brussels. A room designed for subjective QoE tests was used for this purpose. The tests took places from May 8 to May 15, 2017.
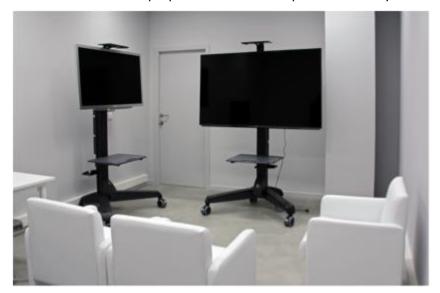
Figure 5: Lab setting imec offices Brussels

Technical set-up

The demo in the pilot has been set up trying to reproduce a living room environment, with 2 sofas in front of the TV and dimmed lights.

The technical set-up of the lab tests in Brussels was different from the one in Porto. Contrary to the lab tests in Porto, a web-based set-up was applied. The set-up consisted in a web server deployed in Brussels with contents for head mounted displays, tablets and television. The contents have been optimized for each device and network, using adaptive video and audio streams consumed by the different synchronized players. A synchronization manager for Windows had to be downloaded from the pilot website in order to achieve frame accurate synchronization in the same local area network. This synchronization manager showed up the television stream in the web player and allowed different devices (tablet mode or HMD mode) to join the session in order to enjoy a more immersive experience. The players were web-based, and ran on any android-based device without installation. The end-user just has to scan a QR code presented with the TV stream in the windows machine web browser.

The same web-based set-up will be applied for the semi-open and open pilot.

Whereas the documentary used in the test in Porto was in Portuguese, with subtitles in English on TV only, this version of the documentary was dubbed in English, with English subtitles on TV only.

Devices used in the lab test were:

- TV: 4K TV Panasonic TX-65AX800E (65 inch)
- HMD: 1 upgraded plastic Google glasses + 1 Samsung Galaxy S6 edge
- Tablet: 1 Samsung galaxy tab s2

Test users that participated in groups of 2 were asked to share the tablet and VR glasses and take turns watching the content on the two devices.

User evaluation test
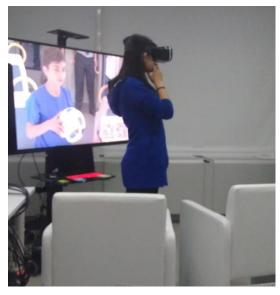
Figure 6: User evaluation test Brussels

The user evaluation was executed as planned in D4.1. After a brief introduction and completion of the profile questionnaire and informed consent, viewers were invited to watch the documentary, individually or in teams of two. When in teams of two, participants were invited to bring a friend, so they would know each other. All participants were informed that they could switch between the devices as much as they wanted, as long as they used each device at least once. They were free to sit down or stand up while using the tablet or VR glasses. The session was observed using the observation protocol. After the observation a brief interview took place. This was recorded on audio. Each session took around 40 minutes in total. All interviews were fully transcribed and analysed afterwards.

Each participant was rewarded with a movie ticket as incentive for participation.

In total, **21 sessions** took place:

- **12 individual sessions**
- **9 duo sessions** (2 users participating together)

The total number of participants was **30**.

10 respondents were male and 20 female. The average age was 27. 16 Respondents had no prior experience with VR, 11 experienced some form of VR before, mostly a short demo at, for example, an event.

An overview of the different sessions and participants is listed in Table 8.

Session nr.	# participants	Gender	Age	Previous VR experience
1	1	F	27	No
2	1	F	23	No
3	2	F	26	No
		M	25	No
4	1	F	30	On an event
5	1	F	21	No
6	1	F	32	No
7	2	F	27	No
		M	25	Oculus Rift
8	1	F	39	In the cinema, on the internet
9	1	F	24	No
10	1	M	27	No
11	1	F	51	No
12	1	F	/	No
13	2	F	27	No
		F	28	No
14	2	M	24	No
		M	25	No
15	2	M	24	In Bobbejaanland (amusement park)
		F	22	No
16	2	F	25	No
		F	24	No

17	2	F	23	Presentation at university
		F	27	During study
		M	24	No
18	2	M	25	At a friend's place
19	1	F	24	No
		F	24	No
20	2	M	32	Short demo
21	1	M	38	No

Table 8: Overview participants labtests Brussels

3.5.3. Obtained results observations

3.5.3.1. First iteration

One main goal of this activity was to understand how people would make use of this kind of multi-device set-up in which a story on television is complemented with content on a HMD and/or a tablet. To see whether this could be considered a social activity, we had individual users as well as users in team. In the observations, focus was on the switching of the devices, the interaction viewers had with each other and when these interactions occurred. We also focused on specific triggers that made viewers switch between devices. Below we will first give an overview of the observations for individual sessions and group sessions. Then we will discuss the results.

Individual sessions

N° of device switches	Devices used	Trigger	Interaction	Other
5	Starts in HMD, then switches between HMD and tablet, only watched TV in the end	No real trigger, switches between all devices	Asks how to rotate tablet image	
3	Starts on TV, but then uses HMD, then back to tablet in combination with TV	Tram scene	Talks about black screens that are confusing and how to rotate screen with finger	Accidentally switched off tablet

6	Starts on TV, then switches between TV, HMD, tablet	Bed scene- HMD, then tablet and then back HMD in car scene – scene changes trigger to switch	HMD not comfortable due to rotation	VR buttons- easily quit application. Tries to walk around
3	Starts in HMD but his doesn't work, then plays with tablet	HMD that didn't work	No	Got out of HMD app and tried to use tablet in both directions
3	Starts in HMD, then tablet, then back HMD and then TV	No particular trigger, football match completely in HMD	No	No
3	Starts on TV, then switches between tablet and HMD	Exploring how devices work, enjoys car scene on HMD	Asks if she can walk around with the HMD	Disappointed with video quality + doesn't speak Portuguese so needs to use TV to catch up with the storyline
5	Starts on TV and switches between all devices	Switching randomly, stands up to explore the scene	/	She switches between all devices in each scene but has difficulties in finding the focus of the information
3	Starts on tablet, then HMD, then TV	Keeps an eye on TV while using the tablet	/	When screen goes black in HMD, switches to TV
2	Starts on HMD, then switches to TV and goes back to HMD	Watches almost complete documentary on HMD	Had a problem with the app and asked for help to get back	
1	Starts on HMD and switches to the TV-set	Pays a lot of attention to the TV-set, because she doesn't speak Portuguese well	/	/
1	Starts on HMD and only switches to	Almost all the content is watched on the HMD	/	/

	tablet in final scene			

Group sessions

N° device switches	Devices used	Trigger	Interaction	Other
3	R1 starts on tablet, R2 on HMD. They take turn in using the devices	R1 uses tablet and TV in parallel, R2 plays with HMD. Then they switch the devices in the car scene, to try the other device	Yes, about switching the devices	Tried walking around with the HMD and with the tablet (not aware they could scroll with finger on the tablet)
6	Both start on TV, then one takes the tablet and one the HMD. In the car scene they switch to the TV set	To try out the other device. In the car scene they checked TV to see what was going on. A new scene to explore was the main trigger to switch	Yes, commented on the content and on the use of the devices. They were guiding each other on what to see	
5	One respondent started on HMD, the other on tablet. They switched regularly between devices	In the tram they focused back on TV to see what was going on. Combined use of tv and tablet, but focused more on tablet	Yes, a lot of interaction, talking about how to use it and about the content	Needed to explain that they could use their finger to rotate
4	They both start on TV and then each take one device. They ask each other to switch	No specific trigger, they want to try out the different devices	They talk about how they want to use all the devices	Did not know how to rotate with finger
6	They each start on one device. Tablet is used in combination with TV	Switching in different scenes, to explore	Yes, shout out the name of the football player. They ask to switch devices	
0	1 respondent watches on TV,	Full documentary viewed in HMD.	No	1 respondent just watched the

	the other on the HMD	Walked around with HMD.		documentary on TV, did not actively participate because didn't speak English
4	Group of 4, one uses the HMD all the time and doesn't share it, the others use the tablet and TV combined	Tablet is given to others to use, HMD is only used by one person who watches full docu on HMD	Very enthusiastic, talk about the documentary and what they see	

Table 10: Observation group sessions labtests Porto

These observations were mainly used as input for the interviews, but also provided us with quite some information on how respondents made use of the documentary in a multi-device set-up.

For **individual users,** most of them regularly switched between the devices. Two respondents watched the documentary almost completely on the HMD. When the tablet was used, this was often used in combination with the TV-set and respondents focused on both devices. The trigger to switch between devices was mainly a new scene that respondents wanted to explore. What was interesting to see is that some respondents tried to walk around while watching the documentary on the HMD. In this case they expected to be able to walk around in the scene, which wasn't really the case. Some respondents also experienced some issues with the different devices. For example on the tablet, sometimes people accidentally touched the switch-off button, which made them exit the application. People could also rotate with their fingers on the tablet, but this was not always clear. Therefore a lot of respondents put the tablet in the air and turned it to get a 360° viewpoint. Particularly when the tablet was held horizontally, people could not scroll. Also on the VR some users experienced difficulties when they accidentally exited the app. At the end of the documentary there is a black scene, this triggered people to switch back to television to see what was happening.

In the **social setting**, we noticed that people indeed interacted with each other. This was important, as one of our main research questions was whether this kind of set-up could be considered a social experience. In the observations we've noticed that people did interact a lot, both on the content as on the devices (asking each other to switch). In the group session, respondents often started watching on one device and then regularly switched to another device. Sometimes a new scene was the trigger to switch, on other occasions the willingness to explore the different devices was the main trigger to switch. One observation also indicated that the use of a HMD might lead to funny situations. One girl was watching the documentary on the television set, while another girl was walking around with the HMD, unconsciously blocking the image of the girl who was watching television.

The number of device switches varied. Some people started on one device and kept watching on that same device, while others switched up to 6 times.

As mentioned, the observations were used as input for the interviews as well.

3.5.3.2. Second iteration

The observation results of the second iteration in Brussels were very similar to those of the first iteration. In the table below, the different sessions are described.

Individual sessions

Session	N° of device switches	Trigger	Interaction	Other
1	5	Scene changes trigger to switch, keeps on eye on TV when using tablet		
2	6	Scene changes trigger to switch		
4	8	Scene changes trigger to switch		
5	2	Wants to test different devices, but HMD hurts eyes	Says that HMD hurts her eyes	
6	2	No real trigger, Keeps VR glasses on a long time		Desynchronization between video on tablet and video on TV
8	4	Scene changes trigger to switch	Fears that glasses make her sick	
9	2	Always used tablet in combination with tv		Smartphone fell out at start test – the respondent only mentioned this only after the test. She watched the docu again for 2 min with the glasses only.
10	2	Mostly only used tablet in combination with TV		
11	7	Wants to watch most scenes with different devices to		

		see differents details		
12	6	Scence changes trigger to switch		Phone image blocked, needed to pause test to unblock the mobile video
19	2	No real trigger	Says that HMD hurts her eyes	
21	7	Scence changes trigger to switch	Remark about the low image quality in the HMD Says he spotted the 360 camera	Lots of frame freezes in the Smartphone video

Table 11: Observation individual sessions labtest Brussels

Group sessions

Session	N° of device switches	Trigger	Interaction	Other
3	2	Scene changes trigger to switch	Talking about the stadium scene they liked	Phone image blocked, needed to pause test to unblock the mobile video
7	2	scence changes trigger to switch	Says glasses are nice experience	
13	2	Scene changes trigger to change + when they want to test other devices	Talk about what they see, talk about difference of quality between phone and tablet	
14	3	The tablet and HMD are passed at random moments	Comment on the image quality R1 says he is triggered to walk around with the hmd, allthough there is no use in this	
15	3	No real trigger	Assumption on video: Think about	Phone image blocked, needed to

			stadium scene (with professionels) that it's 10 years after, when the boy is grown up. Talk about the fact you can see the cameras, they found it is funny.	pause test to unblock the mobile video
16	3	Car and train scence changes trigger, both mostly focus on HMD/Tablet and not on the TV	Talk a little bit, but in foreign language	R2 stands up couple of times
17	2	No real trigger, when they want to test other devices		
18	5	Scene changes trigger to switch + when they want to test other devices	Talk about the fact that it's funny during the car scene to be on the car hood	Phone image blocked, needed to pause test to unblock the mobile video
20	3	Scence changes trigger to change	Wonder if when you move forward, the camera wille move too. Car scene: they think that it's a verry strange point of view on the front of car.	

Table 12: Observation group sessions labtest Brussels

3.5.4. Obtained results in-depth interviews

Here we will report on the findings of the in-depth interviews as part of our qualitative research methodology. These interviews were conducted with one or two (or even four) respondents, depending on the number of persons that participated in each session. The interviews were transcribed ad-verbatim and analysed applying a grounded theory approach (Strauss & Corbin, 1998)[4], including open, axial and selective coding. Below we will discuss the results, structured according to the different topics. Selected interview quotes are used to illustrate the findings.

- Topic 1. Overall user experience

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[4] Strauss A. and J. Corbin (1998) Basics of Qualitative Research – Techniques and Procedures for Developing Grounded Theory, second edition, London, Sage Publications

- Topic 2. Multi-device usage
- Topic 3. Usability
- Topic 4. Interaction + level of control
- Topic 5. Content
- Topic 6. Social viewing
- Topic 7. Future expectations

For each topic, the findings of the first and second iteration of this deliverable are discussed.

3.5.4.1. Overall user experience

Novelty effect:

First iteration

A first question in each inerview was about the respondents' first impressions of the experience. Here it became clear that the **novelty effect** was really important. As we observed, most people immediately started watching on the HMD. All people with no prior VR experience used the HMD first to explore this new viewing experience.

Overall, the first impressions were positive. Some respondents even feared they were not making full use of the options, as the following quote suggests.

> *"I am amazed. And I felt I was doing something wrong or not doing everything I could. Maybe there is something else to explore and I'm not getting into it. Maybe it's because of me because I was introduced to technology a little bit later. The first computer in my house, I was only 6. I had the feeling I was not doing everything that was possible with this technology. I tried to get up and see if I moved I could be closer to the characters. I enjoyed it a lot."*

The experience was considered to be entertaining, even when respondents acknowledge the technology is still in a premature stadium.

> *"I think it was interesting to explore this new technology. It's still in a very primitive way but I think over time it will evolve. But it's already an entertaining experience. You get curious to see how it is and i think in the future it will be something that is common."*

Some respondents even called it an immersive experience.

> *"I think it was a very immersive experience. We can watch the docu on the TV and we can also put on the VR glasses and get into the environment where they are. And for example I really liked the one in the stadium where we could look around and see all the players".*

Second iteration

started watching the documentary on the HMD. This was also due to the novelty effect, as most respondents had no or only limited experience with the HMD.

First reactions were mostly positive, as people were happy to explore a new audiovisual experience. First more negative remarks were made about the low image quality of the video on the HMD and the tablet, compared to the image quality of the video on the television screen.

Generally, the respondents say that due to the editing of the content broadcast on the TV, the viewing experience was very different from the more 'raw' broadcast on the tablet and the HMD.

"The image in the VR is much rawer than the edited image on TV. The two are really different in terms of atmosphere."

After watching the documentary, the respondents were asked to rate to which degree they liked the content of the documentary. The documentary got an average rating of 3,1 on a scale of 5.

Question: *Could you indicate to which degree you liked the content of this specific video? (1=Dislike a great deal, 5=Like a great deal)*

Average	Minimum	Maximum
3,1	1	5

Table 13: Overview responses content rating

Low audiovisual quality as main drawback:

First iteration

The low image quality on both the HMD and the tablet was an important issue. For some respondents, the low audiovisual quality even ruined the experience. Also the synchrony was an issue for the following respondent:

"It was pretty funny to use the stuff and to go from one to another, but the low quality ruined the experience. But it was kind of funny to watch the different perspectives. But another thing was the delay with the television. I didn't felt it on the VR because you have the glasses and you cannot see the TV, but when you use the tablet with the TV in front of you, you see the delay. It's kind of strange, because it's repeating itself again. It's like milliseconds I think."

The fact that the video quality was in low resolution, became even more apparent because it was a huge contrast with the quality on the TV.

"But also the quality is not the same on the 3 devices and I think this is a major issue because it is very like TV quality and the others are not. So as much as you sometimes want to explore, it can't compete with the quality. And another thing is because you want to watch the story, sometimes it's kind of, for instance when they were in the car ride it was a good thing that you could see the sight, that worked very well. Maybe on the soccer field I was hoping to be inside the field and following the ball. So you put your scene from far away and you loose that a little bit. What I think is if the quality was the same in all of them, I think it could be like a very good experience, for sure".

People also naturally expect a better quality from smaller devices such as tablets and smartphones, because that's what they are used to in other contexts.

"The resolution on the tablet is getting blurry and you cannot see it very well and it should be the other way around. On a smaller screen it should be the better quality. When you get an image on a TV-set it's ok, if you put it on a smaller display, it looks better. And that was the opposite. But I didn't think it added so much to the story I guess."

Although others weren't really bothered with the quality. For some it was ok like it was, others noticed it, but didn't really see it as an issue:

"In any case it's funny because yes the resolution is shubby but it doesn't really make a difference. Like in the scene in the car ride, in that particular scene it didn't really make

a difference how high quality it was, because it was enough with the light and the scenary and the sensation of space to be intruiged by what i was looking at. But in other situations there was not much to look at. It's mostly in the movement that you notice such a low resolution."

"It is obvious that there is high definition on TV and on VR there was not that much definition as on television. Although it is possible to have more definition. But yeah a part of me wanted to have a bit more definition in VR, although I've already experienced VR and I'm still bedazzeled with the feeling of the ability to look wherever I want to. But there are differences obviously. On television you are not used to look for detail. In VR, I believe people or at least me are starting to look for a bit more detail, more definition. The perfect scenario would be having the same level of definition and rich quality in all of the platforms".

Besides the image quality, a lot of the respondents also mentioned the audio quality. Now the audio only came from the TV-set and they would prefer to have a surround audio experience as well. Particularly for the HMD this would provide an even more immersive experience.

Second iteration

The low audiovisual quality of the image on the HMD and the tablet was also repeatedly mentioned during the lab tests in Brussels. For some, the image quality on the mobile devices was still acceptable, while for others it really negatively affected the viewing experience. This last group of respondents referred to the much better audiovisual quality they're used to in daily life nowadays.

One respondent even said she would have felt more engaged with the content if the quality would have been better.

