

# Deliverable

<b>Project Acronym:</b>	ImmersiaTV
<b>Grant Agreement number:</b>	688619
<b>Project Title:</b>	<i>Immersive Experiences around TV, an integrated toolset for the production and distribution of immersive and interactive content across devices.</i>

## D2.1 End User Requirements

**Revision:** 0.9

**Authors:**

Wendy Van den Broeck (Imec)

**Delivery date:** M03 – M12

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 688619

Dissemination Level

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

**Abstract:** This deliverable reports on Task 2.1, requirements workshops with end-users. The outcome of this deliverable is a set of end-user requirements for the offline and live produced content scenarios within the ImmersiaTV project.

## REVISION HISTORY

Revision	Date	Author	Organisation	Description
0.1	15/02/2016	Luk Overmeire	VRT	ToC
0.2	15/03/2016	Wendy Van den Broeck	iMinds	First draft version of the deliverable
0.3	22/03/2016	Wendy Van den Broeck	iMinds	Intermediate conclusion: overview of requirements
0.4	24/03/2016	Sergi Fernandez	i2CAT	First review
0.5	7/04/2016	Wendy Van den Broeck	iMinds	Structure
0.6	30/4/2016	Touradj Ebrahimi	EPFL	Final review
0.7	06/06/2016	Pau Pamplona	i2CAT	Template and format improvements
0.8	12/12/16	Wendy Van den Broeck	Imec	Second iteration of the end-user requirements with focus on live scenario
0.9	16/12/16	Touradj Ebrahimi	EPFL	Final review

### Disclaimer

The information, documentation and figures available in this deliverable, is written by the **ImmersionTV** (*Immersive Experiences around TV, an integrated toolset for the production and distribution of immersive and interactive content across devices*) – project consortium under EC grant agreement H2020 - ICT15 688619 and does not necessarily reflect the views of the European Commission. The European Commission is not liable for any use that may be made of the information contained herein.

### Statement of originality:

This document contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

## EXECUTIVE SUMMARY

---

This Deliverable describes the detailed end-user requirements needed for both offline and live produced content in ImmersiaTV.

This Deliverable is a living document that will be updated iteratively by insights gained in T2.1. end-user requirements as well as in content ideation Proof of Concepts (PoCs) (D2.3), content creation (D2.4) and pilots (WP4).

Specific focus is on end user requirements for both (off-line) immersive documentaries (first iteration) and live sports events (second iteration).

In the first version of the deliverable (M3), we reported on the two end-user workshops related to the offline content production scenario that took place in February and March and we discuss the derived requirements from these workshops.

In the current version, which is the second iteration of the deliverable (M12), focus is on the end-user requirements for the live scenario. This is based on the results of a new focus group interview specifically addressing live content. A second requirement session for pilot 2 will be planned as soon as the pilot scenario of the live content is finalized (i.e. whether it will be cyclocross or another sports event or something else). This session will take place in the first quarter of 2017.

This document is structured as follows: in the introduction we discuss the aim of the task and the deliverable, followed by the explanation of the methodological approach. Next we present the research findings and the specific identified end-user requirements for immersive TV-experiences. A first set of requirements relates to the general VR experiences and requirements, followed by requirements related to synchronised content across devices, interactive VR experiences and content format requirements. The document is concluded with an overview of all end-user requirements.

## CONTRIBUTORS

---

First Name	Last Name	Company	e-Mail
Luk	Overmeire	VRT	luk.overmeire@vrt.be
Tom	Cornille	VRT	tom.cornille@vrt.be

## CONTENTS

---

Revision History.....	1
Executive Summary.....	2
Contributors.....	3
Table of Figures.....	6
List of acronyms.....	7
1. Introduction.....	8
1.1. Purpose of this document.....	8
1.1.1. Iteration 1: offline content scenario.....	8
1.1.2. Iteration 2: live content scenario.....	8
1.2. Scope of this document.....	8
1.2.1. Iteration 1: offline content scenario.....	8
1.2.2. Iteration 2: live content scenario.....	9
1.3. Status of this document.....	9
1.4. Relation with other ImmersiaTV activities.....	9
2. Methodology: User requirement workshops.....	11
2.1. Motivation for the workshop approach.....	11
2.2. Detailed workshop procedure.....	12
2.2.1. First iteration.....	12
2.2.2. Second iteration.....	13
2.3. Participants.....	13
2.3.1. First iteration.....	13
2.3.2. Second iteration.....	15
2.4. Analysis procedure.....	15
3. End-user requirements for immersive TV experiences.....	16
3.1. General VR experiences and requirements.....	16
3.1.1. VR is considered an innovative and natural experience.....	16
3.1.2. Physical discomfort.....	17
3.1.3. Evaluation of VR devices.....	18
3.1.4. Image quality.....	19
3.1.5. Social viewing.....	19
3.2. Synchronised content across devices.....	20
3.2.1. Switching between devices.....	20
3.2.2. Integration with regular viewing experience.....	21
3.2.3. Length of fragments and integration in the content.....	22

3.3. Interactive VR experience .....	23
3.3.1. Camera position, viewing perspective and navigation .....	23
3.3.2. User wants to be in control.....	25
3.3.3. Follow the action: make use of triggers.....	26
3.3.4. Haptic feedback .....	27
3.3.5. Gaming element as interactive feature .....	28
3.4. Content format requirements .....	28
3.4.1. For which types of content or programmes is omnidirectional content best suited? 28	
3.4.2. Examples: outcome of content ideation exercise.....	31
4. Overview of user requirements .....	39
5. References .....	42
6. Annex I – Detailed workshop outline and planning.....	43

## TABLE OF FIGURES

---

Figure 1: Relationship between different tasks .....	10
Figure 2: Different levels of knowledge about experience are accessed by different techniques .....	11
Figure 3: Example of call for participants ‘share your thoughts about VR on TV’ .....	14
Figure 4: Weather in a new jacket .....	31
Figure 5: Game show De Mol .....	31
Figure 6: Temptation Island .....	32
Figure 7: The news .....	32
Figure 8: travel program.....	34
Figure 9: Football.....	34
Figure 10: Cooking and hobby program.....	34
Figure 11: Cycling .....	35
Figure 12: Mission to Mars.....	37
Figure 13: Football game.....	37
Figure 14: Live news.....	38
Figure 15: Inspiration kit for the content ideation exercise .....	44

## LIST OF ACRONYMS

---

Acronym	Description
HMD	Head-mounted display
ODV	Omnidirectional video
VR	Virtual reality
UX	User Experience
PoC	Proof of Concept



# 1. INTRODUCTION

---

## 1.1. Purpose of this document

### 1.1.1. Iteration 1: offline content scenario

This deliverable documents in details the end-user requirements for omnidirectional content in the offline content scenario as investigated in Task 2.1.: end-user requirements. The outcome of this task is a set of structured insights and requirements that together with the insights and requirements acquired in Task 2.2: professional user requirements, will serve as input for the content ideation process in Task 2.3 and finally the pilots in WP4.

### 1.1.2. Iteration 2: live content scenario

In the second iteration of this document (M12), specific focus is on the end-user requirements for the live content scenario as preparation for pilot 2.

## 1.2. Scope of this document

### 1.2.1. Iteration 1: offline content scenario

The objective of task T2.1 is to define end-user requirements for the different pilot scenarios. In the first phase of this deliverable, focus was on defining end-user requirements for the offline content scenario. The main scenario defined, in the ImmersiaTV project, that is taken into account is the residential TV-viewing scenario in which a user consumes video content in a home setting with access to multiple devices (e.g. tablet, Smartphone, HMD). The workshops focused on the following specific aspects:

- *General user experience of omnidirectional video:* How do users experience watching omnidirectional video content in different genres and via different devices (HMD, Google cardboard)? How do they evaluate the usability of VR devices and different content formats? What types of possible discomfort do users experience?
- *Omnidirectional content formats:* What do users see as the most appropriate formats or genres to integrate omnidirectional video content? What kind of omnidirectional content formats would they create for themselves? How do they evaluate the developed formats by professional TV makers?
- *Contextual factors:* What is the importance of different contextual factors such as social setting and pricing of the devices for the omnidirectional user experience? How can we develop omnidirectional viewing experiences that take into account social viewing aspects?
- *Synchronised content across multiple devices:* One of the main foci of the ImmersiaTV project is synchronized content across different devices (TV-set, tablet, HMD). How do users evaluate the usage of different devices to watch omnidirectional content in combination with regular TV-content? How do they prefer to switch devices?

- *Interactive formats and portals:* A second central aspect in the ImmersiaTV project is the use of interactive formats and the application of interactive features such as portals. Relevant questions here include: How interactive do users want to be in exploring omnidirectional content? Does interactivity lead to a higher level of engagement? What is the balance of control between the user and the director? What kind of cues should guide the user in the omnidirectional experience? How could portals be a relevant part of the omnidirectional viewing experience?

