Deliverable

Project Acronym:	**ImmersiaTV**
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D4.4. User evaluation

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P	Public	x
C	Confidential, only for members of the consortium and the Commission Services	

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

EXECUTIVE SUMMARY

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

In the first version of this deliverable (January 2017) all the evaluation activities related to pilot 1 are 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.

This deliverable is directly linked to D4.1. “Pilot evaluation and execution plan”. In D4.1. deliverable all the 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.

Two additional iterations of this deliverable are foreseen after pilot 2 and 3.

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Acronym	Description
HMD	Head-Mounted Display
VR	Virtual Reality
Avg.	Average
CAPI	Computer Assisted Personal Interview

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) reports 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 the demonstrator at demo-booths (IBC and NEM- P1.2 and P1.9)
4) Closed pilot test (P1.3- P1.4 and P1.5)

1.3. Status of this document

This is an intermediate version of D4.4. with delivery foreseen in M11. This document focuses on the evaluation activities of the first pilot. Other versions of this document will be delivered in M19 (pilot 2) and M30 (pilot 3).

2. PILOT 1 - 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.:

1) How will the ImmersiaTV experience fit within viewers' current TV-practices?

2) 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.

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.

N°	Activity	Timing	Target group	Location	Status
P1.1.	Evaluation of content creation toolkit (software evaluation)	June 15 2016 (1st SW release) - October	Professional users	VRT (Brussels) Lightbox (Porto)	80% 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	Planned in February 2017
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/ Porto	Planned in February 2017
P1.7.	Open pilot (open online test)	Jan-June 2017	End-users	Barcelona	Planned in February 2017

Two additional evaluation activities were conducted in the meantime:

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

For consistency in the reporting, we will report on 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 the demonstrator at demo-booths (IBC and NEM- P1.2 and P1.9)
4) Closed pilot test (P1.3- P1.4 and P1.5)

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.

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

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 21st. 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 (see annex 1).

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 1: Overview of workshop participants

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 2: 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 the demonstrator at demo booths IBC and NEM (P1.2. + P1.9)

3.3.1. 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.

3.3.2. 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**.

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.

[1] Ibc.org

[2] https://nem-initiative.org/

[3] See immersia TV website

3.3.3. 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 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.

3.3.4. 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.

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

3.4.1. Planned set-up

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 the combination of logging, observation and qualitative interviews, an in-depth analysis of the user practices, user expectations and social aspects can be acquired.

3.4.2. Detailed execution of the activity

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.

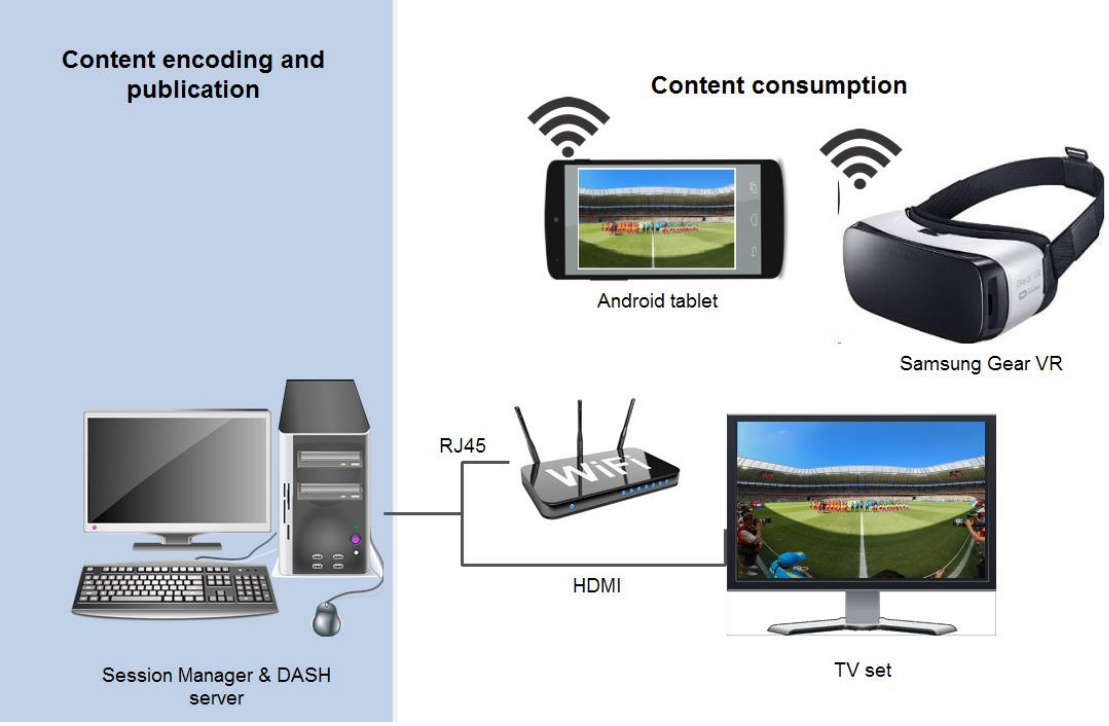

Figure 3: Demonstrator set-up

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

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	# 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 3: Overview of participants

3.4.3. Obtained results

Observations

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 tablet in final scene	Almost all the content is watched on the HMD	/	/

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, the other on the HMD	Full documentary viewed in HMD. Walked around with HMD.	No	1 respondent just watched the 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	

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.

In-depth interviews

Here we will report on the findings of the interviews. These were conducted with one or two (or even four) respondents, depending on the number of persons that participated in each session. Below we will discuss the results, structured according to the different topics:

- 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

Overall user experience

Novelty effect

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".*

Low audiovisual quality as main drawback

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 synchronity 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.