"I think with the glasses I felt more engaged. People are just passing you. But I would feel more if the quality was better. Now I was half engaged."

The image quality of the video on the HMD was considered the worst, and the quality on the TV the best. This was confirmed by the results of the QoE scale. After watching the documentary, the respondents were asked to rate the visual quality of the video on the TV, the smartphone and the tablet.

Question: How would you rate the visual quality of the documentary? (1=extremely bad, …, 5=extremely good)

	Avg.	Minimum	Maximum
TV	**4.3**	1[5]	5
Tablet	**3,3**	1	4
VR glasses	**2,7**	1	5

Table 14: Overview responses quality rating (n=30)

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[5] Only one respondent gave a rating of 1 for the visual quality on the TV. Other respondents gave the visual quality of the documentary on the TV a minimum rating of 3.

Similar to the tests in Porto, during some of the tests there was a synchronity problem, with the video on the smartphone and tablet being played with a delay of some miliseconds, which affected the viewing experience negatively.

Also, during the Brussels test, multiple respondents mentioned they missed surround audio for a better immersive experience.

3.5.4.2. Multi-device usage

Finding the right balance:

First iteration

While some respondents did have previous experience with VR, the multi-device usage was new for all of them. It was sometimes a difficult exercise to find the right balance between the different options and not to miss out on anything.

> *"I first started watching it in the traditional way on television, with no VR. And then I tried to interact with both the headset and the tablet and at some point I sort of lost the plot. And then I was trying unconsiensely to find the best interaction with the three devices in a way of watching the story. Eventually coming to the end of the documentary I found a comfortable place of being controllable which was with no headset but with the TV and the ipad. When i was watching it in the traditional way I was complementing that experience with my finger rotating on the ipad screen. That was in this best case the best way to enjoy the experience."*

Respondents also expect a learning effect to occur, it is considered something they would get used to when they would do it more often.

> *"Maybe it can be a bit confusing to switch all the time between one gadget and another. But I think if you use it more often you'll get used to it. In the beginning it's kind of a shock. I liked the glasses, it's all dark and inside and the image is more immersive I think. I liked the glasses."*

> *"I think it's a little bit confusing switching back and forth between several media. You get the best of both worlds by switching because you get immersiveness on the one hand but then you can go back to the traditional medium and have the director doing the thinking for you. But the switch itself is not something I'm used to doing so I think that given time, I would be able to adapt but generally speaking I would prefer the idea of sticking to a medium, whatever it was. So if I was watching a movie in VR with glasses, trying to do it for one hour. That would feel more natural."*

The different scene switches were used as a natural trigger to explore the content in 360°.

> *"What I felt is I only needed one of both, or the oculus or the tablet. What I found interesting is that I was looking at the TV sometimes I thought this might be a good thing to look around and then I took the tablet or the VR and just looked around. What I thought was most fun about it was just the ability to look at the content on the televsion and then when i felt like it, let me just explore it here. Maybe because I wasn't so interested in what was happening on the TV or when there was something i would like to see, like when they were in the car near the river, let me look around. The story itself was not so important that moment so I started to look around."*

For some the audio was a way to keep track of the storyline.

"Audio was ok, it was fine because we could see the docu on TV and listen to it when you put the VR on. We didn't loose track of what we were watching on tv because the audio came from the tv, so you always knew what was happening."

"Yes, the audio was coming from the TV and I could understand what they were saying. If it was in a language that I couldn't really understand it would be more difficult because there were no subtitles in the VR."

This is particularly important if we would test the documentary with audiences in different locations that don't understand Portuguese.

Second iteration

Similar to the tests in Porto, the multi-device usage was rather new for the users. People are used to rely on a second screen while watching television for reasons not-related to the broadcast (e.g. reading emails) and related to the broadcast (e.g. sending and reading tweets about the broadcast), but there is little to no experience with watching synchronized videostreams of the same broadcast on multiple devices.

Using three devices was considered quite challenging. In a normal viewing situation, the respondents say they would only want to use two devices: the television in combination with either the tablet or the HMD.

A couple of respondents say they prefer to stick to one device only.

"It is impressive, but on the other hand you only need one device to watch it. You should choose the one you like the most."

Similar to the lab test in Porto, the multi-device set-up was quite distracting and made it hard for some repondents to follow the story.

"I was distracted by the glasses and the tablet."

"I couldn't concentrate too much on the story."

"I almost didn't follow the story because I was too busy analysing what I was seeing. The story wasn't the main focus."

There was a fear of missing out on important actions while using the tablet and the HMD.

"I missed a part in the stadium. A goal or something. Because I was watching something else."

"On the TV, editing tells you what to focus on, but with the glasses on, you sometimes don't know where the action is. With the tablet or glasses you're just looking around or you don't know what to focus on."

Because there is the expectation that all the important scenes are broadcast on the television, most respondents used the TV broadcast as a guide to know what to focus on and explore with the tablet and the HMD.

"Really hard to follow up with what is happening. That's why I kept switching with the TV."

"You have to focus on the current scene on the TV, to know what details to look for in tablet."

"The most important things are on the TV. The tablet is just for exploring, but nothing really happens outside the TV."

"But generally, I like the TV the most. I expect the most important thing to be on the TV screen. I want to focus on what was most important."

One respondent said it would be nice to have better audio or visual cues to guide the viewer where to look with the different devices. Another respondent said she always switched back to the TV when someone started talking, so she could immediately see who was talking.

"When someone is speaking. Then I want to know who is talking so I switch to the TV."

Generally, similar cues in the video triggered the respondents to use the tablet and/or the HMD. Usually the respondents were triggered to take the tablet or the HMD and explore the surroundings when there was an outdoor scene with not a lot of action or no talking (e.g. the car scene, when the boy is waiting for the train). The HMD and tablet are a nice extra for the exploration of the content

"I used the tablet at the same moment as I would use glasses."

"For the car scene and in the stadium, I would choose the VR. For the other scenes, I choose the TV. For scenes in a small room and where not much is going on, the TV is more interesting."

(about car scene) "I don't think it was very important. Halfway the conversation I moved around because the conversation was not so interesting."

Tablet vs. HMD:

First iteration

Most respondents preferred the HMD, even despite the lower audiovisual quality. This gave them more the feeling to be in the scenes, while the tablet provided them more with an overview. So each device had its own specific affordances.

"I actually liked the tablet because I could see two things at the same time and I could try to control. Actually for the HMD I was feeling sick in the car scene so I couldn't control it. But I liked more the HMD because I am really inside, in the tablet is more to add information to the scene. With the HMD you're really in the scene, it's different."

"Yes I think the perception towards reality is, I think it is different interaction with the HMD and the tablet. In the HMD you are in the expereince. You can see left, right.

It is like you are eavesdropping, it is like you are a fly in the house instead of watching it from the outside."

One respondent also described a sense of feeling like an intrudor while using the tablet. Surprisingly she didn't have the same feeling when using the HMD.

"I felt that with the 360 video everytime I looked at it I had this sort of sense of being like a voyeur in a way like an experience of seeing something I wasn't really supposed to look at. But with the HMD I felt again like I was more present in the space as some kind of being without a body. I felt like maybe the others in the space were slightly aware of me, but I didn't have the same sense of voyeurism like with the tablet. As if it was a camera that was filming something I was looking at form the outside. But with the HMD I felt some kind of presence, even if nobody was noticing me I felt like they were probably aware of me".

Second iteration

Among the respondents of the Brussels lab test, there was no big preference for the tablet or the HMD. About half of the respondents had a preference for the tablet, and about half of them had a preference for the HMD.

The respondents who preferred the tablet, said they thought it was more comfortable and casual to use. You still have an overview of your surrounding and are not disconnected from reality, there is no risk of bumping into something or getting dizzy and it's easier to combine with the TV.

"The iPad was the better choice for me because it is more comfortable."

"I preferred the tablet. But maybe because the immersive experience made me a little dizzy. With the tablet, it is easier to adjust my focal points. I could see myself using the tablet a lot more casually."

The respondents who preferred the HMD, referred to the fact that it was just more practical and easier to use. You just have to put the HMD on your head and you can look in any direction just by turning your head.

"You don't need to hold it, you just put it on your head."

"The tablet is more difficult to manage. The VR glasses are more useful, easier because they're on the head."

"On the tablet, you have the disadvantages of the TV and the disadvantages of the VR. You have to look around, but you don't have the immersion."

Especially this last quote is interesting, since this points out the biggest difference in viewing experience between the tablet and the HMD: with the tablet you're still connected to the reality, while the HMD completely disconnects you from reality (you're in the movie!).

3.5.4.3. Usability

First iteration

As mentioned, some respondents had difficulties in finding out how to navigate in the content. This was particularly the case in the ipad. A brief notification on the navigation options of the tablet would be welcome.

"I've noticed that you were standing with the tablet, why?

Because I gave him the tablet like this (shows tablet in a horizontal position) and he couldn't scroll with his fingers. Maybe it's good to have a little note on how you could use the tablet. And what the point is, because you just see the front. When you press it just freezes the image. It's missing some information."

First iteration

Most respondents were familiar with the use of a tablet and found it easy to use. However, it wasn't always easy to navigate with the tablet. A commonly made remark was that once the tablet was used to move around in the image, it was hard to quickly find the centre of the image where the 'action' was happening. It could be useful if there was for example an icon or button you could click that takes you immediately back to the centre of the image. When a new scene

starts, the video should automatically centre again as well. This wasn't the case during the lab tests, which made it difficult sometimes to know where to look at the start of a new scene.

> "It's hard to find the centre of the image. It's easier to move to tablet than to touch it to change the view"

> "My normal seating position should be the central point of view in the video. Sometimes I had to turn around to be able to see the central scene in the video."

Also with regards to the HMD some more practical usability issues were mentioned. The glasses were not for everybody comfortable to wear, and some respondents reported that it was very tiring for the eyes because of the short distance of the screen to the eyes. Some repondents were worried to get a headache if they would wear the HMD too long.

> "The HMD was heavy, I didn't really like it. It was not so comfortable. Also, I don't think I can wear it for a long time. Maybe because I'm not used to it. I have to be more concentrated with the VR glasses and I'm less relaxed with it. I like to be more relaxed."

One respondent thought that both on the tablet and the HMD, the navigation or moving around in the image could be more more 'sensitive' or faster:

> "It could be more sensitive. it could go faster. If you want to look back, you have to turn all the way now. Maybe you could experiment with it if you turn 90°, the image moves 180 degrees."

Further, when wearing the HMD, the set-up of the room is important. If you decide to stand up while wearing the HMD, it's important that there is not too much furniture in your surroundings where you can collide with. One respondent suggested it would be nice to sit on a chair that can turn around (e.g. an office chair) instead of a sofa, because then you don't have to stand up to look around in the image.

> "A chair that turns around instead of sofa. Then I don't have to stand up to get all the angles."

3.5.4.4.   Interaction and level of control

First iteration

As mentioned in the observations, some respondents tried walking with the HMD. They expected somehow to be able to walk around in the scene, which wasn't really the case. In some of the scenes, the viewpoint of the camera was too far from the scene. This was particularly the case in the football stadium. Here respondents like the idea of being in the stadium.

> "Maybe on the soccer field I was hoping to be inside the field and following the ball. So you put your scene from far away and you loose that a little bit. What I think is if the quality was the same in all of them, I think it could be like a very good experience, for sure."

Most respondents really liked the scene in the car, because there they could really explore the surroundings. In other scenes the use of the omnidirectional view was considered to be less relevant, because there wasn't actually a lot to see. Therefore some respondents would prefer to have only a few triggered scenes that they could explore.

Other interactive options for the future that were mentioned, was the ability to walk around in the scene, the ability to zoom in on certain content, the option to explore additional scenes and to access additional layers of information with additional content (for example more information on the topic).

Second iteration

The feedback with regards to the interaction and level of control was very similar with the feedback given during the lab tests in Porto. Also, in Brussels, some respondents tried walking with the HMD and expected to be able to walk around in the scene. Many respondents said it would be nice to somehow get closer to or further away from the main characters or at least be able to zoom in and out.

> "I tried to zoom in and was disappointed that I couldn't zoom in to see his face with more detail."
> "It would be nice to have a minimum of movement. Not necessarily through the eyes of the main characters, but at least a certain freedom to watch."
> "It would be interesting to see what they could do to make it more immersive, so you could move forwards and backwards, and be part of the scene a bit more."

Also, in the Brussels test the respondents referred to the stadium scene where the camera was too far away from the scene. Because the camera was so far from the action, they felt less immersed or involved with the content.

> "It didn't feel as if we were really there. 360 didn't add much to it. In the home it was nice. Then I felt like I was there. In the stadium I felt too far from the action. In the home you were close to the family. Maybe it's normal because a stadium is too big compared to a room."

In genereal, the level of control or interactive possibilities the respondents want really depends on the scene or on the type of content.

> "I also agree that it is interesting that you can have a look at the surroundings. (…) I like the potential VR gives, but for a regular movie I'm not sure if I need it."

> "Most people when they watch TV, they want to relax. Its more interactive with VR. After a long day of work, you're not going to use it."

The next section describes the types of content the respondents think would be interesting for VR use cases.

3.5.4.5. Content

First iteration

A documentary was seen as an obvious choice for this kind of set-up. But also movies were often mentioned, as well as games. Another specific content genre that was mentioned, were music concerts.

> "To add information in this kind of documentary style, like documentaries about wildlife etc. because you can experience the spaces. I think it's very good to add infomation and understand this space."

Sports were also mentioned quite often as a genre.

> "When I hear about VR experienes I always think about live stuff like a football match or some sports that I can know well. If you are watching a football game that you can look up the guy who has the ball. So the ability to have it like I was in the stadium, I think that's what I see that can bring more… it shoiuld be interesting."

> "In the near future we could get those glasses at home and watch some good movies, or even football matches like almost everything would be cool to watch through those glasses. So it's a great option for the future. I think that everything would be cool. I like

wildlife documentaries. Football matches would be a good thing to try but I don't know if in the long run, it might be better to watch the game normally. Movies, if watching a movie through the glasses would not take away our attention from the storyline, it would be great."

The question on which genre is most suited for this kind of experience was found irrelevant by one respondent. He thinks this is not necessarily related to the genre or type of content, but more to the specific scene.

"I think it is not genre specific, but more scene specific. In some scenes it works like the car ride, but for instance when they are eating breakfast it doesn't make any difference. So I think it's scene specific, so it doesn't really matter the genre."

Second iteration

Similar types of content were mentioned during the interviews in Brussels.

Documentaries were mentioned by every respondent. Especially documentaries about places you can't go yourself would be interesting, such as documentaries about nature, wildlife, travelling, space, …

"I would like to see the inside of the jungle. Be in the middle of the ocean."

Gaming was also often mentioned, as well as live events. The 360 video experience could offer an added value to events such as sports game, a music concert or a political event, because it could offer the viewer at home the possibility to see the reactions of the audience and get a better crowd and live experience.

"In the stadium, you could get a plenary view of the whole event. See the crowd screaming and shouting... That's something you cannot experience with a normal device."

"With all the fake news now (…) This could help people to have a more clear and true reception about reality events."

One respondent even brainstormed about the idea of having to buy VR tickets for events, where a more expensive ticket offers you a better 'spot' at home.

"Imagine they would sell VR tickets, more money for a 'better spot'."

Generally, there is especially an interest in 360 video experiences for non-fiction content, and less for fiction. This kind of set-up is deemed less interesting for the 'average Hollywood movie or TV show', as the editing of a movie or TV show is important for the viewing experience and, as mentioned before, it can distract the viewer and take attention away from the story.

"For a basic movie you just want to stay seated."

Only for horror or detective movies this set-up could be interesting, if the viewer would have to look for for example hidden cues in the video him- or herself.

"Action, horror movies: movies where something is happening you don't expect. Sneaking around is cool then for a user."

3.5.4.6. Social viewing

First iteration

The fact that it can be considered a social experience was already noticed in the observations. The fact that people could direct each other to look at certain things makes it an enjoyable shared activity.

> *"I think if the idea is sharing it with people it could be a collective experience. You could make it more into a social occasion cause you're able to share ideas to just point out that one should look in that direction or experience this."*

However, some people do see more obstacles for the HMD, since this is considered a more individual experience in comparison with the tablet and the TV-set.

Second iteration

The HMD is considered a much more private viewing experience than the tablet, as it disconnects you from your surroundings.

> *"I wouldn't want to use it together with other people. I wouldn't want other people to know what or who I'm watching with the tablet or VR glasses. I don't want other people know what I'm interested in."*

> *"I think it would be weird if I use the VR and somebody is around me. I would feel like I isolated myself and don't care about the others around me. Tablet is okay, I can also show it to the person."*

> *"This creates a distance. You cannot share the experience anymore if you're watching other stuff. On the TV you watch the same content together."*

However, some respondents point out that it would be interesting to use the HMD in the companion of others, but only if everybody is wearing an HMD. Then you could interact with eachother about the content and for example tell each other in which direction to look if something interesting is happening.

> *"It could be funny with friends. If everybody is wearing it. So, you can say 'have you seen … on your left'. Alone would be less interesting."*

One respondent said he would't want to use the tablet together with another person, because he wouldn't want to take into account anyone else while navigating the content.

> *"Deciding to move the tablet and deciding which scene to give attention, that's a very personal decision depending on what you want to focus on. I wouldn't want another person to say that I have to keep it there or there."*

3.5.4.7. Future expectations

First iteration

The question on future expectations related to the fact whether they would see themselves using this kind of set-up at home in the future. Here answers were rather diverse. For some it is just something they would like to experience in special occasions, but not something to use regularly at home.

"I really don't think so. I think it's really nice to have this expeirence sometimes but I don't think I would be anxious to use it at home. I think it is really cool to have these kind of experiences once in a while, but I don't think it's necessary to use it everytime I watch television."

For others it depends on the specific type of content or the added value.

"In some cases I would see myself using TV for this. It will depend on what you would use TV for. If you would watch tv-series, then the content would have to be, you would have to have immersive or interactive content. If you would manage to do this, probably I would use this. "

"I think the main challenge is how you're going to create content that is different and that enables to use these kind of tools. If you manage to do this, it would be ok, but if I would just see something about a young kid, that is the same on TV. Another thing is if I would change viewpoint, if I could see through their eyes. That would be different, because now I felt like a voyeur."

This last quote illustrates the finding that the offered interaction should provide some kind of added value to the regular TV-experience.

Also the user-friendliness of the offered solution is important. If people would use a similar set-up at home, it should be really easy to install.