### 1.2.2. Iteration 2: live content scenario

In the second iteration, an additional workshop took place with specific focus on the live content scenario. In the discussion, similar topics as during the first phase were addressed:

- *General user experience of omnidirectional video:* In the second workshop, we focused on previous experiences with VR, and expectations on the use of omnidirectional video in a multi-device set-up.
- *Omnidirectional content formats:* In contrast to the first workshops, here we focused particularly on the live scenario. Discussed formats included different kinds of live broadcast programs, including sports, news, reality shows and broadcasting of big live events.
- *Contextual factors:* What is the importance of different contextual factors such as social setting and pricing of the devices for the omnidirectional user experience? How can we develop omnidirectional viewing experiences that take into account social viewing aspects?
- *Synchronised content across multiple devices:* One of the main foci of the ImmersiaTV project is synchronized content across different devices (TV-set, tablet, HMD). In this second iteration, focus was on the different types of content and interaction on each device, as well as the switching between devices and the difference between tablets and HMD.
- *Interactive formats and portals:* In this workshop focus was on possible interactions and level of control between the viewer and the director, particularly in live scenarios.

To distinguish between the results of the first and second iterations of the deliverable, we added subtitles with 'first iteration' and 'second iteration' in each section.

## 1.3. Status of this document

A first intermediate version of D1.2 was delivered in M06. This is the second iteration of the document, delivered in M12. A final version of this document is foreseen in M20. We do foresee a new iteration of the document in M15, once the type of live content for the second pilot is selected.

## 1.4. Relation with other ImmersiaTV activities

The relationship between this task and the other WP2 tasks and relevant WP3 and WP4 tasks is shown below.

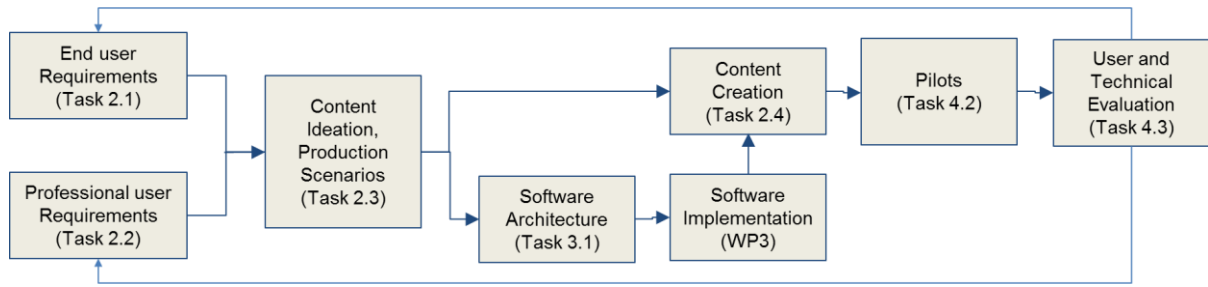


Figure 1: Relationship between different tasks

## 2. METHODOLOGY: USER REQUIREMENT WORKSHOPS

### 2.1. Motivation for the workshop approach

In order to obtain relevant requirements in this first exploratory stage of the project, a qualitative research approach is best suited to address in-depth the different user needs and expectations. Qualitative research methods allow thoroughly exploring and identifying the different dimensions of a certain topic. As a methodological approach for this specific task, we designed a structured workshop that is a combination between focus group interviews and co-creation workshops. This approach is inspired by the context mapping as described by Sleeswijk Visser et.al. (2005). A first step in the approach is the sensitization in which respondents could experience different content fragments in VR on head-mounted displays, Google cardboards and smartphones. In a first part of the workshop, a group discussion took place in which the first experiences of the respondents were discussed. In a second phase of the workshop, a structured content ideation exercise was foreseen in which users could develop their own VR program format on paper (see annex 1 for a detailed description of the assignment). The combination of a focus group interview with a generative technique such as a co-creation exercise, allows for a deep understanding of the user context, as is shown in the figure below by Sleeswijk Visser et. al. (2005:124).

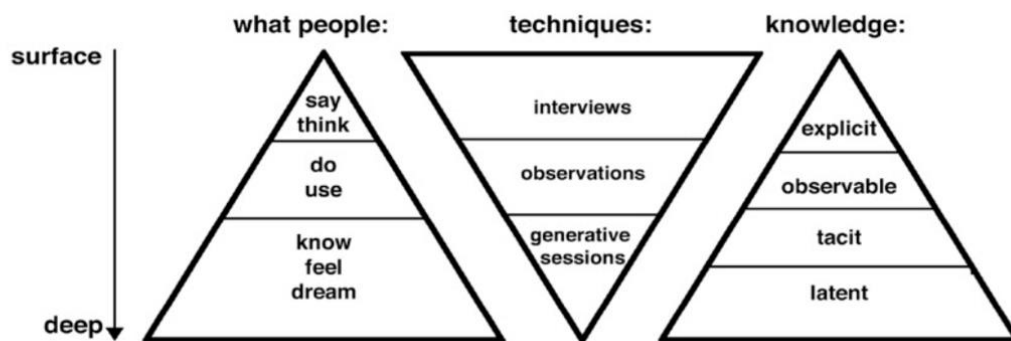


Figure 2: Different levels of knowledge about experience are accessed by different techniques<sup>1</sup>

By making users reflect about their own concept for a TV-program they would like to watch, they are also forced to think about other specific contextual factors, such as social context, the specific devices they would use to access the content, etc. The Advantage of group discussions is that it is an efficient way to aggregate information of a group of people. The researcher can directly interact with the respondents, go in-depth on certain answers and also notice gestures and facial expressions. The answers on the questions are open and formulated in the respondents' own words. The researcher can find deeper levels of meaning, make important links and identify subtle nuances in expression and meaning. The group aspect of the workshop also allows for rich interactions between the participants, as they can build further on answers of other respondents, and people are encouraged to talk about matters that are evident, and that would otherwise not be mentioned. Contradictory responses can immediately be discussed. On the other hand, some participants in the focus groups might be less eager to talk, when their opinion is conflicting with the general opinion. Another important limitation of group discussions is that there is the risk of overestimating the extent to which the results can be generalised (Stewart & Shamdasani, 1990). Therefore, it is important to organise multiple group sessions, including in other involved countries, also to

<sup>1</sup> Sleeswijk Visser, F.,e.a. (2005) Contextmapping: Experiences from practice. CoDesign: International Journal of CoCreation in Design and Arts.

take into account possible cultural differences. These sessions will be planned for the next iteration of the deliverable. In a later phase of the research, a quantitative survey will also be foreseen as part of our mixed methods research approach, in order to make quantitative generalizations possible.

## 2.2. Detailed workshop procedure

### 2.2.1. First iteration

In a first stage of the project, 2 end-user workshops of 2,5 hours took place at VRT premises. The workshops were organised in parallel with the professional requirement workshops that are reported in D2.2. For the introduction and the closing discussion, the end-users and the professional users were brought together for the discussion. The feedback on VR experiences and the ideation exercise took place in separate groups.

The workshops consisted of the following activities (*a detailed overview of the workshop planning can be found in annex I*):

#### INTRODUCTION

- *Introduction and demo of VR examples:* Users could experience some VR examples on different devices (HMD, tablets, Google cardboards).
- *First feedback on VR experiences:* The workshop participants share their first ideas on how they experienced the different demos they've seen as well as their reflections on main opportunities and barriers for omnidirectional video, opportunities for future TV-experiences, optimal content formats and willingness to pay.

#### IDEA GENERATION AND FORMAT

- *Content ideation exercise – design of the experience:* In teams of 2, end-users are asked to create their own ideal future TV-experience. They receive a blank poster and an inspiration kit including different pictures (people watching TV in different settings), different genres, timeline (how would they map out their program in time, when do they foresee which interaction), etc. They are guided to reflect on the content and the context (where, how, with whom, ...)
- *Presentation of content ideas + discussion:* The teams will present their content formats to each other. This is followed by a discussion about the different formats and the context of these formats.

#### DISCUSSION WITH END-USERS AND PROFESSIONAL USERS

For this part of the workshop, the professional users and the end-users are gathered around the table.

- *Presentation of professional content formats to end-users:* Professional users present their concepts to the end-users. The end-users can ask questions and there is a discussion on the developed concepts. In the discussion, we will focus on the professionals' view on the user (what kind of user experience and user expectations did they have in mind for their developed concept) and how users evaluate this.

- *Presentation of end-user formats to professional users:* Also the end-users will briefly present their concepts followed by a discussion.

### 2.2.2. Second iteration

In the second phase of the project, a new workshop was organised with a specific focus on the live scenario. This workshop consisted of two main parts:

#### EXPERIENCES AND EXPECTATIONS ON MULTI-DEVICE CONTENT FORMATS

- *Previous experience with VR:* discussion of experiences of participants with VR content and devices (e.g. Google Cardboard, other HMD)
- *Opportunities and barriers of VR in combination with TV broadcast content:* participants discussed their expectations towards multi-device formats in which TV broadcast content is combined with other devices in which omnidirectional video content is displayed. Different opportunities and barriers were addressed.