Multi-device usage

Finding the right balance

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.

Tablet vs. HMD

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".

Usability

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."

Interaction and level of control

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).

Content

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."*

Social viewing

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.

Future expectations

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 aswers 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 at home to use it. 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 woiuld 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 wpuldn't mind if it was plug and play. If you didn't have to do anything becaude 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."*

3.4.4. Next steps in pilot 1 evaluation

The closed pilot test will be repeated in Brussels. Here an additional challenge will be the language. The evaluation in Porto showed us that users used the audio of the documentary to keep track of the storyline. Since subtitles are only available on TV, this might be an issue for non-Portuguese speakers. Besided the closed pilot test, also a semi-open pilot test is planned. In this test, people will be able to stream the documentary and watch it at home, using multiple devices. Here a good user manual will be crucial to ensure a fluent experience.

3.5. 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
R.1.1	**Avoid physical discomfort in the experience**	*Keep in mind that some users might experience physical discomfort while watching VR.*	*Only very limited physical discomfort was reported in the evaluation activities*
R.1.2	**Ensure a perfect image quality**	*Ensure a perfect image quality for all VR content that is used in the demos and pilots.*	*Image quality was perfect on TV, but low on HMD and tablet.*
R.1.3	**Allow physical social viewing**	*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.1.4	**Allow virtual social viewing**	*By offering a more social VR experience by adding avatars or representations of other VR users in the content.*	*Not available yet*
R.1.5	**Limit the number of VR interactions**	*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.1.6	**Avoid distraction from the storytelling**	*The VR interaction should not completely distract viewers from the storytelling.*	*This was positively evaluated by most of the respondents*

R.1.7	**Think about short VR fragments**	*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*
R.1.8	**Allow interactivity by zooming in and out**	*The user should be able to zoom in and out.*	*Not available yet*
R.1.9	**Adapt camera standpoint to the viewpoint**	*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.1.10	**Allow navigation to select viewpoint**	*Different perspectives or positions should be possible. Users should be able to select their preferred viewpoint.*	*Partly available*
R.1.11	**Give users control over 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.1.12	**Give control to the user**	*Viewers would like to select their own viewpoint (viewer as director).*	*Not available yet*
R.1.13	**Balance the 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.1.14	**Insert natural triggers**	*Natural triggers should provide anchor points to the user of where to watch or what content to explore.*	*Partly available*
R.1.15	**Insert haptic feedback**	*Add haptic feedback to the experience, to make it even more tangible for users.*	*Not available yet*
R.1.16	**Adapt content to viewer**	*The offered content should have a clear added value for the user*	*Positively evaluated by the user*

		in terms of personal interest or originality of the content.	

Professional user requirements

Number	Requirements	Status
R.2.1.1	VR experiences are about presence, "being there". This includes: - 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	*2.1.1.1. and 2.1.1.2. were achieved, 2.1.1.3-2.1.1.5. not yet*
R.2.1.2	Improve the storytelling. This includes: - 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	Don't do everything in 360° - 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	Play with the viewing angle & perspectives - 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	Consider the viewer's role in the story (observation role versus part of story)	*Partly achieved (for example feeling of presence in car scene)*

R.2.1.6	Define the “beats” & 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 - 2.1.6.3: introduce interactions	*Achieved*
R.2.1.7	Balance between guidance and freely looking around	*Respondents could select this themselves*
R.2.1.8	Think about transitions in VR storytelling	*Partly achieved*
R.2.1.9	Think about Social VR experience	*Not available yet*
R.2.1.10	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 implemented*
R.2.1.11	Previsualisation of 360° world of the story based on rough 360° video of the location	*Not yet achieved*
R.2.1.12	On-location live preview in VR of camera view (before the actual shooting takes place) and captured content, including omnidirectional video and audio preview on the set	*Not yet achieved*
R.2.1.13	On-location live replay in VR of captured content, and resulting format experience.	*Not yet achieved*
R.2.1.14	Automatic labelling and sorting of captured shots	*Not yet achieved*
R.2.1.15	Fast ingest (after capturing) or streaming (before capturing) capability of the captured shots, to enable instant preview	*Partially Achieved*
R.2.1.16	Potential integration of live VR preview with VR storyboard mixing captured shots with available rough content (from research phase)	*No shots from the research phase were available, but feasible with current software*
R.2.1.17	Offering similar functionalities for live preview as for VR storyboard in pre-production	*Not yet achieved*

R.2.1.18	Intuitive dashboard indicating status of used cameras in shooting	*Not yet Achieved*
R.2.1.19	Camera equipment requirements: important aspects include high mobility, weight, robustness, rainproof, mud-proof, stability	*Partially Achieved*
R.2.1.20	Better integration of the process of rough stitch, editing, final stitch production chain	*Achieved*
R.2.1.21	Simplify the post production workflow and minimize the required manual steps and used tools. This includes - 2.21.1: Stitching - 2.21.2: Editing and compositing for 360 scenarios - 2.21.3: Adding interactivity and portals - 2.21.4: Synchronous multi-platform content (tv, HMD, tablet)	*Achieved*
R.2.1.22	Preview capabilities in post-production, including HMD and ImmersiaTV Player output viewing.	*Partially achieved*
R.2.1.23	Better findability and searchability of own produced VR content provided by a user-friendly VR app	*Not yet achieved*
R.2.1.24	Custom developed play-out solution that supports interactivity and synchronisation scenarios.	*Achieved*
R.2.1.25	Automated way of exporting to different platforms.	*Achieved*