"Yes maybe. I think for instance hypothetically i like those lame CSI shows, maybe it would be cool to have different perspectives on these action films or whatever. I wouldn't mind if it was plug and play. If you didn't have to do anything because there is one thing I watch TV, I don't want to mess around with technology. if it's plug and play and everything is in synch and working."

Of course also the price will play an important role.

"I don't know what the price of it would be. Maybe not but perhaps one day when it's more common. But I think now maybe not because it's still very expensive and in development. In the future it might be better."

Second iteration

During the Brussels interviews the respondents were asked as well if they would see themselves using this kind of set-up at home in the future.

As mentioned above, this really depends on the specific type of content or the added value. The vr experience needs to have something extra to offer compared to a normal broadcast.

"It will depend on when and what content. When im in bed I would consider the tablet and glasses."

One person said it's actually more practical to use a HMD at home, because you know your house very well so the chances are lower that you collide with your furniture.

"I think its perfect for at home. You have more space, you know your house. No change for accidents."

The price plays an important role in the decision on whether or not to buy a HMD, as well as the maturity of the technology and the availability of content with an added value. The majority of the respondents said they are not yet interested in buying an HMD because they think the technology will still a lot better a lot in the next years and there will be a higher offer of content then.

3.5.4.8.   Expectations on subtitles

For the labtest in Brussels, the originally Portuguese content was dubbed in English. On the TV, English subtitles were shown, but there were no subtitles on the tablet and the HMD. The use of subtitles was discussed during the interviews in Brussels.

Many respondents expressed that they didn't like the fact that the content was dubbed. They said that for normal TV broadcasts, they always prefer subtitles over dubbing. This is probably in line with the cultural habits, in Flanders content is always subtitled and never dubbed. However, for the immersive content on the tablet and HMD, most respondents said they couldn't imagine having subtitles there. The multi-device set-up already distracts from the respondents from the storyline, and the use of subtitles on the mobile devices would make it too complicated.

"I think it is impossible to put subtitles in glasses. You wouldn't know who is talking. (…) That's why I look at the big screen, to know who is talking."

"Dubbing makes is easier. You don't have to read. There is already so much going on."

"I wouldn't like it on my tablet. It would be too complicated to enjoy. You want to be immersed into the reality of a film, documentary… If there are so many things that distract you, that's not possible."

"I prefer to have no subtitles. The screen is already so small."

If there would be subtitles for 360 video on the tablet or the HMD, the respondents say they would like it the most if the head movement and always move with you as you turn your head.

"If there are subtitles, I think its better that if I turn my head, the subtitles would follow the head movement."

"If there are subtitles, they should follow your angle. Otherwise you wouldn't move your head because you wouldn't want to miss the conversation."

One respondent thought it would maybe be a good idea to have the subtitles in a speech bubble above or beneath the character that is speaking.

"Maybe with bubble like in graphic novels. That might be an idea."

Another respondent said that there should be no dubbing when you're only watching the TV (only subtitles) and that dubbing should only start from the moment you put on the HMD.

"Maybe subtitles on tv and no dubbing, and then from the moment you put on the glasses, the dubbing should start."

3.6.   Semi-open pilot test

3.6.1. Planned set-up

The semi-open pilot is the second phase in the end-user evalutation for pilot 1. Contrary to the first phase in which the end-users were asked to evaluate the demonstrator in a lab setting, selected end-users could watch the documentary in their own home setting in the semi-open pilot. The same technical set-up was used as for the closed pilot test in Brussels (see 0). The aim

was to have 80 respondents testing the demonstrator: 50 respondents in Belgium and 30 in Spain.

The semi-open pilot allows us to gather feedback of respondents that consume the content in their natural setting, making use of their own devices. Research questions are:

- How do end-users evaluate an immersive multi-device experience in their home?
- How does the immersive experience fit within the regular viewing activities of users?

An online survey was created which the respondents were asked to fill in after watching the documentary.

For the user evaluation, we planned in Deliverable 4.1 (p.35-36) the following set-up of the test:

"Selected users will be invited to download an app via which they can watch the documentary at home. The online set-up will be installed by i2cat. A dedicated website will be developed with explanation of the test set-up and download procedures in three different languages. Invited users will receive a unique download link so we can track the number of downloads in each country. An online survey will be developed by IMEC in Dutch and English and translated in the different languages. The survey will automatically open at the end of the documentary."

The following changes were made to this planned set-up:

- No dedicated website was created for the semi-open pilot, but the explanation of the test set-up and download procedures were described on the ImmersiaTV project website: http://www.immersiatv.eu/demo-pilot-1-instructions/
- As the documentary was dubbed in English and the subtitles were in English as well, a requirement for participation was that the respondents had a knowlegde of the English language. The explanation of the test-set up and the online survey were created and distributed in English only.

The respondents were asked to follow the following test procedure:

The test procedure consisted of the following steps:

1. Filling in the registration form.
   In this form (see Annex V), the respondents were asked to provide their name, contact email address, age, gender and give their consent for participation.
2. Installing the Immersia TV software on a Windows computer.
   Clear installation instructions were provided on the website and an online video tutorial was created for this purpose as well. Figure 7 shows a screenshot of the online instruction page. The online video tutorial can be accessed here: https://youtu.be/kbZgBv3hAd4
3. Multi-device viewing of the documentary.
   Figure 8 and Figure 9 show a screenshot of the online demonstrator.
4. Filling in the online survey.
   Immediately after watching the documentary, an online survey opened in the app. Filling in the online survey took maximum 10 minutes of the respondents' time. The survey included questions to gather feedback on the usability, the content, the multi-device viewing experience, feeling of immersion, social viewing and future expectations. Likert scales and closed answers were used to ensure a fluent evaluation procedure. See Annex V for the complete survey.
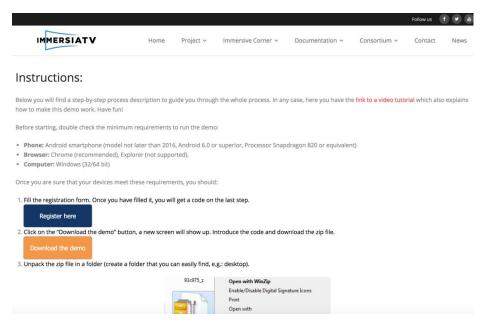
Figure 7: Example of the online instructions for the semi-open pilot 1

Figure 8: Example of the online demonstrator for the semi-open pilot 1 (1)

Figure 9: Example of the online demonstrator for the semi-open pilot 1 (2)

3.6.2. Detailed execution of the activity

Technical set-up

The technical set-up of the test is the same as for the closed lab tests in Brussels (see 0 for description). Contrary to the lab test, in the semi-open pilot the respondents had to use their own devices.

Minimum requirements for the devices were communicated to the respondents. The requirements were the following:

- **Phone:** Android smartphone (model not later than 2016, Android 6.0 or superior, Processor Snapdragon 820 or equivalent)

- **Browser:** Chrome (recommended), Explorer (not supported).

- **Computer:** Windows (32/64 bit)

All respondents used the same plastic Google cardboard virtual reality goggles, which were given as incentive for participation.

Figure 10: VR glasses semi-open pilot

User evaluation test

User feedback was gathered by means of the registration form and the online survey which respondents are asked to fill in after the test. Reponses were collected from July 24 to August 13, 2017.

Only responses by respondents who filled in both the registration form and the post-test survey were taken into account. 43 respondents have filled in the two surveys.

This number is lower then the 80 respondents aimed for. The reason for this is that multiple people experienced technical issues, hindering them form completing or even starting the test. 27 respondents for example registered for the test, but never completed the post-test survey. These respondents were contacted to learn more about their reasons for not completing the test. Most reported problems were related to the regular frame freeze on the mobile devices and a desynchronization of the content on the TV-set vs. on the mobile devices. This feedback is taken into account for the open pilot.

The average age of the respondents who completed the whole test was 34 years old. The youngest respondent was 24 and the oldest 62. 30% of the respondents were female, and 70% male.

3.6.3. Obtained results

As the participation to the semi-open pilot is still ongoing, we describe in this deliverable the preliminary results of the respondents that already filledin the post-test survey (n=43).

Devices and viewing behaviour

The respondents were required to watch the documentary with at least a Windows computer and an Android smartphone (for in the VR glasses) at their disposal. In addition to this, they could also use a tablet as well, and connect their computer to the TV to watch the documentary there instead of on the computer screen. 3 respondents used a tablet during the test, and 5 respondents connected their computer to a TV-screen.

The respondents were asked how much they switched between the different devices during the test. Figure 11 gives an overview of the responses. About three quarters of the respondents indicated to have switched between devices multiple times.
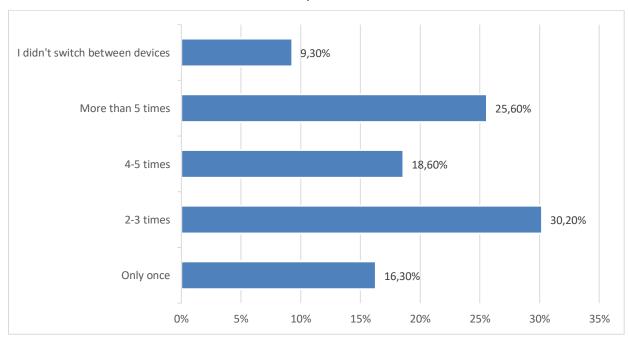

Figure 11: Number of device switches (%, n=43)

We also asked what combination of devices the respondents thought was most interesting to watch the documentary (or if they preferred watching with one device only). In a multi-device set-up, the combination of a computer or TV with the VR goggles is the most popular, with around 30% of the respondents choosing this combination. However, the majority of the respondents (35,7%) says they prefer to watch with one device only. The respondents who indicated to prefer to watch with one device only where asked in an extra question what devices they then preferred (see Figure 13). Over half of these respondents indicates to prefer to watch the documentary on the TV-set only, followed by the VR goggles (33,3%).
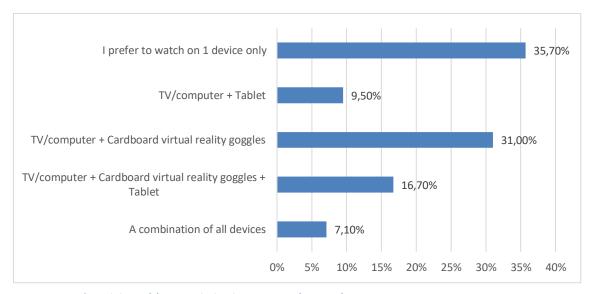
Figure 12: Preferred device(s) to watch the documentary (%, n=42)
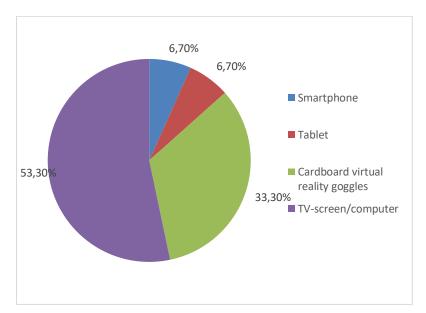

Figure 13: Prefered device to watch the documentary (%, n=15)

Finally, almost 80% of the respondents indicated to have watched the documentary alone, and 20% together with at least one other person in the room.
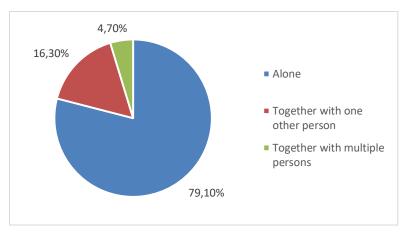
Figure 14: Companion while watching (%, n=43)

Viewing experience

In this section, we describe the viewing experience of the respondents in the multi-device set-up.

First, the respondents were asked whether they experienced any technical difficulties during the test with any of the devices. 24 respondents reported to have experienced technical issues while doing the test. Three issues especially were often mentioned:

- Desynchronization of the content on the mobile devices compared to the content on the computer
- Frame freezes on the mobile devices
- Image on mobile phone freezes, and the page needs to be reloaded in order for the video to start playing again.

Other than that, it was mentioned a couple of times that it was a pity that there was no audio with the video on the mobile phone.

Also, there was a usability issue that was mentioned a couple of times as well. Many smartphone models have the on/off button on the side and when putting them in the VR goggles the button gets pressed, causing the phone to switch off.

Figure 15 gives an overview of the extent to which the respondents liked the content of the video. Responses are a bit divided here, with about one third of the respondents saying they neither liked or disliked the content, and a slightly higher amount of respondents saying they disliked the content (37,2%) compared to the ones saying they liked the content (27,9%).
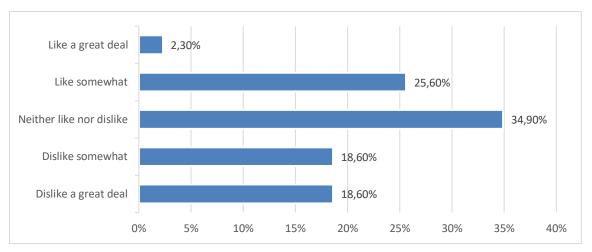
Figure 15: To which degree you liked the content of this specific video? (%, N=43)

Similar to the labtests in Brussels, the respondents were asked to rate the visual quality of the documentary on on the different devices on a 5-point Likert scale. Figure 16 gives an overview of the visual quality ratings. The respondents could only rate the quality on the devices they indicated to have used during the test. The visual qualiy of the content on the computer was rated the best, and the one on the VR glasses and tablet the worst.

(Note: In the questionnaire, a mistake was made in the listing of the devices. Both the smartphone and the VR glasses were listed, while naturally the smartphone was placed in the VR goggles during the test. Some respondents might have been confused by the question and selected or the smartphone or the cardboard VR goggles, while they actually should have selected both devices. This should be taking into account when interpreting Figure 16).
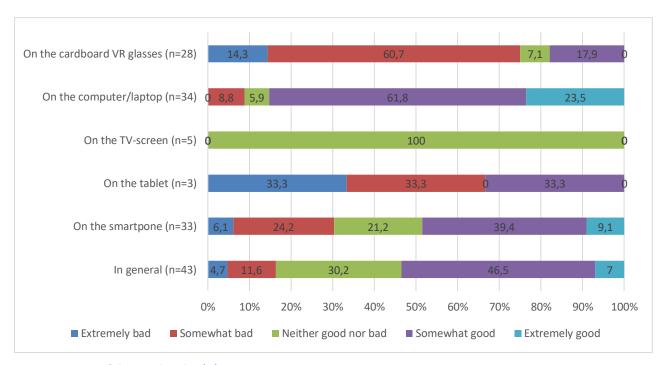

Figure 16: Rating of the visual quality (%)

Next, using 10 statements, the respondents were asked to rate the usability of the multi-device test set-up. For this purpose, we made use of the existing **System Usability Scale (SUS) (Brooke**

& others, 1996). The SUS consists of ten statements that have to be scored on a 5-point Likert scale and helps to assess the effectiveness, the efficiency and the satisfaction with a product or service. Table 15 shows all the statements.

Item	
1	I think that I would like to use this set-up frequently
2	I found the set-up unnecessarily complex
3	I thought the set-up was easy to use
4	I think that I would need the support of a technical person to be able to use this set-up
5	I found the various functions in this set-up were well integrated
6	I thought there was too much inconsistency in this set-up
7	I would imagine that most people would learn to use this set-up very quickly
8	I found the set-up very cumbersome to use
9	I felt very confident using the set-up
10	I needed to learn a lot of things before I could get going with this set-up

Table 15: SUS statements

The SUS yields a score from 0 (negative) to 100 (positive) for the overall usability of the system. Scores on individual items are not meaning full on their own. Figure 17 shows how the SUS score can be interpreted.
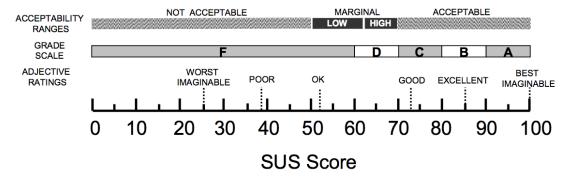

Figure 17: How to interpret the SUS score? (source: (Bangor, Kortum, & Miller, 2009))

An SUS score was calculated for each respondent.[6] **The average SUS score for the 43 respondents of the sample is 57,5**. This means that the respondents gave the usability of the multi-devices test set-up a just above average positive rating.