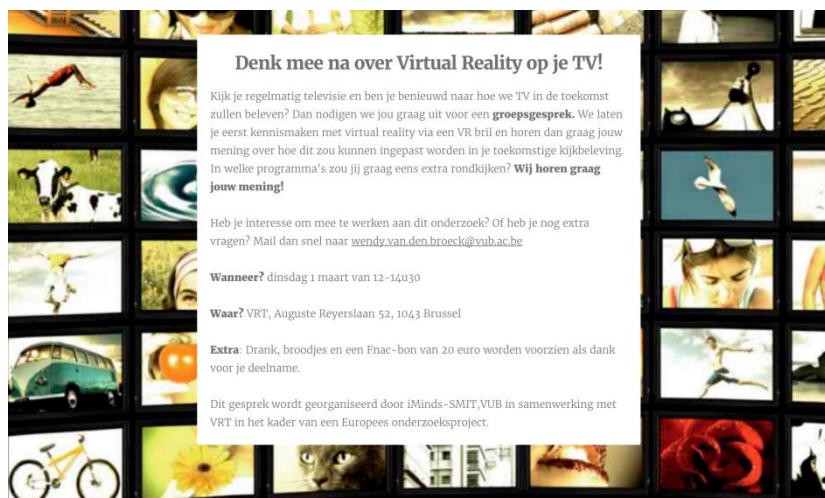
#### IDEA GENERATION AND DISCUSSION

In the second part of the workshop, participants created their own format for a live broadcast event. They could select the event themselves; the only requirement was that it was content that was broadcast live. The different developed formats were presented and discussed with the other participants.

## 2.3. Participants

### 2.3.1. First iteration

Participants were recruited via posters at VRT premises, social media, a specific call via VRT Proeftuin<sup>2</sup> and a specific call via the university network.



<sup>2</sup> VRT Proeftuin is VRT's living lab user panel, consisting of a database of about 1000 users.

Figure 3: Example of call for participants ‘share your thoughts about VR on TV’

In each workshop, there were 9 participants. There was a good gender balance 10M/8F and a good representation of different age categories. The youngest participant was 20 while the oldest participant was 70. The average age was 37. Some users already had some previous experience with VR demos but most of them did not.

All participants signed an informed consent form prior to their participation in the workshops. For privacy reasons, all names of respondents were replaced by acronyms.

**Participants Workshop 1:**

Name <sup>3</sup>	M/F	Age	Occupation	VR experience
Valerie	F	21	Student Master of Science in Adult Education	/
Lisa	F	21	Student Master of Science in Adult Education	/
Tim	M	39	ICT engineer/management	Demo’s oculus rift
Ludo	M	47	Technical engineer	Demo
Rien	F	25	Product designer/ UX designer	Demo + guided VR tour to buy a house
Eva	F	48	Communication	Oculus rift demo VRT news
Amanda	F	28	Graphical design	Demo Samsung gear
John	M	56	Administrative staff	/
Peter	M	70	Pension	/

**Participants Workshop 2:**

Name <sup>4</sup>	M/F	Age	Occupation	VR experience
Mona	F	20	Student	/
Dan	M	61	Director assistant	/
Sarah	F	27	Educational support at NGO	/

<sup>3</sup> Names have been altered to ensure anonymity of the participants.

<sup>4</sup> Names have been altered to ensure anonymity of the participants.

Mike	M	56	Project coordinator Telecom operator	/
Tom	M	26	Communication department	News studio demo
Chris	M	27	Looking for a job	/
Rob	M	53	Webmaster	demo
Joe	M	30	Student psychology	/
Els	F	27	Radio advisor	/

### 2.3.2. Second iteration

In the second iteration, a group interview was organised at the campus of the Vrije Universiteit Brussel. Participants were all students.

Name <sup>5</sup>	M/F	Age	Occupation	VR experience
Simon	M	28	Student communication studies	Tested VR Google Cardboard
John	M	23	Student economics	Brother in law is VR game developer, tested VR games
Sunna	F	22	Clinical psychology	1 demo on Playstation
Jill	F	20	Student communication studies	Google Cardboard short fragments
Sara	F	20	Student communication studies	No experience yet
Ken	M	22	Teaching	Playstation demo
Nadia	F	24	Adult education	Google cardboard short fragments

## 2.4. Analysis procedure

The workshops were fully recorded on video and audio. A full ad verbatim transcript of each workshop was made. For the analysis, a grounded theory approach was applied, using open, axial and selective coding.

<sup>5</sup> Names have been altered to ensure anonymity of the participants.



## 3. END-USER REQUIREMENTS FOR IMMERSIVE TV EXPERIENCES

---

From the discussions during the end-user workshops, different requirements could be identified. In this section, these requirements are structured and described in more detail. General experiences and requirements are discussed in section 3.1. Next, we address the specific ImmersiaTV challenges with regard to synchronized multi-platform content experiences (3.2) and interactivity in general as well as portal-based interactivity (3.3). In 3.4 specific omnidirectional program formats are discussed, starting with an overview of content types respondents thought were most suited for omnidirectional TV-experiences, followed by an overview of their own developed content formats.

The results of the workshop on live content scenarios are listed at the end of each section, explaining the similarities and differences with the results from the first research phase. Some additional requirements are also formulated. Numbering for these additional requirements starts with R1.18 (R1.1- R1.17 were requirements formulated based on the first iteration).

### 3.1. General VR experiences and requirements

Based on the experience with the different demos and the discussion afterwards, different **findings** related to the user experience and contextual factors influencing this experience were identified. In this section we will discuss these more generic experiences and requirements.

#### 3.1.1. VR is considered an innovative and natural experience

##### 3.1.1.1. First iteration

For those respondents that have no prior experience with VR, the demos are mostly received in a positive way. First impressions mentioned by respondents are **innovative, surprising and interesting**.

*I: "What do you mean when you say that it is innovative?"*

*John, age 56: "That you get immersed in the atmosphere and the reality and that you are so close to it"*

Respondents are also surprised about how quickly they get used to the VR experience.

*Ludo, age 47: "What I find remarkable is how quick you get used to it. Within a few seconds, you are really into the story. It is really natural. It is amazing how quick you are into the story"*

*Lisa, age 21: "Yes, you completely forget where you are... I even got scared of movement around me, that I thought, wow, someone came closer and I really thought he's going to bump into me"*

##### 3.1.1.2. Second iteration

In the second iteration, almost all respondents already had some previous experience with VR content, mainly via Google cardboard. Based on this previous experience, they see a lot of **potential** for VR experiences. Mentioned benefits are for example related to **education**, where you could get a 3D omnidirectional view of the study topic (for example in medical training). But also in program formats, some options were seen, for example a **game show**. However,

this respondent doesn't expect it to completely take over the traditional broadcast experience, they see it as **complementary to the traditional broadcast experience**:

*Simon, age 28: The regular framing of a movie on TV will still exist, but I think it can lead to new formats. For example, game shows in which the viewer can look inside the image and find clues. Or movies in which you are actually in there, just like in games. A bit like we know the 3D glasses now, but then taken to the next level. I think a lot is possible, the question is how the average TV-viewer will adopt this, youngsters maybe quicker than older people”.*

The offered **perspective** in VR was also something that was considered beneficial. In VR (if shot correctly), viewers have a realistic perspective on people and objects.

*John, age 23: “Also the scale is different, it is a completely different experience to see a 2D camera recording of a building or to stand in front of it yourself in VR. The size of things is really difficult to see in 2D, this is much better in VR. I’ve played for example a Zombie game in VR, you really see people the same size as yourself coming towards you”.*

### 3.1.2. Physical discomfort

#### 3.1.2.1. First iteration

##### Requirement R.1.1.1 - Avoid physical discomfort in the experience

While most users had a positive experience, some respondents experienced some nausea. One respondent had to take a seat, because otherwise she would get nauseated. Valerie was a bit dizzy because she had the feeling she would fall. This is linked to the fact that she could not see her legs when looking down.

*Valerie age 21: “My problem was that I could not see myself anymore. That I had something, what am I doing now? You’re in two worlds at the same time, you have the real world and the VR world and in the VR world you’re gone. I really had the feeling I would fall while I was walking around.”*

Another linked aspect is the feeling that you are isolated while wearing a HMD with a headphone. Also the use of wearing the HMD is something you need to get used to.

#### 3.1.2.2. Second iteration

##### Requirement R.1.2.1. – Inform people about health risks

In the second iteration, only one respondent experienced a physical discomfort in a previous VR experience. This was related to the **heavy weight of the HMD** that was used, which made it uncomfortable to wear for a longer period of time. The second iteration confirmed that physical discomfort should be avoided. Respondents also expressed their **concern about the health aspects** of using VR for a longer period of time. This relates to both physical and mental health. Physically, the influence of the VR experience on the eyes was questioned.