This survey also applied the **'User Engagement Scale'** developed by O'Brian and Toms (2010) to measure level of engagement of the respondents with the displayed content. This validated

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[6] The SUS score is calculated by following these steps: 'To calculate the SUS score, first sum the score contributions from each item. Each item's score contribution will range from 0 to 4. For items 1,3,5,7,and 9 the score contribution is the scale position minus 1. For items 2,4,6,8 and 10, the contribution is 5 minus the scale position. Multiply the sum of the scores by 2.5 to obtain the overall value of SU' (Brooke & others, 1996, p. 5).

scale consists of nine items which users are asked to rate on a 5-point likert scale (1: Strongly disagree - 5: Strongly agree):

- 3 items measure felt involvement:
    - *The viewing experience was fun*
    - *I was really drawn into the video watching*
    - *I felt involved in the viewing experience*
- 4 items measure focused attention
    - *I was absorbed in the viewing experience*
    - *I lost myself in the viewing experience*
    - *I was so involved in the viewing experience that I lost track of time*
    - *When I was viewing, I lost track of the world around me*

Figure 18 gives an overview of the scores for each item. Table 16 shows the mean score for each item. Taking together all the items, **the overall mean score for 'User engagement' is 2,94**. This means that on a scale of 1 to 5, users were slightly engaged with the content.
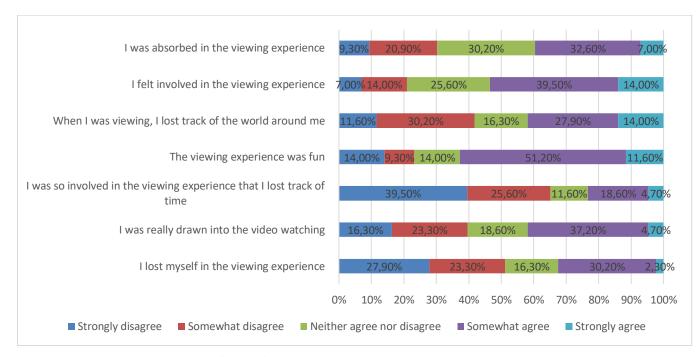
Figure 18: Engagement with the content (%, n=43)

	Mean
I lost myself in the viewing experience	2,56
I was really drawn into the video watching	2,91
I was so involved in the viewing experience that I lost track of time	2,23
The viewing experience was fun	3,37
When I was viewing, I lost track of the world around me	3,02
I felt involved in the viewing experience	3,4
I was absorbed in the viewing experience	3,07
Total	**2,94**

When wearing VR goggles and watching omnidirectional videos, it can happen that people feel disoriented or sometimes even nauseous or dizzy. In this survey, the respondents were asked to indicate on a 5-point likert scale whether they experienced feelings of disorientation and dizziness. Figure 19 gives an overview of the answers. 44,2% of the respondents says to have felt disoriented while trying out the cardboard experience, and 41,9% says to have felt dizzy.
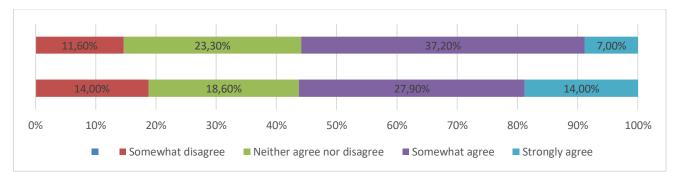

Figure 19: Physical discomfort (%, n=43)

Figure 20 gives an overview of statements that assessed the multi-devices viewing experience. Generally, a majority of the respondents liked to have acces to different viewing experiences of the same scenes and content (66,7%) and liked the freedom to switch between the devices (64,3). However, it stays challenging to find the right balance while switching between the devices. Only 21,4% says to easily find a balance. A little bit more than half of the panel (52,4%) says they would prefer to watch the content on 1 device only. This last number is surprising, as in Figure 12 only 35,7% of the respondents stated to prefer to watch on one device only.
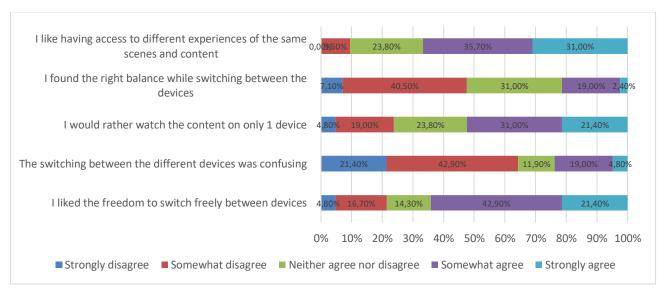
Figure 20: Multi-device viewing experience (%, n=43)

Future expectations

At the end of the survey, the respondents were asked for which type of content a multi-device omnidirectional video experience is most suitable. Similar to the results of the closed pilot, there is especially an interest in 360 video experiences for non-fiction content. Gaming is considered the most suitable, as well as documentaries and live events (music events, sports games).
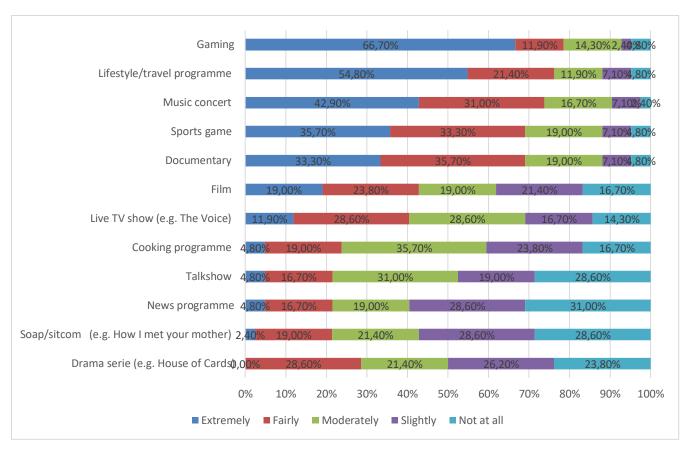
Figure 21: Types of content interesting for omnidirectional video (%, n=42)

In a last question, respondents were asked if they would consider watching content via a similar multi-device set-up in the future at home, if you would have access to devices and content. Over half of the respondents (59,5%) sees themselve using this kind of set-up at home in the future. Only 7,1% would not use this set-up at home.
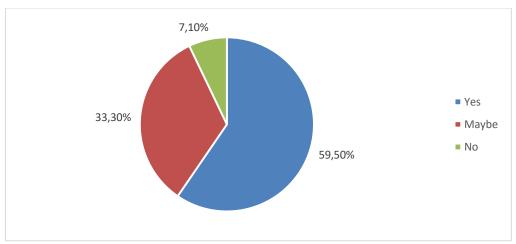
Figure 22: Would you consider watching similar multi-device content in the future at home, if you would have access to devices and content? (%, N=43)

3.7. Open pilot test

The final pilot activity for pilot 1 is the open pilot test. In this phase of the research, the documentary is placed online and publicly available for downloading and viewing. After viewing

the documentary, a survey will pop up with questions on the viewing experience. There will be no specific recruitment criteria, but a short socio-demographic profile will be part of the evaluation survey, so we can create a profile of the involved users. All project partners will promote this via the different available communication channels (website, social media, press releases etc.).

The open pilot test will have the same technical set-up as the semi-open pilot test. For an extensive description of the set-up, we refer to 3.6. The respondents will be asked to use their own devices and, contrary to the semi-open pilot test, their own HMD. However, the semi-open pilot showed us that multiple people experienced technical issues, hindering them from completing or even starting the test. Most problems were related to network issues (server side or player side) or the performance of the mobile devices. The received feedback is taken into account for the open pilot. In order to deal with issues end-user might encounter, a clear help page with frequently asked questions will be created, with with an overview of problems that might occur and what the causes & solutions could be.

An extra small scale test was executed to to check compatibility of the open pilot with different types of android phone models. People were asked to check if the pilot 1 content played fluently on their device, and give their feedback in a short survey that asked for the exact model of the test device, the download bandwith and possible issues. Annex VII shows the survey questions. The test procedure consisted of the following steps:

- Connect your smartphone to a WiFi network
- Go the the **Google Chrome browser** on your phone
- Go to the following website: http://150.254.161.51:8080/player/
- Select the cardboard icon in the bottom right corner
- Select the 'Pilot1.5' video and start the video
- Watch the video on your mobile phone **for a couple of minutes**
- Let us know if the video plays fluently on your mobile phone by filling the online form.

15 responses were collected. 4 people said to not be able to play the video fluently on their phone. Further analysis revealed that these cases were caused by a saturated network or by using a low performance device.

The open pilot test will be executed February- March 2018.

3.8. Overview of end-user and professional user requirements

We conclude this deliverable with an overview of the current status of the end- and professional user requirements as listed in D2.1. and D2.2. The software requirements are further discussed in D4.4.

End-user requirements

	Requirement	Description	Status
General VR requirements			
R.1.1.1	**The end-user shall be informed about possible health risks (e.g., motion sickness, epileptic issues…) by adding a warning to the content**	*Keep in mind that some users might experience physical discomfort such as nausea or dizziness while watching VR, because they cannot see their own legs in the VR environment and therefore feel detached.*	*Only very limited physical discomfort was reported in the evaluation activities*
R. 1.1.2.	**The end-user shall be offered a way to control his/her surroundings while watching VR content**	*Users might feel isolated when watching VR content via a HMD. Therefore it is preferable to offer them a way to keep in contact with their environment while they are in the experience, for example via an optical see-through display.*	*Not available*
R.1.1.3	**The end-user shall watch the VR content with an image quality that is equal or better than the image quality on their TV**	*The image quality of the demo and pilot content should be in line with the quality end-users are accustomed to from their own TV-set and portable devices (smartphone, tablet). They expect that the image quality in the HMD is at least as good as what they are used to.*	*Image quality was perfect on TV, but low on HMD and tablet.*
R.1.1.4	**The end-user shall enjoy a physical social viewing experience via picture in picture or via content duplication of the HMD content on other devices**	*By allowing interaction when 1 user in the household is using a HMD (for example by allowing other viewers to see what he or she is seeing via a picture in picture on the TV screen or to explore the content themselves via other devices).*	*Not available yet*

R.1.1.5	**The end-user shall enjoy a virtual social viewing experience via virtual representation of others in the content**	*By offering a more social VR experience by adding avatars or representations of other VR users in the content.*	*Not available yet*
Synchronised content across devices			
R.1.1.6	**The end-user shall only have a limited number of VR interactions (3 or 4) in one content format**	*The number of VR interaction should be limited in order to limit the burden of switching devices while watching.*	*Respondents could select the number of interactions*
R.1.1.7	**The end-user shall not be distracted from the storytelling by the implemented VR interactions**	*The VR interaction should not completely distract viewers from the storytelling.*	*This was positively evaluated by most of the respondents*
R.1.1.8	**The end-user shall view short VR content formats (max. 5 minutes) with short VR interactions**	*Viewers seem to prefer short VR fragments (couple of minutes) and a maximum of 3-4 interactions/program.*	*Respondents could select the length of their interactions*
Interactive VR experiences			
R.1.1.9	**The end-user shall be able to explore the content by zooming in and out**	*The user should be able to zoom in and out.*	*Not available yet*
R.1.1.10	**The end-user shall view VR content that is recorded with the camera standpoint adapted to the viewpoint of the user**	*The camera standpoint should be adapted to the position or the viewpoint of the user. Eye height is recommended in several cases.*	*With video-based content it is only possible to define a mean height during the shooting, it is not adjustable afterwards. This was taken into account*
R.1.1.11	**The end-user shall be able to select his/her preferred viewpoint from a range of different fixed positions**	*Multi-viewpoint content shall be developed. Different perspectives or positions should be possible. Users should be able to select their preferred viewpoint.*	*Partly available*

R.1.1.12	**The end-user shall have control over the camera perspective**	*Users should be able to choose when to change perspective themselves, or the transition should go more natural and not interrupt the experience.*	*Not available yet*
R.1.1.13	**The end-user shall be able to select his own viewpoint anywhere in the content and act as a director**	*Viewers would like to select their own viewpoint (viewer as director).*	*Not available yet*
R.1.1.14	**The end-user shall be able to choose viewer vs. director control**	*Users should be able to choose whether they want to be directed to certain events, or whether they want to be able to look around freely.*	*Respondents could select their own interaction with the content*
R.1.1.15	**The end-user shall be guided on where to look in the VR content by natural triggers that serve as anchor points**	*Natural triggers should provide anchor points to the user of where to watch or what content to explore.*	*Partly available*
R.1.1.16	**The end-user shall be guided by haptic feedback to make the experience more tangible**	*Add haptic feedback to the experience, to make it even more tangible for users.*	*Not available yet*
Content format			
R.1.1.17	**The end-user shall view VR content that is adapted to his/her preferences**	*The offered content should have a clear added value for the user in terms of personal interest or originality of the content.*	*Positively evaluated by the user*

Professional user requirements

Content Format requirements

Generic Requirements		
R.2.1.1	The content creator shall take into account that VR experiences are about presence, "being there"	*2.1.1.1. and 2.1.1.2. were achieved, 2.1.1.3-2.1.1.5. not yet*

		- 2.1.1.1: show insight in situation without subjective choice of director - 2.1.1.2: use a correct perspective and height of camera - 2.1.1.3: see yourself/character in images when looking down - 2.1.1.4: add tactility and tangibility - 2.1.1.5: give user active role/give user impact on story	
R.2.1.2	The content creator should consider the use of gamification paradigms to improve the storytelling for VR. - 2.1.2.1: search for new VR formats (do not start from existing TV formats) - 2.1.2.2: connect technical people with storytellers - 2.1.2.3: apply the gamification paradigms	*Partly achieved*
R.2.1.3	The content creator shall make proportional use of omnidirectional content - 2.1.3.1: find balance between 360° and 2D (keeping available time, … in mind) - 2.1.3.2: take care of switching between 360 and 2D in HMD(/TV) - 2.1.3.3: allow the user to choose between auto switching to 360°, or to configure the "frequency"	*Participants could select this themselves*
R.2.1.4	The content creator shall be able to play with the viewing angle & viewpoints. - 2.1.4.1: play with different viewing angles and transition when viewing angle change - 2.1.4.2: experiment with different viewpoints	*Achieved*
R.2.1.5	The content creator shall carefully consider the viewer's role in the story	*Partly achieved (for example feeling of presence in car scene)*
R.2.1.6	The content creator shall define the "beats" and find a good balance between static and dynamic shots. - 2.1.6.1: define a good rhythm/pace of story "beats" - 2.1.6.2: find a good balance between static and dynamic shots	*Achieved*

R.2.1.7	The content creator shall take care of the balance between guidance and freely looking around.	*Respondents could select this themselves*
R.2.1.8	The content creator shall apply good usage of transitions and cuts in VR storytelling.	*Partly achieved*
R.2.1.9	The content creator shall be able to adequately address the social aspects of the VR experience.	*Not available yet*
	Synchronized content across devices	
R.2.1.10	The content creator shall give the user the choice when to switch between devices.	*Not available yet*
R.2.1.11	The content creator shall not mix TV storytelling with VR storytelling.	*Not achieved*
	Interactivity and portal concept	
R.2.1.12	The content creator shall be able to apply interactivity via portals.	achieved
R.2.1.13	The content creator shall be able to include extra graphical content in the HMD interface.	*Partly achieved*

Creative workflow requirements

Preproduction		
R.2.1.14	The content creator shall have tools for pre-production, to define the VR world and content format and to enable more complex and interactive 360° scripting possibilities.	*No pre-production tools implemened*
R.2.1.15	The content creator shall be able to previsualise the 360° world of the story based on rough 360° video footage of the location.	*Not yet achieved*
Production		
R.2.1.16	The content creator shall be able to have an on-location live preview in VR of the camera view (before the actual shooting takes place) and	*Not yet achieved*

	captured content, including omnidirectional video and audio preview on the set.	
R.2.1.17	The content creator shall be able to have an on-location live replay in VR of captured content, and resulting format experience.	*Not yet achieved*
R.2.1.18	The content creator shall be able to automatically label and sort captured shots.	*Not yet achieved*
R.2.1.19	The content creator shall be able to fast ingest (after capturing) or to stream (before capturing) the captured shots, in order to enable instant preview.	*Partially Achieved*
R.2.1.20	The content creator shall be able to use live VR preview tooling that integrates with the VR storyboard (preproduction phase).	*No shots from the research phase were available, but feasible with current software*
R.2.1.21	The content creator shall be able to use similar functionalities for live preview as for the VR storyboard tooling in preproduction.	*Not yet achieved*
R.2.1.22	The content creator shall be able to use an intuitive dashboard indicating the status of the used cameras in shooting.	*Not yet Achieved*
R.2.1.23	The content creator shall be able to use specific 360 video camera equipment with requirements including high mobility, weight, robustness, rainproof, mud-proof, stability.	*Partially Achieved*
Post-production		
R.2.1.24	The content creator shall be able to use tooling that provides better integration of the process of rough stitching, editing and final stitching in the production chain.	*Achieved*
R.2.1.25	The content creator shall be able to use a more simplified post production workflow that minimizes the required manual steps and used tools. This includes: - 2.1.25.1: Stitching - 2.1.25.2: Editing and compositing for 360 scenarios	*Achieved*

	- 2.1.25.3: Adding interactivity and portals - 2.1.25.4: Synchronous multi-platform content (tv, HMD, tablet)	
R.2.1.26	The content creator shall be able to use preview capabilities in post-production, including HMD and ImmersiaTV Player output viewing.	*Partially achieved*
R.2.1.27	The content creator shall be able to export to different platforms in an automated way.	*Not yet achieved*
Publication		
R.2.1.28	The content creator shall be able to use tooling for better findability and searchability of own produced VR content.	*Achieved*
R.2.1.29	The content creator shall be able to use a custom developed play-out solution that supports interactivity and synchronisation scenarios.	A*chieved*

4. PILOT 2 – USER EVALUATION RESULTS

4.1.   Evaluation of the live director's toolkit (P2.1)

4.1.1. Planned set-up

The aim of this pilot activity was to organise an iterative development of the Immersia TV live director's toolkit in which intermediate feedback of the professional users at Cinegy and VRT can be incorporated in new versions of the software. Whereas the focus of the professional evaluation of the software development toolkit in pilot 1 was on post-production and the evaluation of the ImmersiaTV plug-in for Adobe, the focus in pilot 2 is on the live-production features. The live toolkit is developed by Cinegy.

Three central questions guided this activity:

- Is the developed software in line with the formulated software and professional requirements as part of WP2 research activities?

- How do professional users evaluate the live production tools in terms of usability, usefulness and satisfaction?

- How do professional users evaluate the added value and complementarity of live 360° editing when compared to traditional live editing?

The detailed set-up of this activity was defined in D4.1., pg. 41-46. For the development and testing of the director's toolkit, three phases of testing with professional users were foreseen. First the software was iteratively developed and tested by professional users with a direct link to the ImmersiaTV project. In a second phase, once a stable version of the software was released, professional editors with no direct link to the ImmersiaTV project would test the software in an offline simulation of a live scenario by having live streams recorded and prepared for re-broadcast. In the third phase, professional editors would test the software in a real live scenario.

The expected outcome of the software evaluation activities was a validated toolset that integrates well within directors' workflow, has a high-perceived usefulness and is intuitive and user friendly.

4.1.2. Detailed execution of the activity

The three foreseen phases for the testing software were executed as follows:

Phase 1: Iterative development of the toolkit

The first phase is the software development phase, where an iterative approach was applied. Professional users at Cinegy, VRT, i2cat and PSNC tested the software tested and evaluated the software after each software drop. They did a technical evaluation of the software and ensured that the WP2 profesional and technical requirements were implemented as requested. New versions of the software were released on a regular basis. Feedback was gathered in an informal way via online and offline meetings and via email. In D4.1, it was foreseen that professional users at VRT and Cinegy would be asked to send feedback on the different functionalities via a short online survey including the USE (Usefulness, Satisfaction and Ease of Use) questionnaire as developed by Lund (2001). However, this method was not applied as this method was used as well for the evaluation of the pilot 1 content creation toolkit and it did not integrate well with

the informal way of working (experiences were shared and discussed more easily in meetings) and the rather low number of responses made it hard to make significant statements on the USE scale.

Phase 2 and phase 3: Professional user evaluation of the software in a live scenario and in a simulation of a live scenario

Some changes were made to the set-up of the second and third phase as described in D4.1. Due to some technical constraints, a fully stable version of the software was only released by January 7, when the actual cyclocross event and closed pilot test took place. This prohibited us from testing the software in an offline simulation of a live scenario (phase 2) and a real live scenario (phase 3) before the closed pilot test.

A first professional user evaluation activity took place during the cyclocross event, where a professional user tested the toolkit in a real live scenario. The cyclocross event took place in Leuven on January 7 2018. The technical and professional evaluation activities wer organized in a room that was set up next to the cyclocross track especially for ImmersiaTV. Feedback was gathered by means of observation and an interview. The professional user was asked to continuously 'think out loud' or say their thoughts while using the software and its basic functionalities (= Think-aloud evaluative method) and the imec researcher present asked additional questions about the actions of the professional user when required. After the testing, some additional questions were asked.
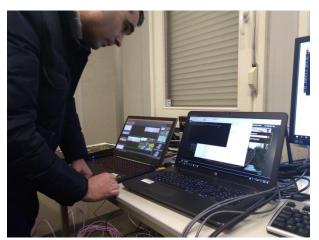

Figure 23: Example of the professional user evaluation

Next, in a second phase, two professional directors with director skills and with no direct link to the ImmersiaTV project tested the software in an offline simulation of a live scenario by having the cyclocross live streams recorded and prepared for re-broadcast. After a short introduction, the test users were asked to 'play around' with the software. Also here, feedback was gathered by means of observation and an interview. The tests took place at VRT premises on January 17 2018 after the cyclocross event.

In annex VIII, an overview of the different screenshots of the evaluated toolkit can be found. In annex IX, the observation protocol and interview guide for the professional user evaluation can be found.

An overview of the participants of phase 2 and 3 can be found in the table below:

Participant	Date test	Gender	Profession
1	07/01/2018 (Live test)	Male	Audiovisual producer, Innovation research
2	17/01/2018 (Simulation of live test)	Male	Multicam director, innovation research
3	17/01/2018 (Simulation of live test)	Male	Enterprise architect, professional experience in media production, recording, editing & finishing

Table 17: Overview professional users pilot 2

4.1.3. Obtained results

Overall evaluation of the concept

The general concept of the tool was received well.

"I like the concept, that you as a director make the scene (…) and then you release the scene to the end-user."

The toolkit enables the professional user to **preconfigure scene compositions** for the HMD and tablet experiences before the start of the live event, and **select, initiate and change scene compositions** for the HMD and tablet interface during the live event. However, the main use of the tool for actions realated to the scene composition is considered before the start of the event. During the event, not much should change to the set-up of the user portal in order to not confuse the end-user and because the director might not have the time for this.

"The scene compositions should be made before the start of the event. (…) I don't think a director has the time to do this during a race."

During the race, the director can decide to push a certain camera source to the user and thus **change the main scene video**. Besides this, the possible actions of the director with the tool are considered limited during the event. One professional user noted that the role of the director when using the tool before and during the race should be more clearly defined.

"If it is offered to me like this and you have work with it during the race, you can't really do that much with it …".

In general, it is **not considered a good idea to push a certain camera source to the end-user** in order to let the end-user keep his/her feeling of control and to not create a feeling of frustration. Instead, it would be better if the director could **highlight a camera source in the portal** in order to notify the end-user if an important action is happening near a certain camera.

"If the user doesn't want to see it, then he or she has to manually change the camera source again. Maybe it would be better to just highlight the source then instead of pushing change. It is not nice to push something to hard."

Missing features

What was not possible to do with the tool was the possibility to get a **live preview** of the interactive HMD and tablet experiences. It was mentioned by all users that **this should be part of the tookit**.

"You don't do the preview part."

"I would expect to be able to watch the view with a shortcut. That I can see my changes. I don't know now what I have done."

Further, it would be nice if the tool would enable the director to show the end-user repetitions of certain actions in the user portal.

"There could be a scroller in al the camerastreams to define time for the replay and an extra button for replay."

"And there should be a special box for it. So that you can then change the order of the replays or decide to not show some of them. If something shocking happens for example that you don't want the public to see again."

Evaluation of the usability of the toolkit

In general, the user interface is **not considered intuitive**. Without explanation, it is considered hard to understand the different features of the tool. A tutorial is necessary to learn how to work with the software. Once the professional user is given an explanation on how to use it, the software is considered fairly easy to work with.

"You don't immediately a 100% understand what has to go where and how to go back".

Especially the placement and order of the different camera sources in the race set-up was considered very confusing.

The placement and order of the camera sources

The user interface of the live director's toolkit shows 3 different 'columns' of the incoming sources and assets, as can be seen in Figure 24. At first glance, this was very confusing for the professional users. What is the difference and relation between the different columns?
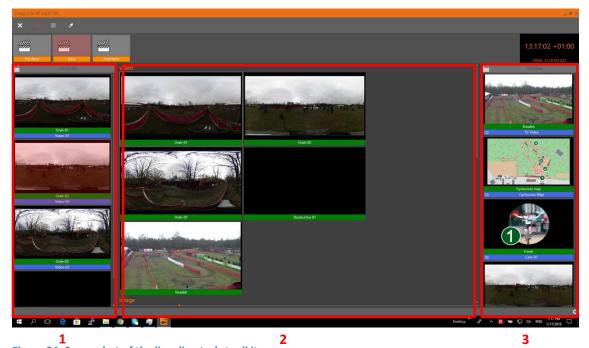

Figure 24: Screenshot of the live director's toolkit

Multiple remarks were made here:

- **The order of the 'colums' is not considered logical**. The ordering is different than in the tools normally used which causes confusion.

    "The way how it is ordered here is different. And you can do that, but I don't see the added value of it. Just order it like what people are used to."

- **Column 2, which shows all the incoming sources, should be shown first** and take the place of column 1.

    (on column 2) "I would put it immediately on the left. Because you always have the sources on the left, in the middle what you do with it and then on the right your output. But like here with the sources in the middle? Then you have to jumpt to that and then to that… I wouldn't do that."

    "I would order the GUI differently. People are used to having the left column at the top".

- It is unclear what the relationship is between the right column and the middle column. **The names of the assets in column 3 do not correspond with the names of the camera sources in column 2** (e.g. Orah-01 in column 2 and CAM-01 in column 3).

    (on column 3 – the assets): "But it is visually very unclear. It says CAM-01, but I don't see a CAM-01 in column 2? It says Orah-01 there. It would be handy if you could see in the right column that Orah-01 is coupeled to it."

- The relation between the right column and the user interface is also considered unclear. It would be nice to have a graphical tool to attach the right sources to the user portal.
- The use of the column 1 is considered unclear.

    "Do you actually need the left column then? (…) Delete it and merge it with the middle column".

- In general, there seems to be **no shared terminology of the naming of the different 'columns'**. This should be defined.

The settings

The settings to preconfigure and change the scene compositions and camera sources are considered very **complex**. Also here, a tutorial is needed to learn how to work with it.

Further, in order to change something, the professional user has to go through **two confirmation steps**, while one should suffice.

> *"Sometimes there are too much confirmation steps necessary. You have to register and then validate. (….) You have to press two differente buttons while you could just press one."*

One user thought it was weird that there was no toolbar with all the settings at the top, as is the case for typical software interfaces.

> *"As a software user I think it's strange that I don't have 20 possibilities with settings, preferences, edit … at the top."*
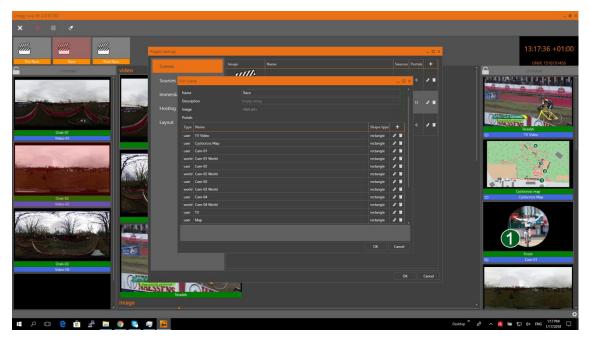
Figure 25: Screenshot of the settingspage of the life director's toolkit

Operating the director's toolkit: on a touchscreen device?

All professional user evaluation tests were done on a touchscreen PC. For a simple set-up, the touch screen is considered very convenient.

One respondents said it would be handy if he wouldn't have to scroll through the right column in order to see alle the thumpnails, e.g. by making the thumpnails smaller.

> *(on the right column). "I would definitely put it in a touch screen device. I'm looking for a way to not scroll through… It would be handier if all the thumpnails would be a bit smaller. And that there then also is a zoom button for if you really like big thumpnails."*

Complementarity of the tool with the traditional workflow

The respondents say the tool doesn't require a very different way of working than tools for traditional live editing, and therefore integrates well within their normal workflow.

However, it must be taken into account that during the race, a director doesn't have a lot of extra time to follow all events happening near the different cameras and push highlights of these to the end-user.

> *"Why should a director push content? That a director should be intervene, yes. (…) But in standard modus you will not have an extra person in the room to just follow every step in the race."*

4.2. Closed pilot test (P2.2)

4.2.1. Planned set-up

The aim of the closed pilot activity was to organize at a cyclo-cross event in Belgium evaluation activities with end-users and professional users, in close cooperation with VRT. The goal of this closed pilot is to explore the following:

- How do end-users experience and evaluate live viewing of a cyclo-cross event in a multi-device immersive setting?
- How does the (technical) director experience the production toolkit in a live scenario? How different is the workflow from a traditional workflow where the user has no immersive viewing experience?

For the end-user tests, a room would be set up in close proximity to the cyclo-cross race, including at least 1 TV-set, 2 HMD devices (Samsung Gear VR) and 2 tablets. End-users would be invited to enter the test room during the cyclocross race and watch the race on the TV, HMD and tablet in the room. They can freely decide which devices they would like to use during viewing. Data would be gathered by means of observation of the test-users and a survey in which the test users are asked to evaluate the viewing experience on the different devices.

For the professional user evaluation, a director would be asked to use the live director's toolkit during the cyclocross race. After the event, an interview was planned with the director to explore his/her experience with the toolkit indepth.

The expected outcome of this closed lab-test was a detailed insight into how sports fans experience the immersive multi-device viewing of a sports event in a live setting, and on how this changes the live production workflow of a professional user.

4.2.2. Execution of the activity

Some changes were made to the set-up of the closed pilot test as described in D4.1. Due to some technical constraints, a fully stable version of the software was only released by January 7, when the actual cyclocross event and closed pilot test took place. Due to organization issues, it was not possible to organize end-user evaluation activities at the cyclocross location and date. However, in order to cope with this, two other closed pilot tests with end-users were organized for pilot 2.

I. A closed lab test at imec (Brussels) in December 2017 with a demonstrator that showed a live simulation of a soccer game and a basic portal for the HMD and tablet.
II. A closed lab test at VRT (Brussels) in January 2017 with a demonstrator that showed an offline simulation of the cyclocross event and a more elaborate portal to interact with the HMD and tablet content.

The inter interview guide for the end-user interviews can be found in Annex X.

The professional user evaluation activity was executed as planned at the cyclocross event. For consistency in the reporting, the results of this are discussed in the previous chapter (see 4.1).

Closed lab test in Brussels (I)

In December 2017, a closed pilot test took place at the imec offices at the campus of Vrije Universiteit Brussel. A room designed for subjective QoE tests and with a living room set-up was used for this purpose. The tests took places from December 14 to December 18, 2017.

First, the participant was invited to watch a developed demonstrator for pilot 2. After viewing the demonstrator, an interview took place with each participant. These user tests and interviews combined two user research activities for the ImmersiaTV project. The interview therefore consisted of two parts:

1. **Part 1: End-user evaluation (WP4)**: here, the participant was asked to evaluated the developed demonstrator and the viewing experience and portal on the different devices. The results of this part of the interview will be discussed in this deliverable.

2. **Part 2: End-user requirements (WP2)**: in this part of the interview, input was gathered for the end-user requirements of the live pilot 3. The results of this first part of the interview will not be discussed in this deliverable, but are discussed D2.1 which reports on the end-user requirements

The demonstrator showed a live simulation of a soccer game. A web-based set-up was applied, that consisted of a web server deployed in Poznan (Poland) with contents for head mounted displays, tablets and television. On the tablet and HMD, there was a basic portal to interact with the content (see Figure 26). Devices used in the test were:

- HMD: 1 Samsung Gear VR + 1 Samsung Galaxy S7

- Tablet: 1 Samsung Galaxy Tab S2

Figure 26: Screenshot portal tablet (left) and screenshot portal HMD (right)

7 respondents were invited to watch a developed demonstrator for pilot 2. Respondents could participate individually or in teams of 2. 3 participants took part in the test individually, and 4 participants took part in the test in teams 2 (2x2 people) and had a duo-interview. These last individuals knew each other already before they participated in the test, as we wanted to observe the social interaction of the participants while viewing the demonstrator. The pilot activity consisted of a viewing of the content in which participants could decide for themselves how they wanted to make use of the different available devices (TV, tablet or Head-Mounted Display). Each session was observed to see 1) how participants made use of the different devices during viewing; 2) how they used the different devices (e.g. sitting, standing, ...) and 3) which social interactions they had during viewing (e.g. talk about the content etc.).

After the viewing, an interview took place to discuss the viewing experience, navigation and portal on the different devices.

Interview	# participants	M/F	Age	VR experience
1	1	F	26	Google cardboard short fragments, has seen one complete documentary in VR on event
2	2	F	23	Demo in electronics store
		M	23	/
3	1	F	24	Demo in electronics store
4	2	M	28	/
		F	32	Demo at event
5	1	M	43	Demo of gaming applications

Table 18: Overview respondents closed lab test I (pilot 2)

Closed lab test in Brussels (II)

In January 17 2018, a second closed pilot test took place at the VRT premises in Brussels. 6 respondents were invited to watch an offline simulation of the cyclocross event that took place on January 7 2018. The set-up consisted of 1 laptops and 1 pc with sufficient CPU and GPU power, a gigabit router and a switch to cover all the incoming and outgoing Ethernet cables. Recorded streams of the men's elite race of the cyclocross on January 7 were shown, with contents for head mounted displays, tablets and television. On the tablet and HMD, there was a portal to interact with the content (see Figure 27). The portal allowed users to switch between 4 different camera sources and showed a map of the cyclocross track (left upper corner) and and the live directive stream (right upper corner). The map and the live directive stream could be switched on and off.

Devices used in the test were:

- HMD: 1 Samsung Gear VR + 1 Samsung Galaxy S7

- Tablet: 1 Samsung Galaxy Tab S2

- Touch screen computer

Some technical issues were encountered during the closed lab test. At the player side, the HMD only delivered one camera source (while all the portals were visible in the HMD portal). As a consequence, it was for the end-users not possible to select another camera source. The tablet gave at the time of the test a black screen with only the interface portal visible. In order to cope with this, the tablet interface was displayed on a laptop with touchscreen which allowed the test users to interact with the content in a very similar way as on the tablet.

Figure 27: Screenshot portal tablet

6 respondents took part in the test, each in teams of 2 (2x3 people). These individuals knew each other already before they participated in the test, as we wanted to observe the social interaction of the participants while viewing the demonstrator. The pilot activity consisted of a viewing of the content in which participants could decide for themselves how they wanted to make use of the different available devices (TV, tablet or Head-Mounted Display). Each session was observed and the participants were encouraged to to continuously 'think out loud' and give their thoughts on the viewing experience. After the viewing, an interview took place to discuss the viewing experience, navigation and portal on the different devices in-depth.

Interview	# participants	M/F	Age	VR experience
1	2	F	23	Yes: playstation VR, shorfilm VR
		F	22	Yes, demo at school
2	2	M	37	Yes (not specified)
		M	40	Yes: playing around, demo's
3	2	M	30	Yes, demo at events
		M	28	/

Table 19: Overview respondents closed lab test II (pilot 2)

4.2.3. Obtained results

In this part we describe the findings of the interviews as part of our qualitative research methodology. The results of the two closed pilot tests will be discussed in different chapters, as a different demonstrator evaluated in the tests. Focus of both user tests was placed on the interaction with the user portal.

4.2.3.1.   Closed lab test I

Below we will discuss the results, structured according to the different topics. Selected interview quotes are used to illustrate the findings.

The topics discussed are:

- The overall viewing experience on the different devices
- Navigating with the tablet and HMD
- Evaluation of the tablet and HMD portals

- The user friendliness of the tablet and HMD interactions
- Future expectations

Overall viewing experience

Similar to the user tests in pilot 1 and for similar reasons, part of the respondents preferred the tablet viewing experience, while others prefer the HMD experience. Some people prefer the tablet because they're used to it and it keeps them closer to reality. However, the HMD is much more succesfull in creating a feeling of immersion.

> *"I thought the tablet was easier to use than VR glasses. (...) But maybe I also just have more experience with using a tablet."*

> *"You really feel like you're on the field. That's nice."*

In general, the multi-device set-up with three screens (the TV, the HMD and the tablet) felt quite overwhelming for some respondents, as they needed to focus too many things at the same time.

> *"It's a lot of information to follow."*

One common remarked that was raised by all respondents on both the tablet and the HMD experience was that **the cameras were too far from the action**. VR offers the possibility to let the viewer see things from a closer and better angle than broadcasted on TV. However, in the demonstrator, the cameras were placed on the sideline. Some respondents even said that the TV gave a better overview on what was happening than the tablet and HMD.

> *"It would be interesting to be closer to the players. Now I don't have a nice angle."*

> *"Now you could see the players from very far away, because of which you didn't see a lot of action. It would be cooler if you could stand more in the field."*

> *"The camera should be more on the field, not off the field."*

> *"I think that it's a big mistake in VR in your POV is that of the spectator in the game. ThIs is not a benefit. If a camera can be put at any point, you don't want the spectator experience."*

Navigating with the tablet and HMD

The navigation on the tablet was considered a bit easier then with the HMD, because people are used to work with a tablet and the tablet gives the viewer a quicker overview of the field and the action.

> *"The tablet gives you a clear view of the field. You quickly know where you can go. In the HMD you really have to start searching."*

However, some respondents said that the zooming in and out on the tablet wasn't very easy though. One respondent didn't even know that you could zoom in and out. It would be good to indicate this somehow, for example with a zoom icon on the screen.

> *"You had to put a lot of effort in it. It was tiring."*

> *"Aaah I didn't know you could zoom (…) Maybe you should indicate this with an icon."*

> *"Maybe an onboarding thing should be good. Give people a hint that you can zoom in."*

Contrary to the tablet, a HMD is something rather new for the respondents, and this takes some time to get used to. **Navigating with the HMD is not considered intuitive enough yet**.