*John, age 23 “I do have questions on the fact that, before they always told you not to sit too close to the TV-set because it was bad for your eyes and now they stick the screen on your face. I don’t know whether that’s really healthy.”*

Related to the mental aspects, a psychology student in the group questioned the ability of people to distinguish the real and the virtual if different cues would be offered at once.

### 3.1.3. Evaluation of VR devices

#### 3.1.3.1. First iteration

##### Requirement R.1.1.2 - Enable users to control their surroundings while watching VR content

All respondents agree that the HMD gives them the feeling that they are truly in another world, however there are some aspects to take into account.

One important element is the **feeling that you are isolated** while wearing a HMD with a headphone. You have to be able to really trust the environment you are in. For example, users would not use a HMD to watch something on the train. But also in other settings you might feel vulnerable while wearing a HMD, as you are audiovisually completely isolated.

*Amanda age 28: "There should be something that allows you to have more control over your surroundings. For example, that you would have a button and that you would immediately get a normal view of the room when you push it, in case you hear something, without having to take off the HMD. That would give me more trust to use the HMD".*

The **feeling of wearing the glasses** is also something that needs some getting used to. Some respondents didn't like the feeling of having headphones over the HMD, others thought that the HMD were rather heavy. But compared to the Google cardboard, respondents did agree that the HMD gave them the real feeling of being completely in the content.

Although there was almost no prior experience with HMD, how it worked was considered quite **user-friendly**. The only thing you can do is adjust the sharpness and select content by tapping, so there is no long learning curve to be able to work with the devices, it is rather straightforward.

In terms of **pricing**, respondents agree that it would be quite expensive if everyone in the household would need a HMD. If only one of them has one, they question what others in the household would do while one is watching the additional VR content. For example, if they are watching a program together with a VR moment, what should others do then? For some it might be interesting to have a picture in picture on TV that shows what the one with the HMD is seeing. For others a combination of different devices, others using for example a smartphone or tablet is a realistic option.

Price will be the main drawback for the adoption of a HMD. A Google cardboard offers a cheap and affordable alternative, but it will not offer a similar engaged user experience as the HMD would offer.

*Tom, age 26: "To me it is the added value that you put on the glasses (HMD) and that you are in there. While holding a smartphone, it seems like something I already had. We can already click around in smartphones for a long time".*

#### 3.1.3.2. Second Iteration

In the second iteration, the requirement on the ability to **control the surrounding** was confirmed. For Julie, the fact that not all types of HMD allow to indicate the walls of the room, led to people bumping into the walls in previous VR experiences.

*Jill, age 20: "When I tried it out myself, I was standing on a wooden platform and I saw people falling on the floor, because you don't have any control on the surroundings,*

*you only see in the glasses... I think there should be someone with you, to avoid you hurting yourself”.*

Other respondents tested HDM that allow you to **indicate obstacles**, to make the experience safer, as this system will warn you when you are near an obstacle. Of course this is linked to a higher price tag, as only the high-end HMD offer this possibility.

### 3.1.4. Image quality

#### 3.1.4.1. First iteration

##### **Requirement R.1.1.3 - Ensure a perfect image quality for all VR content that is used in the demos and pilots**

Some respondents were surprised and somewhat disappointed about the image quality of some of the demos as they expected a perfect image quality. This is of course related to the content that was used for the demo and also all respondents might not have optimally used the settings for the sharpness in the HMD. Some respondents referred to a grain in the image and the pixels that were too large. It is of course important to keep in mind that users expect a perfect HD image quality and in the recordings for the pilots, we should also strive for a perfect image quality. Users see this as the next step beyond HDTV, so they also have high expectations in terms of quality of experience.

#### 3.1.4.2. Second iteration

In the second iteration, no specific feedback on the image quality was provided.

### 3.1.5. Social viewing

#### 3.1.5.1. First iteration

##### **Requirement R.1.1.4 & R.1.1.5 - Social viewing should be facilitated, either:**

- *R.1.1.4 - 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).*

The HMD display is automatically linked to individual viewing as people tend to talk to each other when watching content with other people. The use of headphones is not really compliant with this social viewing experience.

*Tom: I'm not certain it always has to be with audio. If we are watching together, we talk about the programs and give our opinion. If you would look around and have no interaction with your family members anymore, this would make it very individual. I would prefer to have the audio of the TV if you're with a group of people”.*

The image of a family all using HMD is not something that is realistic at this moment in time. Respondents feel this is rather awkward and it is also rather expensive to buy multiple HMD.

- *R.1.1.5 - by offering a more social VR experience by adding avatars or representations of other VR users in the content*

The fact that you see no other VR users in your VR experience is also something that makes it a solitary experience. A social setting in which users could imagine using HMD is a remote use case, in which they would watch a program together with family members or friends at a

distant location. Then of course there would have to be a way to interact with other VR viewers. The use of avatars or a real-life representation of the users would then be beneficial.

Also in the content examples that are discussed below, for example in the news enhancement, the representation of and interaction with virtual friends and family in the VR world was mentioned. This should not necessarily be a spoken interaction, also a non-verbal interaction with gestures would be sufficient.

### 3.1.5.2. Second iteration

In this workshop, requirement 1.1.5 (offering a more social viewing experience by adding avatars or representation of other VR users in the content) was considered one of the main opportunities of VR experiences. In this group, a lot of potential was seen in **created social experiences**, in which people with similar interests could watch content together in VR and interact with others. Examples here were a debate on the US elections that was broadcasted in VR and in which the audience could interact with each other in VR via avatar representations. Other examples were experiencing a movie in VR with friends that lived miles away. Participants agreed that this could be a good **alternative for the loss of real-life social interactions**, which they see as an inevitable effect of the HMD, as this leads to a form of isolation.

However, the use of **avatars** would not only be useful for distant VR experiences. It might also be part of a planned social activity with family members or friends.

*Simon, age 28: "It is also an activity that you will probably actively choose to do and then it might be more fun to share this with family or friends. That everyone has a HMD and watches a movie together or plays a game. You can also do this on a tablet, than it's less isolated. I don't think it will completely be asocial, it's a choice you can make for yourself."*

The social setting might also have an **influence on the selected device**. One of the respondents expects that the company and the availability of the HMD will influence his choice for a specific device:

*Ken, age 22: "I think it will depend on whether you're in a group or not. If you're in a group and not everyone has a HMD, that you would take the tablet because otherwise it's asocial, but if everyone has a HMD, that you would use that"*

## 3.2. Synchronised content across devices

In this section we address the different aspects related to the multi-device scenario in which content is synchronised across different devices.

### 3.2.1. Switching between devices

#### 3.2.1.1. First iteration

**Requirement R.1.1.6 - the number of VR interactions should be limited in order to limit the burden of switching devices while watching.**

The idea of having short fragments integrated in the content, would mean that you would have to put the glasses on and off several times during the program. For some this is ok, others would prefer using a Smartphone for that reason. Important is of course the added value of

the content. It is not something they would do for every program, there should be a clear added value. It would also be something they would probably not use every day, but for example once or twice per week, for specific selected programs.

*Els: "I think with the glasses, if you really have to switch them on and off all the time that it will become something that is only used for 1 program every week. In the beginning you would probably use it more often, but after a month? We are very lazy when it comes to TV- viewing. I think it requires some effort to put the glasses on and off 5 times in a row."*

*Dan: "Maybe the look of the glasses will also change. It doesn't always have to be this heavy thing. Maybe in a couple of years it looks very different."*

### 3.2.1.2. Second iteration

#### Requirement R.1.2.2 – Create sequences that are long enough to make the switching of the devices worthwhile

In the second workshop, respondents agreed that the number of VR interactions should be limited, but they were also worried about the duration of the interactions. The offered interactions should at least take **more than a couple of minutes**, to make the experience worthwhile. The option to interact should also be indicated on the TV-screen well in time, so people don't miss the interaction. This is particularly relevant in live scenarios, where it is more difficult to pause or rewind the content than in offline content scenarios.

*Sara, age 20: "When they say on TV: now there is a VR interaction moment, it can only work if it is for a longer duration. Not for one minute, because then you are probably too late when you are putting on and off your glasses, It should at least be for like 10 minutes or something."*

#### Requirement R.1.2.3 - offer the option to preview the VR on a smartphone or tablet

There was an agreement that the HMD offers a better experience compared to the tablet. The fact that you are really in the image when you are wearing the HMD, the 3D effect compared to the 2D effect on the tablet, the difference in perspective and height and the experience of being more immersed in the content, lead to a clear **preference for the HMD to watch VR content**. Of course the content has to be relevant, which leads to the suggestion of the respondents to use other mobile devices such as the smartphone and the tablet to **preview the VR option**. This way they can decide whether the VR content is sufficiently attractive and relevant to use the HMD. This of course also indicates that while they consider the HMD more enjoyable, they also see it as taking more effort to use it compared to the tablet.