> *"I wasn't really sure how the HMD worked. The image kept moving without me wanting it to move around."*

"When I got it it was kind of diagonal. I also didn't know how to use the device. I felt like it kept moving without me moving it."

"From the moment I put it on, it should probably start at the field. Now I need to do a 180 to find the centre of the field."

Evaluation of the tablet and HMD portals

The tablet portal:

In general, the portal on the tablet was considered **self-explanatory**. It was considered **an added value that there was a football field plan** in the portal that indicated where all the cameras are placed on the field.

However, multiple respondents made the remark that it was **not clearly indicated which dot on the football field plan corresponded with which camera source**. One respondent didn't even realise at first that there was a link between the dots on the field drawing and the camera sources. Instead of a dot, a number could for example link the camera sources with the positions on the field.

"It would be great if you could see on the field which dot represents which camera."

"If there would be more cameras, it would be confusing. Instead of a dot on the field, it could just show a number. Now the dots didn't show which camera was where."

"I was first pressing the dots on the map. And only after that I realized that I should press the 'pies'. And only after that I realized that the pies represented the dots. That's logical, but I didn't realize it."

Futher there was **no indication of what camera source is at a certain moment the main scene video**. The end-user should be informed from what POV he or she is currently watching, e.g. by highlighting a certain camera source.

It was mentioned multiple times that it would be helpful if the field drawing was more interactive, and could for example show where in the field the ball is. This would make it easier for the viewer to choose the most interesting camera source.

"It would be interesting if the portal would indicate if something was happening on this side of the field. Or that the map would indicate in which area the bal isl. Now you were just clicking around."

Some respondents considered it **annoying that the portal on the tablet was always there**, as the football field and camera sources were considered quite big. **It should be possible to let the portal appear and disappear,** e.g. by pushing a button on the HMD or touching the tablet screen.

"The 'pies' on the tablet are too big. They were really blocking my view. They should disappear after a couple of seconds."

"It should disappear like when your computer mouse disappears when you watch a movie".

The HMD portal:

It was considered very hard to select a certain camera source with the HMD. This didn't go as smoothly as with the tablet.

Because of this, most respondents said they would still prefer **to just use buttons on the HMD to switch between camera sources** without having focus with their eyes on a certain camera source in the portal as well.

"I would rather have a button on the side of the HMD to change camera viewpoints. Maybe we're just not used yet to select things with are eyes."

"If I touch the button on the side, it should bring up the portal. Then choose something and it switches. This makes more sense then the floating balls."

Similar to the portal on the tablet, **the end-user should be informed from what POV he or she is currently watching.** One respondent said that also on the HMD **it should be possible to let the portal appear and disappear** so it isn't always in sight.

"Or just that the three balls appear and disappear again after 5 seconds if you don't look at them. (…) It can be frustrating if they're there all the time."

In the tablet portal, there was a football field drawing that indicated where on the field the cameras were place. However, in the HMD portal, it was not clear which camera source corresponded to the different cameras on the field. This should be somehow indicated.

"Also, I can't remember which view is which. There should be some tag that indicates that this is the corner view."

Usability of the tablet and HMD portal

The respondents were asked if there was anything related to the user friendliness of the tablet and Hmd that they would like to see improved. Multiple remarks were made:

- The comment most often made was that the **image quality was too low**, especially on the tablet. This really interfered with the viewing experience.

"But the resolution makes it frustrating. The purpose of the exercise is to watch the game, but I cannot see the ball."

"The quality on the tablet is worse. I wouldn't want to watch a soccer game if the quality is so low."

- Both on the tablet and on the HMD, **the moment between clicking on the camera source and the changing of the source takes too long.**

"There is too much time between selecting and the changing of the source. You could miss a goal."

- **Zooming in and out on the tablet wasn't very user friendly**. The zooming in and out goes too fast.

"I don't like the zoom on the tablet. You immediately zoom in too much."

"Suddenly I was superclose."

- **The names of the camera sources on the tablet** (in the demonstrator: cam 01, cam 02, Base camp) **should** be better and **indicate where they are placed on the field**.
- One respondent made the remark that the light and colour spectrum from the different camera sources was different, which was a bit weird when switching cameras.

"It's weird that the light from the different angles is different. The colours are not consistent between the different cameras. This makes the experience strange. It looks like you switch to a completely different game."

Future expectations

The respondents were asked if they would watch live TV broadcasts at home in a multi-device set-up similar to the one in the user test.

Similar to the findings in pilot 1, people are would only do this in certain usage situations.

Multiple 'screens' with video can quickly become hard to follow. Having extra video content, extra camera streams, extra info… is tiring as well, and for some types of TV broadcasts or on certain moments people just want to relax and just watch a normal TV broadcast.

Similar to the findings in pilot 1, if there are other people in the room, people are not keen on using an HMD.

> *"if you have friends, family around you, I would not use the vr headset. Seems a bit rude."*

However, also similar to the pilot 1 findings, one respondents said it would be nice to use a HMD with someone else, but only if the other person is also wearing an HMD because then you can tell each other where to look.

> *"Then you can say 'go to that room' or 'zoom in on that'."*

Sports broadcasts are considered an interesting use case. However, this set-up is more interesting for certain types of sports than others. Generally, if you have a good overview of the field of action (e.g. soccer), then TV is considered the best option. For for types of sport where this isn't the case (e.g. Cycling, Formula 1), VR can offer an added value.

4.2.3.2. Closed lab test II

Below we will discuss the results, structured according to the different topics. Selected interview quotes are used to illustrate the findings.

The topics discussed are:

- The overall viewing experience on the different devices
- Evaluation of the tablet and HMD portals
- Interaction between the live directive stream and the VR experience
- The user friendliness of the tablet and HMD interactions

Overall viewing experience

In general, **the cyclocross race is considered as a very cool use case** for the immersive multi-device set-up. Instead of running towards the action on a cyclocross track, you can now just 'jump' to it by changing the camera source.

> *"A real cyclocross fan runs to the places where something is happening. With VR you can do that from your couch. (…) My grandfather is a cyclocross fan for example, but he cannot walk very well anymore. Then he could still have the feeling of being there. That's a highlight."*

In a cyclocross race many quick actions can happen on a short time period. Compared to the tablet, the glasses enable the viewer to quicker and more naturally look around.

> *"I think it's a hassle to move with the tablet. (…) But with the glasses it goes faster. Then I can just look around."*

One respondent said that he missed immersive sound.

Evaluation of the tablet and HMD portals

In general, the **portal on the tablet was considered self-explanatory**. Most respondents however still needed an explanation on how they could select a different camera source with the HMD. Some respondents also didn't immediately find the HMD portal while wearing the glasses.

> *"Aaah I found it! Djeezus."*
> *"I didn't immediately found the balls. So I would need like an arrow or something that shows me where to look for the balls. After a while you won't remember where the menu is."*

What is missing on both the tablet and HMD portal, is a clear indication of what camera source is on a certain moment the main scene video. The respondents didn't know from what camera sources they were currently watching. This should be indicated, for example by highlighting a certain camera source.

> *"On which camera am I now? I think it's 2."*

Both the display of the live directive stream and the map of the cyclocross track are considered big added value of the tablet portal. However, what if people only use the HMD in combination with TV and not the tablet? How will they know where all the cameras are placed on the field? It should be taken into account that not every viewer will use 3 devices to watch a broadcast.

> *"There will be people who will only use the HMD and not the tablet. 3 devices, who is going to do that."*

Multiple respondents said it would be nice if the map of the cyclocross track could become interactive and **show where the cyclists currently are on the map**. It's hard to find the cyclist you want to see in the different camera sources, and an interactive map could make this much easier.

> *"I want to see on the map where the cyclists are." "Yes, then you know which camera to select." "Actually I would want to follow all the cyclists and see them in close-up. But then you have to know when they are appearing in which camera source."*

Interaction between the live directive stream and the VR experience

Some respondents say it would be nice to receive some kind of **notification if something is happening or has happened (for replays) near a certain camera source**, so they can choose to go there.

> *"How do I know it's useful to use the HMD?"*

> *"There could appear an exclamation mark near one of the camera sources."*

One respondent expressed **some frustration with regards to the interaction of the live directive stream on TV and the different camera sources on the tablet and HMD**. When seeing something important on TV (e.g. a fall, an interview …), you immediately would want to 'jump' to for example the tablet to have a closer look via the best camera source. However, as there is currently **no indication of where the cyclists are on the graph with the cyclocross track** and **camera sources are not highlighted to indicate important events**, it becomes quite challenging to find the right camera source and viewing angle in time.

"With this interface, you can't follow the cyclists fast enough. But what is the reason you watch the race? To see the cyclists! (…) I don't know what to click on. (…) I can't follow and this frustrates me."

Usability of the tablet and HMD portal

Some things related to the user friendliness of the tablet and HMD interactions could be improved.

- The **image quality** on the tablet and HMD could be better. After watching the content, the respondents were asked to rate the visual quality of the video on the HMD on a scale from 1 to 5 (1=Dislike a great deal, 5=Like a great deal). The average score for the HMD was 2,75.
- **Not every respondent realized the map of the cyclocross track** (in the upper left corner) **and the live directive stream** (in the upper right corner) **could be 'switched off'**. In order to do this, the buttons in the lower right corner should be pressed (see Figure 28). Because these buttons are place so far from the assets to which they belong, it is hard for the end-user to notice the related between the buttons in the assets. **The buttons should be placed closer to the assets.**
- One respondent remarked that the **map of the cyclocross track and the live directive stream should be placed more in the corner.** The same thing goes for the 4 camera sources. Another respondent said it would be nice if the end-user could **drag these to a place of choice.**

"I would put the map completely in the corner. Now it seems like it's floating." "Or that you as a user can drag it somewhere else yourself." "Yes, that would be ideal."
"Move the balls more to the side. They're standing in the way now."

Figure 28: Screenshot portal tablet (II)

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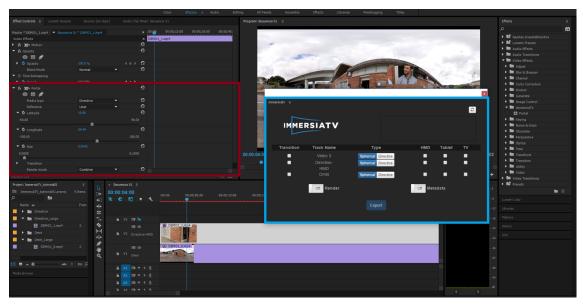
6. ANNEXES
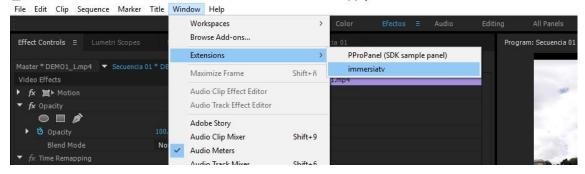
6.1. Annex I: Screenshots software evaluation (pilot 1)

Screenshot of the general interface

Screenshot of the open export panel
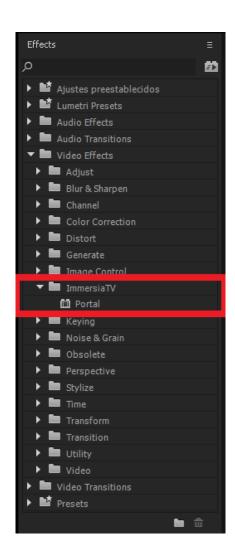
Screenshot of the export panel
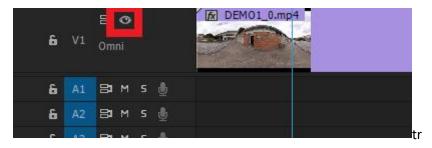
Screenshot of the portal effect

Screenshot of the detailed toggle track output

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6.2. Annex II: Tutorial Premiere Pro Plugin

IMMERSIATV

TUTORIAL

The ImmersiaTV Premiere Pro plugin

Outline: This tutorial teaches in approximatively two hours how to use the ImmersiaTV Premiere Pro plugin to edit video-based content for multi-device consumption. At the end of the tutorial the editor will know how to create video content that can be consumed synchronously across head mounted displays, tablets and the traditional TV

CONTENTS

TABLE OF FIGURES

1. INTRODUCTION

Welcome to the tutorial of the ImmersiaTV Premiere Pro extension. In this tutorial you will learn to use this tool.

In this tutorial we will:

A. Go through an overview of the main components of the plugin and the basic actions involved in using it (Section 2).
B. Do some exercises to discover its main functionality (Section 3).

Remember, if you get lost, that Section 4 contains a list of all the functionality available in the user interface.

2. OVERVIEW AND BASIC ACTIONS

2.1.   Overview

The ImmersiaTV Premiere Pro Extension contains 3 parts:

1. **The ImmersiaTV Video Effects** There are two video effects, both controlled through the Effects control (see figure 1). The Portal effect allows defining the position and the interactive behavior of traditional videos composing your scene. The 360 Projection Mapping effect allows defining the behavior of omnidirectional videos

2. **The ImmersiaTV transitions** The ImmersiaTV transitions are like any regular video transition, to the exception that they will blend appropriately with the ImmersiaTV video effects. This means that the transition will be part of the interactive behavior defined by the video effects. There are different transitions, such as Dissolve, FadeIn/FadeOut, IrisClose, IrisOpen, SlideLeft, SlideRight, WipeClose, WipeLeft, WipeOpen, WipeRight

3. **the ImmersiaTV Export Panel** The ImmersiaTV Export Panel allows defining which tracks go to which devices[1]

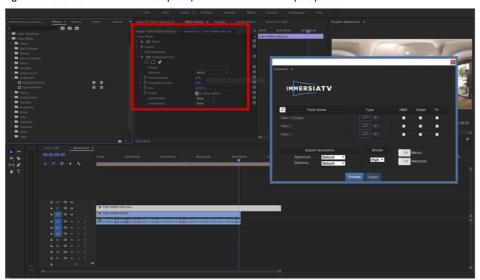Figure 1 shows the ImmersiaTV Effect panel, and the ImmersiaTV export panel

Figure 1. The ImmersiaTV Premiere Pro Extension contains an Effect Controls (highlighted in red), and the ImmersiaTV Export Panel (highlighted in blue)

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[1] This tutorial was implemented with release 0.20 of the ImmersiaTV software suite. The user may find minor changes in appearance when using later versions.

2.2. Basic functionality in Adobe Premiere Pro

You should also keep in mind some icons that will help you be functional in Premiere Pro. Concretely:

This icon, just next to every track, is used to toggle the visibility on a given track

This icon is used to toggle on and of the keyframes, for example, in the effects panel

This icon can be found in the tools, to cut a video sequence

This icon can be found in the export panel, use it to refresh the elements shown in the panel

2.3. Basic actions when using the ImmersiaTV plugin

To apply an ImmersiaTV transition to a video clip, simply drag and drop it on the targeted video (see figure 2).
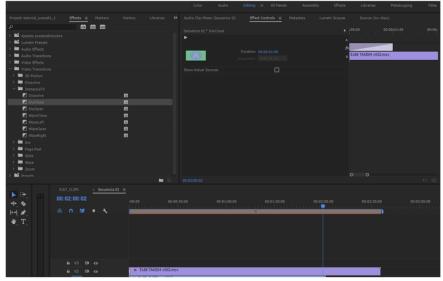
Figure 2 The ImmersiaTV transitions. At the left of the image, the list of transitions. At the right, a transition applied to a video clip, as viewed in the Effect Controls panel

To apply the Portal effect, you must add the Portal effect to your clips. The effect can be opened from the Effects snipet, under Video Effects, under the folder ImmersiaTV. The effect is called Portal. It is enough to drag and drop it over the clip that you want to apply the filter. The 360 Projection Mapping works in the same way (see figures 3A and 3B).
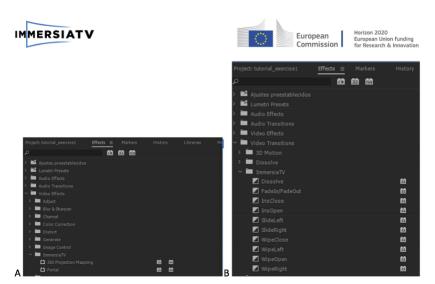
Figure 3 A. The Portal Effect can be selected inside the folder ImmersiaTV, within the Video Effects available. B. Detail of the list of ImmersiaTV Transitions, which allows for a wide range of options in transitions.

To open the ImmersiaTV Export Panel, go to Window > Extensions > immersiatv (see figure 4)

Figure 4 How to open the ImmersiaTV export panel

3. HOW TO USE IT

3.1. Introduction

To show the functionality of the ITV premiere pro extension, we have designed a series of exercises.

3.2. Exercise 1. Effects, Inserts, Preview, Keyframe insertion and content exportation

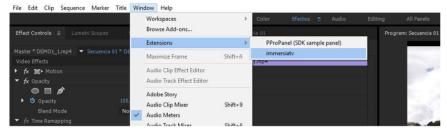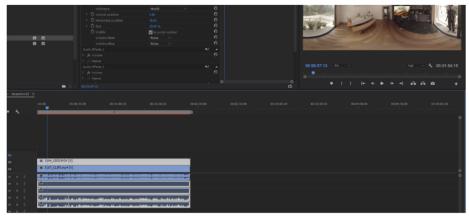In this exercise you will create one omnidirectional scene with 2 directive inserts and learn how to introduce video inserts with the Portal Effect. More specifically, you will:

a. Learn how to use the Portal effect panel.
b. Insert 2 inserts in an omnidirectional scene (one user referenced, one world referenced).
c. Learn how to use the preview. Try both tablet and HMD.
d. Learn how to export content using the ImmersiaTV export panel, and include differences in export for tablet, HMD and TV

Steps:

1. Create new project and a new sequence, call the sequence exercise 1.
2. Import the assets in the folder "breakfast" in the project
3. Drag and drop the omnidirectional clip (5167_CLIP5.mp4) in the sequence. Check the resolution is fit for equirectangular format (aspect ratio 4096x2048)
4. Explore the timeline and find the clapperboard in the video. Use the zoom if necessary.
5. Cut the omnidirectional video to start at the clapperboard
6. Introduce a directional video (5164_C005.MOV) on a higher video track (V2), find the clapperboard, cut at the clapperboard and align the timecodes of the two tracks.
7. Pick the immersiaTV effect called Portal (find it in the Effects pane) and it to V2. In Effects control, adjust the horizontal position to 45 (the value is in degrees)

At this stage, you should have something similar to Figure 5.