## 3.2.2. Integration with regular viewing experience

### 3.2.2.1. First iteration

#### Requirement R.1.1.7 - avoid distraction from the storytelling

Respondents also reflected on **how this would fit in their viewing experience at home**. Walking around could be dangerous, because you could bump into certain objects. If you are seated, you have to be able to look around 360°, so you almost need a chair on wheels to be able to fully make use of the omnidirectional image. Although it is of course also expected that

no one would be constantly turning to look around all the time, this is also not what we do in real life.

Some respondents question their involvement with the content, they feel they might become too **distracted** by the visual content so they might not hear what is said anymore, for example in the news or in a documentary, when you would be able to look around.

*'Dan, age 61: "You don't realise what is being said anymore. You are looking to what is happening in 360°. You have to be careful that you don't lose a part of your story".*

This is also the reason why respondents expect that it will not be a continuous experience, but that you would have **shorter intermediate fragments** in which people would be able to look around in VR. This would be like fixed break-out sessions within the program in which people could start looking around.

### 3.2.2.2. Second iteration

In the second iteration, this was foremost linked to requirement 1.19, here it was expected that people might lose track of the storyline if switching between devices takes too much time. This should be avoided.

## 3.2.3. Length of fragments and integration in the content

### 3.2.3.1. First iteration

#### Requirement R.1.1.8 - think in terms of short fragments to integrate in the program flow

Particularly in the first developed examples, it is interesting to see that in most of the formats short fragments are integrated.

*Rien: "It is interesting to see that in many of the concepts short fragments are used. This might also be the power of VR".*

Dan also questions whether it would be possible to keep a longer program such as a political documentary interesting for 25 minutes when it's fully in VR. He also thinks it will be shorter fragments that are shown in between.

So most participants expect that it will be shorter VR fragments or moments that are integrated in a regular TV-show. In the discussion they also talked about how this integration would work. Some mentioned that there would for example be a regular channel and a **separate VR channel** and that the program was broadcasted on both channels, one for viewers who want to watch the program without any VR and the other one for the VR enhancement.

Another problem would be the **linearity of the program**. If you would for example allow for a VR break in the program, but one person is finished after 1 minute and the other wants to look around longer, how do you cope with that? How would the linear story proceed in that case? Having these VR moments also means that programs will last longer than they do now, which is also something to take into account.

### 3.2.3.2. Second iteration

This is also closely linked to requirement 1.19. While in the first sessions, respondents agreed that shorter fragments are the way to go, in this group they were foremost worried about the **effort the switching of devices** takes. Therefore they would go for longer fragments of at least a couple of minutes and the content fragments should also be sufficiently relevant.

In terms of linearity, programs with a different duration might be an option. Of course this is only possible for non-live programs, **for live content** it is important that viewers **keep the regular pace of the broadcast**.

*Simon, age 28: "I can imagine that you would have programs in which viewers have to do assignments. It can be programs that follow the pace of the viewer. Some people would do it (the assignment) in 20 minutes, others in 40 minutes for example."*

### 3.3. Interactive VR experience

#### 3.3.1. Camera position, viewing perspective and navigation

##### 3.3.1.1. First iteration

###### Requirement R.1.1.9 - the user should be able to zoom in and out

Some respondents mentioned they felt as if being too close to the image while experiencing some of the demo content. This had as an effect that they felt uncomfortable while trying to grasp the scene, they constantly had to turn their head from left to right to get an overview of what was happening. **Being able to zoom in and out** is a necessity in this case. It would also make the experience more interactive.

*Dan, age 61: "I constantly had to look from left to right to see what happened. I had the feeling I was too close to the image."*

###### Requirement R.1.1.10 - the camera standpoint should be adapted to the position or the viewpoint of the user. Eye height is recommended in several cases.

In the first workshop, most users experienced the content standing, in the second workshop most users were seated while watching the demos. This led to some differences in how the content was experienced.

In the second workshop where most people experienced the content while being seated, they often complained about the perspective. This is very important as in the ImmersiaTV use cases, we envision an audience that is seated in their living room and thus consumes the content from a different perspective.

*Joe, age 30: "I've seen the Music for Life<sup>6</sup> demo and what I noticed was that the camera was positioned so high. If I looked between the camera and the audience, that zone, there was really a hole, you really looked into the deep. It would have been better if the camera would be positioned on eye-height of the audience."*

*Els, age 27: "The proportions seem to fit better if you are standing... I think it is easier for your brain if you are standing."*

###### Requirement R.1.1.11 - different perspectives or positions should be possible. Users should be able to select their preferred viewpoint.

One of the questions was, assume that you would have a format like a football game, how would you want to decide where you would want to look? Here it becomes clear that this is

---

<sup>6</sup>Benefit concert of music group Sigma in De Schorre (Boom), for a charity purpose, in December 2015. Link: <https://www.youtube.com/watch?v=opnLc-J3qHs>



also closely linked to the content. In the example of football, the idea is mimicking being there, on an actual seat in the stadium and being able to look around without any limitations.

*Tim, age 39: "I think that this is an example where there can be no direction at all, where you really want to have the experience as, coming as closely as possible to the idea of I bought a seat in the football stadium and I'm just looking around. I think that needs to be the first step".*

On the other hand, there is also the need for a **"god-figure approach"**

*Amanda, age 28: "But also that you would have a kind of god figure. Because that is VR, you can also play a bit like God, because you can also fly. You're not just in the stadium, you can also fly or stand in the middle of the field"*

In this discussion, the idea of multiple viewpoints that can be selected emerged.

*Tim, age 39: "What would be great is that you would be able to look through the eyes of the players.*

*Amanda, age 28: "Or be the ball"*

In the examples users give, the being **in someone's shoes perspective** often pops up. For example, being able to view things from the viewpoint of someone else. In that case it is also important to be able to see the feet and hands of the person, to make it a more realistic experience.

### **Requirement R.1.1.12 - users should be able to choose when to change perspective themselves, or the transition should go more natural and not interrupt the experience**

Related to navigation and switching of perspective, was a comment related to the Music for Life demo<sup>7</sup>. In this demo, there was some changing of the viewer perspective. The image automatically jumped to another viewpoint. This was something that wasn't really appreciated by the users, as it interrupted their viewing experience. Also the stitching was not seamless, which made it even more intrusive.

*Rob, age 56: "I didn't like the cutting. I expected that I would be able to continuously select my viewpoint myself. But now it was cut and I didn't ask for this, I was watching this so don't interrupt me.*

*Sarah, age 27: "Yes you should be able to choose from which viewpoint you want to watch, but not the constant switching."*

#### **3.3.1.2. Second iteration**

In the second iteration, the aforementioned requirements were confirmed. The perspective was seen as one of the main benefits of a VR-experience, so the right **perspective** (eye-height) is crucial. Also the selection of different viewpoints was considered a positive affordance. One of the respondents already experienced a content fragment from the perspective of the main character and found this a very positive experience.

*Ken, age 22: "Everything is also maximised when you are in the image. I've seen something about football from the perspective of the ball boy. You really see what he sees when he looks to the left and to the right. If you see it on TV, you see people on the field, but here it was really from his perspective, and it felt much bigger".*

---

<sup>7</sup> Benefit concert of music group Sigma in De Schorre (Boom), for a charity purpose, in December 2015. Link: <https://www.youtube.com/watch?v=opnLc-J3qHs>

### 3.3.2. User wants to be in control

#### 3.3.2.1. First iteration

##### Requirement R.1.1.13 - Give control to the user

Respondents in the focus group really liked the idea of being in control themselves, being able to **decide for themselves what and where to watch**. They like the idea of **viewer as director**.

*“Lisa, age 21: “Normally if you watch an image, it is always the person behind the camera that decides what you see. And with the VR glasses, you can really decide for yourself, no I don’t want to watch there, I prefer to take a look over there. That you have the feeling that you are not pushed in your viewing experience, but that you can take the lead yourself.”*

*Amanda, age 28: “I also like the idea of viewer as director, because even though I have for example nothing with football, I can imagine that for some people that like to watch football, it is interesting to be able to say: I would like to see how that trainer is doing or I want to take a look at the bench. That you can really decide for yourself I now want to see this or that. That really sounds cool for a sports experience.”*

Of course it is important to keep in mind that even though users clearly say they want to be in control, this is not necessarily always the case in every situation. Sometimes a limited level of control is already sufficient, for example being able to look freely around in an image, but at fixed moments in time that are selected by the storytellers. So there should be a balance in the level of control that is given to the user and that is given to the director or storyteller. Here there will probably also be an important difference in terms of live versus non-live content. This is something to further explore in the next phases of the research.

##### **Level of control: user vs. director**

##### Requirement R.1.1.14 - 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.

When users would look around in a certain image, it is possible that something interesting happens elsewhere in the image. For example, in a football game, there might be an interesting action that you might not want to miss. For some users it is essential that they would be directed and receive a kind of notification of where to look in case something interesting happens. There should be a way to keep the overview at all time.