Figure 5 A simple scene with one world-reference Portal inserted, magnified to facilitate reading the details

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To continue, we will now:

8. Add in V3 the clip 5163_C005.mov, find the clapperboard, cut the video to start at the clapperboard and align them with tracks V2 and V1. Introduce the Portal effect on the clip in V3 (find it in the Effects pane. In the Effects control panel, find the Reference field, and set it to *user*, X position to 0% and Y position at 50%. In the Premiere preview, you should be able to see an omnidirectional lvideo and have two video inserts. Overall, The result should be similar to Figure 6
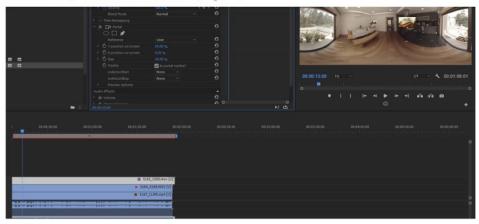
Figure 6 The same scene with a user-referenced portal added

9. To preview the result in an external device, open the ImmersiaTV export panel (in Window > Extensions > immersiaTV, as shown in figure 4), select video1 to be omnidirectional, and videos 2 and 3 to be directive. Select Video 1 and Video 3 for the HMD device, and all 3 tracks for the tablet device (see Figure 7).

Figure 7 The export panel after having selected the preview options

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10. It is also important to select the right kind of content format. In the present case, the track Video 1 is omnidirectional, and it should be selected as such in the column *Type* of the export panel.
11. Pressing the button *Preview* should show a QR code. Use a mobile device and a QR scanning app to open the browser and show a preview of the scene composition corresponding to the visual layout at the place where the Premiere Pro timeline cursor is set (see Figure 8). It is important that preview is done with the device on <u>horizontal</u> layout.

Known Issue: If the timeline bar is at 0, the preview may not work well. In this case, just move the timeline bar some frames forward.
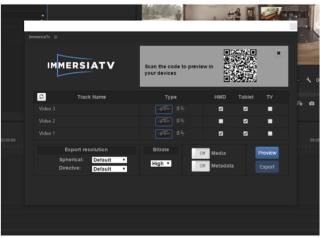
Figure 8 The export panel after having generated the preview for the QR code

Once the preview is loaded, you should verify that:

- The previewed images correspond to the content corresponding to where the timeline bar is placed
- When you move the mobile device, the video insert with the Portal effect where the *Reference* field is set to *user* (in this case, V3) should appear in a fixed position <u>on the screen.</u> Opposite to this, the video insert where the *Reference* field is set to *world* (in this case, V2) should appear in a fixed position <u>on the omnidirectional scene</u>, and only be visible when the mobile device faces in the appropriate direction.

Verify that you understand the connection between what you adjusted in the settings of the Portal effect, and the behavior in the preview.

12. To export the resulting project, open again the ImmersiaTV export panel (in case you closed it), and select: V1 is an omnidirectional video, V2 and V3 are traditional. For HMD, we only want Video 1. For Tablet we want all of them, and for TV we only want Video 2.
Make sure Media and Metadata are both toggled on. At this stage, it should look quite similar to Figure 9.

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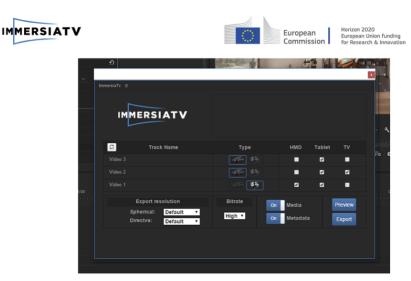
Figure 9 Export settings to complete exercise 1

The only thing left to do is press the export button and select a destination folder. When you do this, an XML file is generated immediately, and the Adobe Media Encoder is launched to generate all the necessary videos for later playout. Once the encoder has finished his job, the outcome of this exercise should look like the folder shown in Figure 10. Notice how each track corresponds to a different exported video. The xml file corresponds to metadata that tells the end-user player how to combine the videos to compose a scene that is equivalent to what you saw at the preview stage.

Figure 10 The outcome of exercise 1 once export is completed.

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3.3. Exercise 2: transitions between omnidirectional videos

The goal of this exercise is to get the end-user to trigger a transition between two omnidirectional videos by pressing a (user-referenced) directive video insert. Then, once it is working with one transition, we will introduce a second insert to be able to go back and forth between the 2 omnidirectional videos. For this:

1. Create a new sequence and call it exercise2. In addition to the assets from the breakfast scene, import the materials from the car scene.
2. Add the omnidirectional video corresponding to the breakfast scene (called 5167_CLIP5) in track Video 2. Remove the fragment that have code bars, and use only the part of the clip showing content.
3. Add the omnidirectional video corresponding to the car scene (called 5188 TAKE04 v002) and add it to the track Video 1 Place it in a track that is below because, at the beginning of the scene, we do not want it to be visible. We will want it to become visible only when another video insert is pressed.
4. In track Video 3, add a directive video that appropriately shows the car_trip scene content (for example, 5190_A0005). Add to it the Portal video effect, and in the effect controls select the field *Reference* to be *user*. This will make the video insert to be user referenced. To place it, select simply that the X and Y positions are 0%. This will place it in the upper left corner of the screen. Adjust the size to be 30%.
5. In the pane to adjust the different fields in the Portal effect, click on the field *Portal* (the field on top, which gives name to the effect). This will show a grid that can be used to adjust the position of the video inserts. Notice how changing the *Reference* to *user* or *world* changes the way the grid appears. To better preview how it will look, on the preview pane you can adjust the size to 100% and it will show an image corresponding only to the size of the end-user device. If you want to go back to the whole scene, you can select Fit (see Figure 11). Play around with the *position* and *reference* fields, and make sure you understand well what the grid shows. Then leave the adjustment back to step 4.
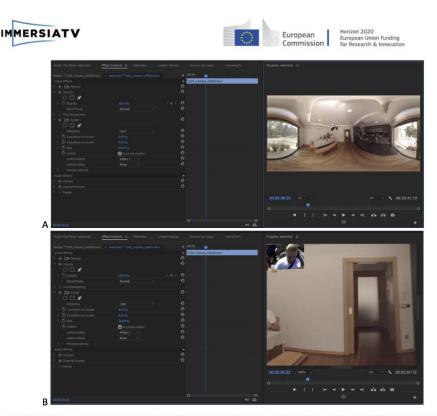
Figure 11: an insert ready to trigger a transition between 2 omnidirectional videos. The visual layout of the scene composed can better be seen playing with the Zoom Level, between 100% (top) and fit (bottom).

6. In the pane to adjust the fields of the Portal effect, in the field *OnActionStart*, select Video 1. This means that when the video insert of Track 3 is pressed (or looked at it when using an HMD) it will trigger a transition to the track "Video 1". In other terms: clicking on the the track on which you have applied the effect will trigger a transition to the track that is selected in the field *OnActionStart*.

7. To prevent the appearance of the track "Video 1" from being instantaneous, we want to add an ImmersiaTV transition in the track Video 1. This will make the transition between omnidirectional videos smoother. For this, select the ImmersiaTV IrisOpen transition, and add it to the beginning of the video track Video 1. Select the transition, and in effect controls, you should see the field Duration appear. Make it last 3 seconds.

8. It is important to understand that the transition will only be triggered through the user input. This is what makes an ImmersiaTV transition different from a traditional one. To visualize the dynamics of the transition, it can be done directly in Premiere by hiding track 2 (press on the eye-like icon) and playing with the timeline bar. It is important to keep in mind, though, that the transition will only be triggered by the event. However, the targeted video will start from the current playout time, and not from the beginning of the targeted video. In other words:

> The timing of the transition may be triggered by the user input, but the playout time of the videos will be determined at the editing stage.

---

9. To visualize the transition as triggered in the end-user device that you are targeting, you can use the preview. For this, go to the immersiaTV export panel, select tracks 1,2 and 3 for the target device *tablet*, choose tracks 1 and 2 to be omnidirectional, track 3 to be directive, and click on preview. Check with the device how it looks like.

An important feature of the preview is that its behavior changes with the position of the time bar inside the editing track:

- If you put the time bar at 1 second, i.e., within the 3 seconds of the transition duration, the preview will show a screenshot of the exact stage at which the transition is, if triggered at the same moment it is placed in the Premiere Pro timeline.
- If you put the time bar *after* the transitions, the preview will show a screenshot of the different tracks, but the transition between tracks will be triggered *dynamically* depending on your input. This allows you checking if the timing of the transition feels appropriate.

Check with the mobile device these different options.

Once it is working with one transition, we want to introduce a second video insert to be able to go back to the first video. For this purpose, we will

10. From the assets in the Breakfast scene, add 5164_C005 to video track 4, add to it the Portal effect, and in the Effect controls set to User reference, X position to 100% and Y position to 0% Size at 30%.
11. Make sure track 4 is selected. In the effect controls, in the onActionStart field, select Video 2. This means that pressing the video insert corresponding to Video 4 it will trigger a transition to track 2.
12. We also want to have this transition to occur softly. Therefore, we want to add an ImmersiaTV transition to track video 2. To do this, simply add the WipeLeft transition, set its duration to 3 seconds. This should give a result similar to Figure 12.
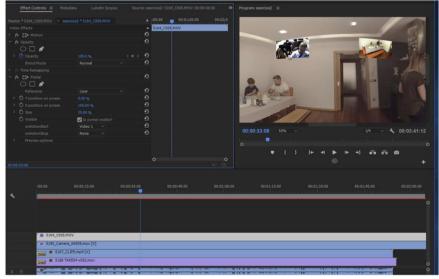
Figure 12: transitions between 2 omnidirectional videos triggered by inserts of traditional videos

13. At this point, exporting all the tracks for tablet, and for HMD, should give a scene that allows the end-user to transition between 2 omnidirectional videos. Check with the preview that this is the case. You shall notice that we have assumed that we are OK with seeing the transition in video 2 being played at the beginning of the video playout.

Overall, it is important to keep in mind that:

> **In the ImmersiaTV player, for performance reasons only one omnidirectional video will be played at any time, except when the end-user triggers a transitions through a button press, when two omnidirectional videos are rendered, the time of the transition.**

If the content editor wants to combine two omnidirectional videos and have them exported as a single video track, the simplest is to use nested sequences: use one sequence to combine the different videos with traditional transitions, and then embed the resulting sequence in a super-sequence where we introduce the ImmersiaTV effects and transitions. In the third exercise we will see an example using nested sequences.

Finally, we point to the fact that if in the previous scene we want to be able to switch smoothly between omnidirectional videos. To understand this means to understand that:

> **An ImmersiaTV transition is very different from a normal video transition: it will only be triggered when the end-user triggers a transitions through a button press.**

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3.4. Exercise 3: traditional TV content and omnidirectional combined on a tablet

In this third exercise, we will further explore the idea of nested sequence. In particular, we will study how it can be put to benefit to combine a multi-camera setup for a tablet with an omnidirectional video display. For this purpose:

1. Open the project tutorial_exercise3, and notice it contains a sequence called exercise3_edited_sequence4tv. This sequence is a professional edit for traditional TV.
2. Create the sequence exercise3, and drag into the track video1 the sequence exercise3_edited_sequence4tv. This is already sufficient for the TV content.
3. Import the assets from the folder Conversation and put some omnidirectional content on track Video 2 (for example, SCENE 02 360.mp4).
4. Now assume that for the tablet we want to add an omnidirectional video, in addition to 2 .png images that allow selecting the TV content or the omnidirectional track. You therefore need to add 2 more tracks, with a total of 4.
5. If you haven't done it already, import the assets in the folder conversation > icons. Put the icon *televisions.png* on track 3. Add the the Portal effect, and configure it as User reference, at position X=0% and Y=0%. Set the Portal at visible and the onActionStart snippet targeting at the track Video 1.
6. Put the icon *360-degrees.png* on track 4. Add the Portal effect, and configure it as User reference, at position X=0% and Y=100%. In the Effects configuration pane, set the Portal at visible and the onActionStart field targeting the track Video 2. The result should look similar to Figure 13.
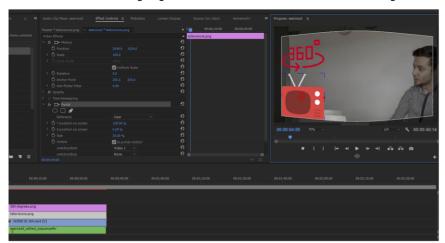
Figure 13: an edition to combine a multi-camera editing and an omnidirectional video on a tablet

Finally, you can now:

7. Use the Preview on tablet to verify that the interaction works as desired. For this, generate a new QR code.
8. To export it, simply select tracks 1 to 4 for tablet, and track 1 for TV. Make sure Render and Metadata are selected

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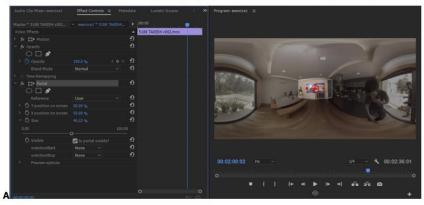
This completes the tutorial going main functionality of the ImmersiaTV Adobe Premiere Pro plugin. Next section contains a more exhaustive list of functionality for each of the panels used throughout the tutorial. For further technical doubts and questions you can contact mia.support@i2cat.net

4. A CLOSER LOOK

4.1. The Effect controls

This section details exhaustively all the commands in the ImmersiaTV Premiere Pro plugin components.

The first component are the effects. The behavior of the Portal effect and the 360 Projection Mapping work in a similar way. We now detail exhaustively the functionality available for the user in the Portal effect.
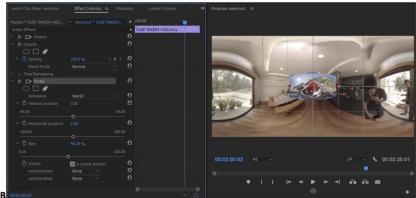
Figure 14. The controls of the Portal effect. The preview is designed for sequences with an aspect ratio corresponding to omnidirectional videos.

These are the different fields of the Effect controls:

Portal:

> Clicking on the title of the name of the effect (Portal) will reveal a reference frame to place the portal relative to the entire frame (assuming it is an omnidirectional video), as shown in Figure 14 A, or to the window frame (as shown in Figure 14 B).

Reference:

> World: if you want the insert to be fixed with the reference frame of the world

> User: if you want the insert to be xifed with the reference frame of the user screen

Vertical Degrees:

> If World reference, select a value between -90 and +90 the vertical shift (+90 corresponds to top, -90 to bottom)

> If User reference, select a value between 0% and 100%, corresponding from the left extreme to the right extreme on the user screen.

Horizontal Degrees:

> If World reference, select a value between -180 (towards left) and +180 (towards right)

> If User reference, select a value between 0% and 100%, corresponding from the top to the bottom of the screen.

Size:

> It defines the visual size of the insert.

> If the insert is defined as World reference, it is defined as relative to the overall omnidirectional. In practical terms, values over 40% will distort too much the video in the insert.

> If the insert is defined as User reference, it is defined as relative to the overall user screen.

Visible:

> Should the video be visible? It can later be changed through interaction. This is the reason we might want to have an insert that is initially not rendered.

OnAction Start:

> What happens when the end-user activates that portal (either by looking at it in an HMD, or by touching it on a tablet)

Preview options:

> It gives different options for the user to adjust the size of the preview screen.

4.2.   ImmersiaTV Export Panel
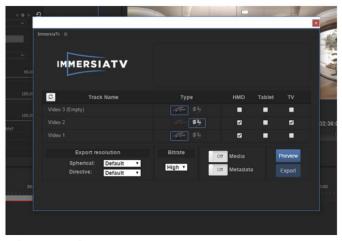
Figure 15. The ImmersiaTV export panel

In the ImmersiaTV Export panel, you can find the following fields, for each track:

- The *Track Name* column lists the tracks in the edit
- The *Type* column allows selecting the kind of video format. On the left, the camera shown refers to a traditional video in 16:9 format. To the right, an omnidirectional camera rig, meaning that an omnidirectional video (in an equirectangular projection) is expected
- The list of devices the content applies (*HMD, Tablet* or *TV*).

In addition, below you can find the following options:

- The Export resolution allows defining explicitly the export resolutions. By default, should be to *Default*.
- The Bitrate, by default, should be *High*
- The Media and Metadata buttons should be marked as "on". Metadata contains the specification of the transitions, interactions and information for synchronized playout. The Media refers to the videos and audios to be generated for the different devices.
- The Preview button, when pressed, shows a QR code that can be used to visualize the output with different devices.
- The Export button asks a path to be selected, where the files generated will be stored
- On top left, there is a refresh button. This should be used when the number or the name of the tracks in the export panel does not match the number of tracks in the Premiere timeline.

6.3.   Annex III: Drop-off questionnaire labtests

Profile information

Name:

Gender:

Year of Birth:

Education:

Profession:

1. **How many hours of video content (online + on TV) do you watch on an average on a day <u>in the week</u>?**

     …hour … minutes

   How many hours of video content (online + on TV) do you watch on an average on a day <u>in the weekend</u>?

     …hour … minutes

2. **How do you watch TV most often?**
   - ☐ Alone
   - ☐ Together with family
   - ☐ Together with others (friends,…)

3. **Which of the following devices do you own?**
   - ☐ Smartphone
   - ☐ Tablet PC (vb. iPad,…)
   - ☐ Laptop
   - ☐ Desktop computer
   - ☐ TV-set
   - ☐ Digital television
   - ☐ Game console

☐ Mediacenter

4. Do you already have experience with VR?

☐ Yes

☐ no

If yes, which experience?

(→ TO BE FILLED IN AFTER WATCHING THE DOCUMENTARY)

5. Could you indicate to which degree you liked the content of this specific video?

Dislike a great deal	Dislike somewhat	Neither like nor dislike	Like somewhat	Like a great deal

6. How would you rate the <u>visual quality</u> of the documentary?

	Extremely bad	Somewhat bad	Neither good nor bad	Somewhat good	Extremely good
On the TV					
On the tablet					
On the VR glasses					

6.4. Annex IV: Topic list indepth interviews

Topic 1. Overall user experience

(open question, aim is to see whether people refer to the experience in general, the multi-device aspect, the 360°, the content and whether they felt like they were more engaged with the content...).

How do you evaluate the overall viewing experience of the documentary?

What was the main difference with watching a regular documentary on television?

How do you evaluate the image quality of the documentary? (R1.3) (on tv – on tablet – on hmd)

Did you experience any physical discomfort while watching the documentary? (R1.1)

Topic 2. Multi-device usage

(*aim is to see how they experienced the use of different devices to watch the documentary*)

How did you experience the use of different devices to watch the documentary?