*John: “You should be able to keep the overview, you need to have a choice, you can now go over there. But you still need to keep the overview. There might be a goal”.*

For others this is not the case, they see it is a risk, it is also something that happens in real life if you look into the wrong direction and it is part of a natural viewing experience.

*Amanda, age 28: “Yes, but that is the risk, it is also possible in real life that you look into the wrong direction. It is about making choices; you cannot watch two things simultaneously”*

A suggested solution by the users is that you **build in an option**, where viewers give permission to the directors to turn your viewpoint to where the action is (for example if you are watching the bench and there is a goal). Then they would be certain that they could look around in a relaxed manner, without having to fear they would miss out on something. But this should be optional, to give users the opportunity to fully keep in control if they want to.

Here we noticed in **important difference for live content compared to offline content**. In offline content it would make a lot more sense to implement or to make use of pauses in the program to offer viewers the option to look around or to explore.

### 3.3.2.2. Second iteration

Particularly for live content, requirement 1.14 was confirmed. The viewers should get the choice to be directed to certain events or to freely look around. For Sara for example, being able to take over control is an essential part of the VR experience:

*Sara, age 20: "They (the directors) cannot decide everything, because then it is what it is now on TV and then the concept of VR gets a bit lost".*

#### **Requirement 1.2.4. - offer the option to replay certain parts in VR during and after the live broadcast**

For live content, the **fear of missing out** is certainly an issue. The idea of being able to select for yourself what you would like to see, is not always possible in a live setting, because you will miss part of the simultaneous action. One possible option is to have multiple VR streams, each from a different perspective. For example in cycling, viewers could choose to follow the stream that features their favorite cyclist. Another option is to explore events after the live broadcast. For example in live news reporting, viewers might be willing to take a look at the location of the event after the live reporting as well. This idea was also integrated in one of the developed formats (see infra).

### 3.3.3. Follow the action: make use of triggers

#### 3.3.3.1. First iteration

#### **Requirement R.1.1.15 - natural triggers should provide anchor points to the user of where to watch or what content to explore**

Related to the fear of missing out on something is the idea of providing **some anchor points** for the user so he or she always knows where to watch. This can be an automatic tracking of the ball and an indication of where in your view (to the left or to the right) the ball is at any moment in time. This could also be the case in action content, that you would be able to know where the action is. Although here this is also seen as the role of the content creator, to be able to draw viewers to where the action is.

*"Tim, age 39: "I was also thinking, if you would have an action movie in 360°, then it would be cool if you could always see where the action is. But that is of course the art, that you are able to pull people towards the action. I think that is the difficulty, if you have the freedom to watch, in the meantime you might have missed out on the action".*

Other examples of possible triggers would be if you are watching together with other VR users and you would be able to see them, that they would also be able to point you in a certain direction.

Also **audio cues** might be a good natural way to trigger people to look in a certain direction.

The concept of **portals** was also demonstrated via an example and discussed in the workshops. One of the respondents, Rien already had an experience with a VR tour in a house for sale

where they applied a similar concept to go from one room to another. She thought this was very useful in this context, but she questions whether this will be this easy in every situation.

Portals are also considered a good trigger to point the user in a certain direction, so they know, you can now go there.

Important when using triggers is that they **not interrupt the VR experience** by being too out of line with the content. Therefore, it is essential that the portals are integrated as natural as possible in the content.

*Amanda: "audio is always good as this is a typical natural cue. Also visual things, but they cannot break with the visual experience"*

*Ludo: "I also have the feeling that certain signals will break with the story. I think it will be weird when you're in that world and you suddenly see something flashing. It should be something natural."*

*Amanda: "For example that a certain type of bird would fly by and that that is your cue to look somewhere. Or a balloon that flies, it should be something natural, not a button that suddenly emerges."*

*Rien: "Also in the example of the VR news demo, the news anchor pointed to the weather presenter and you were automatically taken to the weather presenter, I thought that was a good transition".*

*Ludo: "You actually need a kind of VR director, someone that based on your interests points out: hey did you notice that?"*

### 3.3.3.2. Second iteration

The type of clues was not discussed in the second phase.

## 3.3.4. Haptic feedback

### 3.3.4.1. First iteration

**Requirement R.1.1.16 - add haptic feedback to the experience, to make it even more tangible for users.**

Watching VR is also considered a physical experience. People actually believe that objects will bump into them or that they can touch it. At the moment this is not the case, but some haptic feedback would be a useful addition to the experience, making it even more interactive and engaging.

*Amanda, age 28: "I think it is a very physical experience. I remember the first time I tried it at home, I never sat still, while when I'm watching TV I'm always sitting still. Now you try to even get closer to the thing, you try to grasp it. It's not that you actually feel something physical, but you can imagine yourself. So it would be even more interesting if there would be some kind of haptic feedback experience with vibrations or something. That would make it even more valuable for me."*

*Tim, age 39: "What I miss is a kind of deep motion, a kind of kinect, that you would be able to see your own hands. This would give a completely different feeling, than you would not feel displaced. It would be good if you would also be able to see your hands."*

*Lisa, age 21: "Certainly to interact. I think there is already this kind of glove with pressure so you have the feeling that you are really touching something."*

### 3.3.4.2. Second iteration

Also in the second phase, haptic feedback was seen as bringing an additional dimension to the experience. Being able to touch and feel things for yourself was considered as the optimal experience. This is also very useful in the interactions with other avatars in a VR environment, because then also gestures could be used to interact.

## 3.3.5. Gaming element as interactive feature

### 3.3.5.1. First iteration

One of the respondents would like to have a HMD at home, but then he would also expect to have a more interactive approach to the content, he would prefer a kind of gaming element.

*Chris, age 27: "I would like to have a HMD, yes. I'm not such a die-hard TV-viewer. It is because I don't like to just sit still and watch. The interactivity appeals to me. And certainly also a gaming aspect."*

### 3.3.5.2. Second iteration

In this workshop, some of the respondents already had experience with VR in gaming, on the Playstation for example. However, they didn't necessarily want to translate the gaming concept to a multi-device TV VR experience. One content example that was provided, was looking for particular cues in a game show, in which viewers would be able to participate in a game in a virtual environment.

## 3.4. Content format requirements

In this section we will discuss the different content formats for which omnidirectional content formats are deemed best suited according to the respondents.

### 3.4.1. For which types of content or programmes is omnidirectional content best suited?

#### 3.4.1.1. First iteration

##### **Requirement R.1.1.17 – Adapt the content to the viewer.**

The offered content should have a clear added value for the user in terms of personal interest or originality of the content.

Some demos were evaluated more positive than others, so the content itself is really important, even for short experiences in a demo. This is of course linked to personal interest, but also to seeing things you could otherwise not experience.

*Rien, age 25: "I think if it is something you normally cannot see. I've seen a Jurassic World movie in which a dino suddenly emerged in front of me. You know that it is not real, normally you never see something like this happening. So things that you would normally not be able to see."*

While this is a rather extreme example in terms of things you could otherwise not experience, other examples like watching behind the screens in a concert, seeing a set of a soap opera, take a look in the dressing room at a football game are also examples of being in places you would normally not be able to see. Also distant or remote locations were mentioned as possible interesting content to explore.

In the discussion with the users, the importance of the content was stressed a lot. **Users will only make use of VR when it is content that interests them.** This is often the case when it links close to their **personal interests** (for example sports and travel), or when it allows them to **see something they would otherwise not be able to see for themselves** (for example take a look in a refugee camp).

Below we will discuss the **different content genres** that were mentioned in the first part of the conversation. The different format examples the users created themselves and the feedback on the professional format examples are discussed in the next section.

1) *Sports: it's all about being there (presence)*

Football is an obvious example, but also cycling was often mentioned. In football the main attraction of VR is that you would be able to experience the atmosphere of the stadium. Just as in a real stadium, you would be able to look around to the other supporters, the trainers, the players, etc. You could even go one step further and explore parts of the stadium you would normally not be able to see, for example the players' tunnel and the dressing rooms.

In cycling, TV-viewers now often pause certain scenes to be able to take a look into the environment, or to watch certain phases in more detail. Here being able to watch the cycling game from different viewpoints was mentioned and also further elaborated in one of the user format examples.

2) *Documentaries*

Typical nature documentaries, but also destinations abroad are typically mentioned as interesting VR experiences. Being able to experience certain things as you're there on the first row, nature scenes, cities, but also war zones. This would increase the viewers' empathy, as now a lot of these events are experienced as something that happens far away from here.

3) *Game shows*

Game shows in which viewers can also look for certain hints, etc. would also be an interesting format, because it would allow users to do more than simple viewing, you would be able to become part of the game.

4) *Fiction and human interest*

This is a dubious category, as some say that it would not work in content like this where images are really used to tell the story. In human-interest programs for example, every shot is shown for a reason, the program maker will probably not want to give away the control over the narrative.

Others could imagine the integration of VR in fiction such as soaps for example, where users would be able to experience the content from another perspective or to take a look around in the image. Even though they realise that the typical sets of a fiction series are not made to look around in 360°. For outdoor location it might be an interesting addition. Nevertheless, it would not be something for the daily episodes, but for special events, such as a season finale.

#### 5) *Travel programs*

In travel programs it might be a good opportunity to be able to discover certain regions.

#### 6) *Children programs*

A final category that was mentioned is kids programs, for example practical chemistry experiments or something. It would be a safe way to let them experience this for themselves. Also interactive games would be nice for children.

### 3.4.1.2. Second iteration

#### Requirement R1.2.5. - offer unfiltered reality in live content scenarios

Since this workshop focused more on live events, the discussed examples were also live broadcasted content. Although also documentaries, movies and game shows were mentioned as possible formats. Below we describe the three live formats that were mentioned in the discussion. Of course it all depends on what is offered in the VR content (type of content and type of interaction) that will determine whether it is considered a worthwhile experience. Specific for live content is that respondents expect to have **the unfiltered reality**. They expect to have full control of what they see. An example they gave was that in football games, now streakers on the field are filtered, but that would not be possible in VR. A main difference with pre-recorded content is that it is less easy to insert certain cues in the content. So they expect less interactive options, such as for example gaming elements.

#### 1) *Sports programs*

A typical live category are live sports. Here football, cycling and motocross were mentioned as possible formats to watch in VR. The main benefit here would be to experience the game as if you were there (for example as part of the audience) or see it from the perspective of your favourite athlete (for example in cycling). The social aspect of sports experiences was also stressed and should be translated in the VR experiences.

#### 2) *News and current affairs*

In news and current affairs, the main benefit is being able to access places you would not be able to access otherwise. For example, being on the location of a live event (e.g. US presidential debate) and being able to look around and interact with other people with similar interests was considered a benefit.

#### 3) *Unique once in a lifetime events*

In this category respondents referred to experiencing certain events such as an astronaut mission to Mars. By enabling a VR experience, complete nations could experience this type of unique events.

### 3.4.2. Examples: outcome of content ideation exercise

#### 3.4.2.1. First iteration

As part of the content ideation exercise, end-users paired up in teams of 2 or 3 to develop their own concept for a content format in which VR could be implemented. The assignment was to think about a program format that they would enjoy watching themselves. They were asked to reflect both about the content and the context.

The developed concepts are described below. Each of the two end-user workshops led to some specific concepts that are presented below. In parallel of the end-user workshops, also in the two professional user workshops some concepts were defined. These are explained in D2.2.

**Workshop 1:**

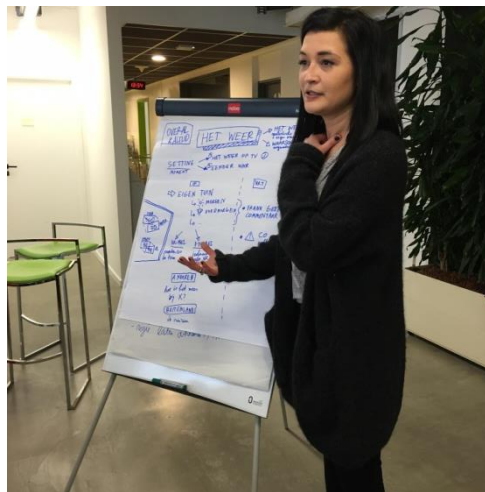


Figure 4: Weather in a new jacket

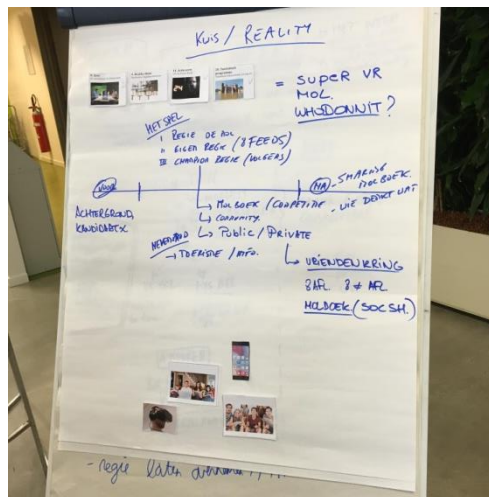


Figure 5: Game show De Mol





Figure 6: Temptation Island



Figure 7: The news

### 1) Weather in a new jacket

In this idea users would have an app in which they could put on their VR glasses and **experience the weather forecast as if they were standing in their own garden**. For example, if they would ask to see the weather of tomorrow, they would see rain in their garden. It would also work for other locations (for example travel destinations). Other types of information such as on CO<sub>2</sub> and air pollution could also be visually represented in the system. The advantage of the system would be that it is more local and very realistic.

### 2) Game show – ‘De Mol’

A popular TV format that is aired in Belgium at the moment is “De Mol” (Who is the Mole). It is a program about 10 candidates that have to do assignments to earn money. One of the candidates is the Mole and his or her goal is to make the assignments fail. The other candidates need to unmask the mole. Also the viewers at home don’t know who it is and try to find out his or her identity.

The program is a mix of a quiz, a reality show and an action series. In the second developed idea, this program is placed central. There would be the option to provide viewers with information before the program starts, for example additional information about the candidates. **Then you would be able to choose between different ways to watch the program.** A first option is that every candidate would have a 360° camera on his head and that you would be able to watch through the eyes of the candidate that you are following. You could also have an option that other viewers could **direct their own TV-episode** making use of these different camera streams. This could be part of a kind of **community**, for example a group of friends and everyone is able to direct one of the episodes and share this with the others.

### 3) Temptation Island

Another reality show that is aired in Belgium is Temptation Island. This is a program in which 5 couples test their relationship. The couples are separated and placed with a bunch of bachelors on an island. The TV-show focuses on how the couples interact with the bachelors.

The idea that was developed during the brainstorm was a novel way to make use of the **commercial breaks** in between the program. The idea is to integrate VR in the commercial break in which viewers could spy on the island. They would for example be able to look around in the rooms of the participants, or even follow an additional couple that is only there in the VR stream.

In this format you would still see the regular TV-show on the TV-screen, but during the break you would put on your HMD to interact with the additional content.

### 4) The news

The idea in this format is that informative fragments could be **represented as realistically as possible**, to provide the viewers with new experiences. This is possible for news, but also for documentaries for example. Lately there is some criticism on how media frame certain events on TV. This would be a way to let viewers take a look for themselves, without only having to rely on the director.

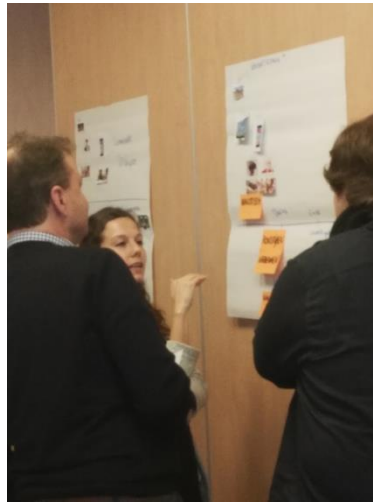
Linked to the idea is a **personalised news profile** based on your personal interests. The concept could work as follows, you would see regular news items passing by and you would be able to bookmark them via an interactive menu in your glasses. You could then use the portal to go to the additional related content, based on your own interests. You could be on the place of the action, for example in a refugee camp.

There would also be a **social aspect**, if you would be able to look around together with others and also see them in the VR world. This could be with audio communication, but also with non-verbal communication, that you would see for example your friends' avatars and that you could wave to them and interact with them in this way.

In the discussion the users thought that this would indeed generate more impact of news items, as you would be able to really experience the situation by yourself. However, some users thought it was a bit strange that you would be standing there as the western guy or girl with your VR glasses, looking at all the misery around you.

The transition from one item to another would make use of the portal idea, that you could switch to another item or that you would consume related content for an item.

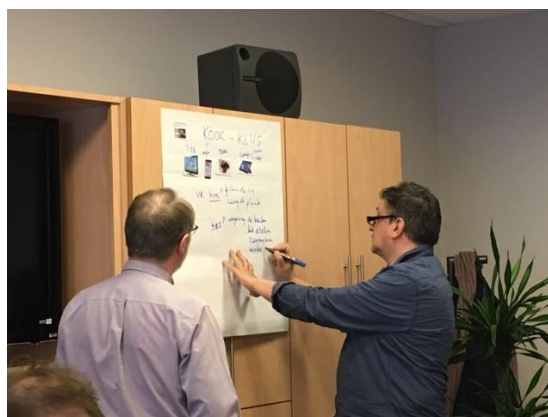
**Workshop 2:**



**Figure 8:** travel program



**Figure 9:** Football



**Figure 10:** Cooking and hobby program



Figure 11: Cycling

#### 1) Travel program

In this idea, an additional layer is added to a travel program. The starting point would be the program on TV, in which you would have your smartphone at hand to check Twitter or Facebook. And then you would have **moments in the program in which you would be able to look around**. If you would do this alone, you would use your HMD, but with others you would use the cheaper option (Google cardboard), because then it is easier to still talk to your friends and because the presenters of this concept also consider it less important to have good quality when you're with friends because they believe it is not an ideal viewing experience anyway.