How do you feel about switching between the different devices? Was there a difference in your experience when switching from one type of device to another? (R1.6)

What do you think about the content that was displayed on each device? Was this in line with what you expected? (R1.7)

How would you describe your feelings while watching the documentary? (aim is to find out whether they feel they were fully into the story, did they feel more involved, or maybe they felt interrupted by the different scenes, fear of missing out,..)

Topic 3. Usability

(*aim is to focus on usability of the multi-device documentary*)

How do you evaluate the user friendliness of the interaction with the content?

Was it clear how you could switch between devices?

What kind of cues did you notice that made you switch from one device to another? What did you think about these cues?

How do you evaluate the use of the Head-Mounted Display?

How do you evaluate the use of the tablet?

How did you experience the 360° viewing/ the navigation on the HMD and tablet? (*this can also be linked to the observation, whether people turned their head or not*)

You've watched the documentary standing/seated, why? How do you evaluate the viewpoint in that position? (R1.10)

Is there anything related to the user friendliness of the experience that you would like to see improved?

Topic 4. Interaction + level of control
How would you evaluate the level of control you had over the content while watching the documentary? Is there anything you would like to see different about this? (R1.13)

Topic 5. Content
(*aim is to see whether they enjoyed the content and thought the scenario was interesting*)

What did you think about the content of the documentary? (R1.17)

The content was in originally in Portuguese and dubbed in English, how did you feel about that?

Topic 6. Social viewing

(*aim is to focus on the social aspects of the multi-device viewing experience*)

(Only for respondents who watched together with another person) **You've watched the documentary with your friend/family member/… How did you experience this?**

(Only for respondents who watched together with another person) **Do you consider this a social viewing experience? Why/why not?**

(Only for respondents who watched together with another person) **(based on observation) You've talked a lot/not that much while viewing. Why? Is there a difference with how you regularly watch television?**

If you would watch this kind of multi-device content at home, would you watch it alone or with others? Why?

Topic 7. Future expectations

Could you imagine yourself watching a documentary like this in your own home setting? Why/why not?

Would you consider buying a head-mounted display? Why/why not?

For what other types of content do you think this multi-device set-up is useful?

6.5.   Annex V: Registration form semi-open pilot

ImmersiaTV Pilot 1 registration form

Welcome to ImmersiaTV demo space.

Before we can give you access to the demo of our first pilot, we need you to fill in this registration form.

At the end of this registration form, we will give you a code you need to start the demo.

If you don't fill all the required fields, you won't get the code… so please, it will take only 1 minute, and we promise we will not spam you. Are you ready?

What's your name?

_____

What's your contact e-mail?

_____

- - - - - - - - - - - - - - - - - - - Page Break - - - - - - - - - - - - - - - - - - -

What's your age?

_____

What's your gender?

◯ Male (1)

◯ Female (2)

◯ Other (3)

_____

- - - - - - - - - - - - - - - - - - - Page Break - - - - - - - - - - - - - - - - - - -

Finally, as a last step, we need you to accept the terms and conditions of this study:
Aim of the study: This study is part of the European research project Immersia TV on future TV-experiences. The study is conducted by IMEC and i2CAT. In this study, we focus on the opinion and expectations of TV-users towards Virtual Reality (VR) and new TV-experiences.
Privacy and confidentiality: All data gathered in this study will be processed anonymously and only be used for this project. All participants will be coded (for example using pseudonyms) in the analysis and reporting of the data.This means that your name will not be linked to the gathered information.

○ I agree to take part in this study (1)

Page Break

- -

Thanks for filling in the registration form! The code you need to run the demo is: **immersive**

You can now go back to the instructions page to continue with the demo process. Do not forget to submit the survey before leaving. Have fun!

End of Block

6.6. Annex VI: Survey semi-open pilot

ImmersiaTV pilot 1 Post-test survey

Viewing setting

Q1 **Thanks for watching our demo! We would like to know a little bit more about your viewing experience while watching the videos, so we can make the viewing experience better. Filling in this questionnaire will take about 10 minutes. Are you ready?**

- - - - - - - - - - - - - - - - - Page Break - - - - - - - - - - - - - - - - -

Q2 What's your name?

Q3 What's your contact e-mail?

- - - - - - - - - - - - - - - - - Page Break - - - - - - - - - - - - - - - - -

Q4 Which of the following devices did you use while watching the documentary?You can select multiple devices.

☐ Smartphone (1)

☐ Tablet (2)

☐ TV-screen (connected to a PC) (3)

☐ Computer/laptop (4)

☐ Cardboard virtual reality goggles (5)

- Page Break -

Q5 **How often did you switch between the different devices?**

○ Only once (1)

○ 2-3 times (2)

○ 4-5 times (3)

○ More than 5 times (4)

○ I didn't switch between devices (5)

- Page Break -

Q6 **How did you watch the video?**

○ Alone (1)

○ Together with one other person (2)

○ Together with multiple persons (3)

- Page Break -

End of Block

Viewing experiences

Q7 Did you experience any technical issues during the test with one of the devices?

○ No (1)

○ Yes: (2) _____

Q8 Could you indicate to which degree you liked the content of this specific video?

○ Dislike a great deal (1)

○ Dislike somewhat (2)

○ Neither like nor dislike (3)

○ Like somewhat (4)

○ Like a great deal (5)

Q9 How would you rate the visual quality of the documentary?

	Extremely bad (1)	Somewhat bad (2)	Neither good nor bad (3)	Somewhat good (4)	Extremely good (5)
In general (1)	○	○	○	○	○
If Which of the following devices did you use while watching the documentary?You can select multiple devices. Smartphone Is Selected On the smartphone (2)	○	○	○	○	○
If Which of the following devices did you use while watching the documentary?You can select multiple devices. Tablet Is Selected On the tablet (3)	○	○	○	○	○
If Which of the following devices did you use while watching the documentary?You can select multiple devices. TV-set Is Selected On the TV-screen (4)	○	○	○	○	○

If Which of the following devices did you use while watching the documentary?You can select multiple devices. Computer Is Selected	○	○	○	○	○
On the computer/laptop (5)					
If Which of the following devices did you use while watching the documentary?You can select multiple devices. Cardboard virtual reality goggles Is Selected	○	○	○	○	○
On the cardboard virtual reality goggles (6)					

Q10 How would you rate the audio quality of the documentary?

	Extremely bad (1)	Somewhat bad (2)	Neither good nor bad (3)	Somewhat good (4)	Extremely good (5)
In general (1)	○	○	○	○	○
If Which of the following devices did you use while watching the documentary?You can select multiple devices. Smartphone Is Selected On the smartphone (2)	○	○	○	○	○
If Which of the following devices did you use while watching the documentary?You can select multiple devices. Tablet Is Selected On the tablet (3)	○	○	○	○	○
If Which of the following devices did you use while watching the documentary?You can select multiple devices. TV-set Is Selected On the TV-screen (4)	○	○	○	○	○

If Which of the following devices did you use while watching the documentary?You can select multiple devices. Computer Is Selected	○	○	○	○	○
On the computer/laptop (5)					
If Which of the following devices did you use while watching the documentary?You can select multiple devices. Cardboard virtual reality goggles Is Selected	○	○	○	○	○
On the cardboard virtual reality goggles (6)					

Page Break

Q11 Could you please indicate to which extent you agree or disagree with the following statements related to your viewing experience while watching this documentary on multiple devices?

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I think that I would like to use this set-up frequently (1)	○	○	○	○	○
I found the set-up unnecessarily complex (2)	○	○	○	○	○
I thought the set-up was easy to use (3)	○	○	○	○	○
I think that I would need the support of a technical person to be able to use this set-up (4)	○	○	○	○	○
I found the various functions in this set-up were well integrated (5)	○	○	○	○	○
I thought there was too much inconsistency in this set-up (6)	○	○	○	○	○
I would imagine that most people would learn to use this set-up very quickly (7)	○	○	○	○	○
I found the set-up very cumbersome to use (8)	○	○	○	○	○

I felt very confident using the set-up (9)	○	○	○	○	○
I needed to learn a lot of things before I could get going with this set-up (10)	○	○	○	○	○

Page Break

Q12 Could you please indicate to which extent you agree or disagree with the following statements related to your viewing experience while watching this documentary on multiple devices?

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I lost myself in the viewing experience (1)	○	○	○	○	○
I was really drawn into the video watching (2)	○	○	○	○	○
I was so involved in the viewing experience that I lost track of time (3)	○	○	○	○	○
The viewing experience was fun (4)	○	○	○	○	○
When I was viewing, I lost track of the world around me (5)	○	○	○	○	○
I felt involved in the viewing experience (6)	○	○	○	○	○
I was absorbed in the viewing experience (7)	○	○	○	○	○

Q13 Could you please indicate to which extent you agree or disagree with the following statements related to your viewing experience while watching this documentary with the cardboard virtual reality goggles?

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I felt dizzy when I tried the cardboard experience (1)	○	○	○	○	○
I felt desoriented when I tried the cardboard experience (2)	○	○	○	○	○

Page Break

Q14 Could you please indicate to which extent you agree or disagree with the following statements related to the switching between devices?

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I liked the freedom to switch freely between devices (1)	○	○	○	○	○
The switching between the different devices was confusing (2)	○	○	○	○	○
I would rather watch the content on only 1 device (3)	○	○	○	○	○
I found the right balance while switching between the devices (4)	○	○	○	○	○
I like having access to different experiences of the same scenes and content (5)	○	○	○	○	○

Page Break

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Q15 On which of the following devices do you prefer to watch the documentary?

○ A combination of all devices (1)

○ TV/computer + Cardboard virtual reality goggles + tablet/smartphone (2)

○ TV/computer + Cardboard virtual reality goggles (3)

○ TV/computer + tablet/smartphone (4)

○ I prefer to watch on 1 device only (5)

Display This Question:

If On which of the following devices do you prefer to watch the documentary? I prefer to watch on 1 device only Is Selected

Q16 On what device do you prefer to watch the documentary?

○ Smartphone (1)

○ Tablet (2)

○ Cardboard virtual reality goggles (3)

○ TV-screen/computer (4)

End of Block

Background info

Q17 **Did you have a previous experience with virtual reality before this test?**

○ Yes (1)

○ No (2)

Q18 **What are your experiences with virtual reality?**

_____

_____

_____

_____

End of Block

Future expectations

Q19 For which types of video content do you think a multi-device omnidirectional video experience (as the video you have just seen) is most suitable?

	Not at all (1)	Slightly (2)	Moderately (3)	Fairly (4)	Extremely (5)
Film (1)	○	○	○	○	○
News programme (2)	○	○	○	○	○
Documentary (3)	○	○	○	○	○
Sports game (4)	○	○	○	○	○
Drama serie (e.g. House of Cards) (5)	○	○	○	○	○
Soap/sitcom (e.g. How I met your mother) (6)	○	○	○	○	○
Talkshow (7)	○	○	○	○	○
Live TV show (e.g. The Voice) (8)	○	○	○	○	○
Music concert (9)	○	○	○	○	○
Lifestyle/travel programme (10)	○	○	○	○	○
Cooking programme (11)	○	○	○	○	○
Gaming (12)	○	○	○	○	○
Other: (13)	○	○	○	○	○

Q20 **And then finally, the last question.** Would you consider watching similar multi-device content in the future at home, if you would have access to devices and content?

○ Yes (1)

○ Maybe (2)

○ No (4)

Q21 **This was it. Thanks for taking the time to fill in this survey! In the coming year, we will create new demos for this project. We will then also need people to try out these demos for us. If you're interested in trying out other demos for the ImmersiaTV project, we will send you an email with more information once the new demo is ready. Are you interested in trying out other ImmersiaTV demos?**

○ Yes (1)

○ No (2)

End of Block

6.7. Annex VII: Survey technical test open pilot

* Required

1. **What is the exact model of your smartphone (e.g. Samsung Galaxy S6)** *

2. **Can you fluently play the video on your smartphone?** Yes/No

3. **If no, what exact problem occurred? Be as detailed as possible.**

4. **What is the name of the internet service provider you used for this test to connect to the WiFi (e.g. Orange)?** *

5. **What is your download bandwidth? You can quickly check this by going to** http://beta.speedtest.net/ **and pressing GO. For the example below, the answer is 85,06 Mbps.**
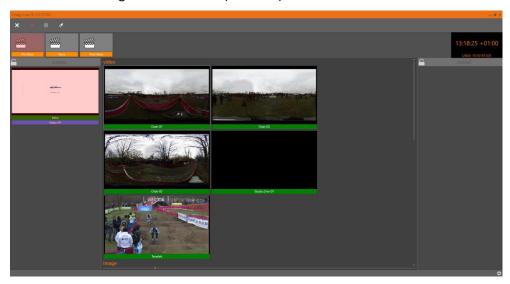

6. **In what country and city do you live?** *
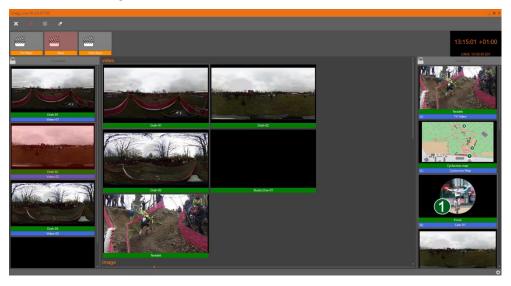
7. **Do you have any other remarks?**

6.8. Annex VIII: Screenshots software evaluation (pilot 2)

Screenshot of the general interface (Pre-race):

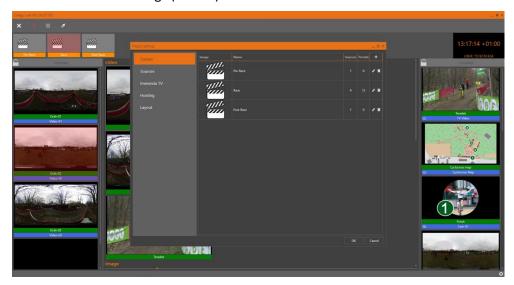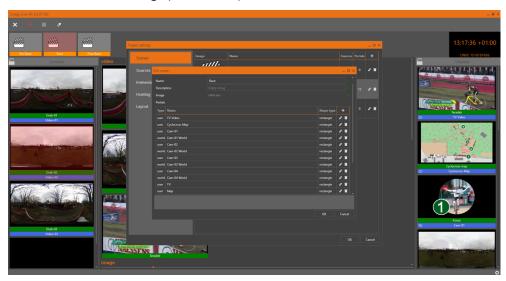Screenshot of the general interface (Race):
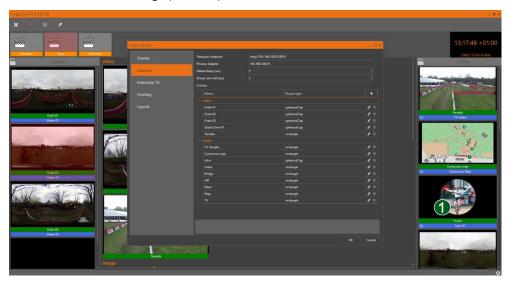
Screenshot of the settings (scenes):

Screenshot of the settings (edit scenes):

Screenshot of the settings (sources):

6.9. Annex IX: Observation protocol and interview guide professional user evaluation pilot 2

Respondent nr.:

Date:

Observer Name:

Background information interviewee:

Age	Gender	Occupation	Familiar with ImmersiaTV? (Yes/No)	Experience with VR

Additional relevant notes about the interviewee:

OBSERVATION PROTOCOL

Does the test user asks a questions or gives a comments during the explanation of test?

Yes/No

If yes, describe possible questions/comments:

What features of the toolkit do they use during the testing?

Questions or comments during the use of the toolkit:

Describe for each comment or question what triggered the remark (e.g. the use of which feature) and what the remark or question was.

Remark 1	
Trigger	
Description	

Remark 2	
Trigger	
Description	

Remark 3	
Trigger	
Description	

Remark 4	
Trigger	
Description	

Remark 5	
Trigger	
Description	

Were there any technical issues during the test?

Yes/No

If yes, describe the issues:

INTERVIEW TOPIC LIST

Evaluation of the toolkit

How do you evaluate the live editing toolkit in general?

How useful was the toolkit for you? Did it help you in being more efficient? (First open question, then rating)

- Give score on a scale from 1 (Not at all) to 7 (Extremely): "It makes the things I want to accomplish easier to get done" :

Do you think the toolkit was easy to use? (First open question, then rating)

- Give score on a scale from 1 (Not at all) to 7 (Extremely): "It is easy to use":
- Do you think it's easy to learn how to use the software?

What 3 features of the toolkit did you like the most?

What 3 features of the toolkit did you like the least?

What would you change?

What is missing?

If available, would you use it for professional activities?

Integration with normal workflow
What is the main difference of the live 360° editing toolkit with the tools you regularly use for traditional live editing?

How well do the tools integrate in your normal production workflow? Would you like to see changed about the integration?

Round-up: **Do you have any other comments?**

6.10.   Annex X: Interview guide end-user evaluation pilot 2

1. **Introduction**
   - *Informed consent*
   - *The project scope and aim user test is briefly explained*
   - *Participants present themselves briefly (name, age, occupation, possible previous experience with VR, interest in football)*

2. **Show demonstrator**

   - **Closed lab test I: demo football content**
   - **Closed lab test II: demo cyclocross content**

→ *Observe:*

   - *Usage of different devices (What devices do they use? When do users switch to another device?)*
   - *Feedback (Do they say anything when watching the content?)*
   - *Social interaction (Do they talk with others while watching the content? What do they say? What different devices do they use?)*

3. **Part I: END-<u>USER EVALUATION</u> (simulated)-live pilot 2**

   - First impressions?
   - How do you evaluate the use of the Head-Mounted Display? And Tablet?
   - Tablet:
     - How did you experience the 360° viewing/ the navigation on the tablet?
     - What do you think of the portal on the tablet?
     - Was it clear how you could switch between camera viewpoints?

   - HMD:
     - How did you experience the 360° viewing/ the navigation on the HMD?
     - What do you think of the portal on the HMD?
     - Was it clear how you could switch between camera viewpoints?

   - How do you feel about switching between the different devices to watch the content?
   - Usability:
     - How do you evaluate the user friendliness of the interaction with the content?
     - Is there anything related to the user friendliness of the experience that you would like to see improved?

   - Would you like to watch a football match in a multi-device immersive setting in real life?