**The VR intermezzos would be limited to maximum 2 minutes and a maximum of 3 VR moments within 1 program of half an hour.** The presenter would first give some explanations about a certain area and then you would be able to explore this, based on your preferences. As some viewers prefer nature, others city scenes, they would have the choice in what they would want to explore further. The aim is to make people curious about the location and make them travel there in real life. There would also be the option to add an interactive element in the end, for example a quiz question on the content, in which people could win a price.

#### 2) Football

This idea focuses on football. You would have the option **to watch certain phases from different viewpoints and look into certain details**. And also after the game you would be able to see certain phases of the match in replay, that you would be able to select them from a menu. You would also be able to receive additional information, zoom in on certain players, and see more than you would normally be able to see.

#### 3) Cooking and hobby programs

In this concept the idea was that in certain cooking or hobby programs you would be able to **zoom in on certain procedures** and see over the shoulders of the chef or the handyman to experience how it is done.

#### 4) Cycling

In this idea the cycling game would start with a poll. Then people could vote which cyclist would be followed. You would also have the panoramic images in VR, as a lot of people now watch cycling (for example tour de France) for the nice images of the area. You would also be

able to provide backstage images or images from inside the VIP-tent. The **viewpoint could also be shifted** from the reported on the motorcycle to the helicopter and back. A question they have themselves with this concept is which kind of comments you would include in this experience. The regular comment or a version that is also adapted to the viewpoint you are selecting, for example if you want to focus more on a certain team.

#### ***Lessons learned from the content ideation exercise***

The content ideation exercise was a valuable exercise as it forced the participants to think about relevant formats for themselves and integration of these formats in their personal viewing experience.

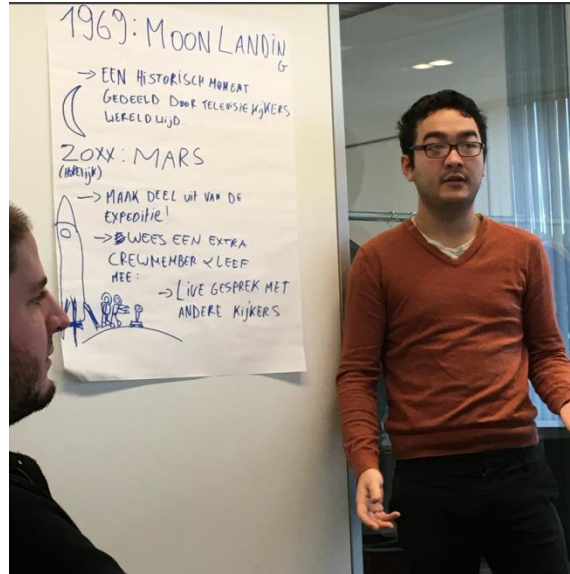
##### *Common aspects of the examples:*

- Most of the examples relate to short fragments in VR. Being able to look around as part of a travel program, have additional VR content during the break of the program, check out a certain procedure in VR... It is clear from these examples that **viewers see the VR experience most suited for short fragments, maximum a couple of minutes**. Only for sports it would also be relevant to watch the full game in 360°.
- In most examples the **HMD** was seen as the preferred device for the experience.
- The **social aspect is very important**. In some concepts the participants reflected on how they would be able to experience this as a group (for example with google cardboards instead of HMD to keep the group contact during the exercise) but also on how the social aspect could be inserted in the virtual experience (for example a virtual representation of family and friends in the VR experience).
- The main device in the examples is still the **TV-screen**. This is the screen on which the main program is displayed. HMD and tablets, smartphones are considered as secondary devices in the experience.
- The **content** they refer to in the examples is news and documentaries, sports, lifestyle programs (related to travel, cooking programs) and reality shows.
- The specific purpose of the VR experience is to have additional **information**, to watch behind the scenes or to **explore** places or situations in **real-life**, as if you were there.
- In the examples, **control** was balanced between the viewer and the director or storyteller of the program. In the cycling example, people would be able to vote for a certain viewpoint, but the choice of viewpoints would not be unlimited, in the travel example people would be able to look around, but only in those scenes that are chosen by the director.

#### **3.4.2.2. Second iteration**

In this workshop, respondents were asked to reflect on the options for specific **live events**. Since at the time of the workshop, the scenario of the live pilot was not yet decided, they were free to choose a format, the only requirement was that it was a live broadcasted program. Three program formats were developed.

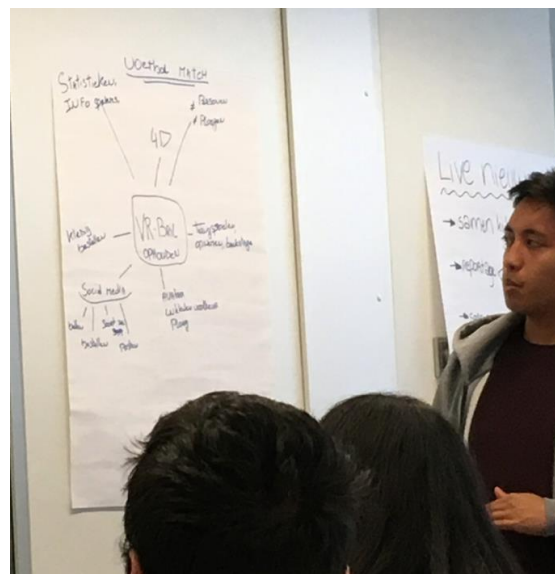
- 1) Mission to Mars



**Figure 12: Mission to Mars**

In this format, viewers would be able to be part of an expedition to Mars as a crew member. The idea is to be able to step on Mars together with the complete mankind. You would be able to look around during the mission, interact with other viewers and get all types of information on the mission. Real-time interaction with the crew members would not be possible because of the delay, but viewers could send in questions that would then be answered. The astronauts would speak directly to the 360° cameras, giving them a presenter role. On the TV-set, people would see the directed image, by the broadcaster. On the HMD, people would be able to freely look around in the image and to interact with other viewers. This format would also be usable for other types of events such as expeditions and documentaries. It all evolves around the idea of being somewhere you could never be in real life.

2) Football match



**Figure 13: Football game**

In this format, the workshop participants developed an interaction uniquely for the HMD. They feared they would miss out on something if they would combine it with the regular TV-experience. They would use the VR to experience the game from different perspectives, but also to look into additional information on the players and the game (e.g. statistics etc.). In this format, viewers would also be represented as avatars, wearing a shirt of their favourite team. They would also have the option to order a shirt of their favourite player for example. An interesting addition in this format is the link with social media. Since every VR experience is unique, they would foresee the option to record a screenshot or video of their VR experience and share this on social media. During the break, they would be able to interact with other VR supporters in the VR bar.

### 3) Live news



Figure 14: Live news

In this format, a personalised news broadcast was developed in which viewers would have two options. A first option is to watch the news together, but focus on different items depending on your specific interest. A second option was to go back to certain events after the live broadcast. For example, what is happening at this moment at the scene of the bomb attack at Brussels airport, so people would be able to follow the event also after the live reporting. The wish to explore additional content of course depends on the type of item. If it's something political, viewers might be less inclined to watch VR content.

#### ***Lessons learned from the content ideation for live content***

- The **fear of missing out** in live content was certainly present. In the football example, this even led to the fact that respondents want to keep their HMD on during the game, in order not to miss anything while switching.

- The social aspect was present in all the examples. A virtual representation of the audience is present in all the examples. Also the interaction with other supporters, other people with similar interests, was considered a must.
- The interaction with social networks was quite unique in the examples. All respondents agreed that this was a nice addition to the football format.
- In contrast to the previous examples, here VR experiences were used for longer content fragments.
- The HMD was presented as the preferred device. The tablet would be useful to preview the interaction.
- In the live scenario, respondents expect full control over the content. They want to be able to watch the live content unfiltered. They should be able to choose for themselves whether they want some form of direction or not.
- All examples relate to a form of presence, actually being there, where the action is

## 4. OVERVIEW OF USER REQUIREMENTS

---

*Overview of end- user requirements – first iteration (M3):*

	<b>Requirement</b>	<b>Description</b>
R.1.1.1	<b>Avoid physical discomfort in the experience</b>	<i>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.</i>
R. 1.1.2.	<b>Enable users to control their surroundings while watching VR content</b>	<i>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.</i>
R.1.1.3	<b>Ensure a perfect image quality</b>	<i>Ensure a perfect image quality for all VR content that is used in the demos and pilots.</i>
R.1.1.4	<b>Allow physical social viewing</b>	<i>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).</i>
R.1.1.5	<b>Allow virtual social viewing</b>	<i>By offering a more social VR experience by adding avatars or representations of other</i>



		<i>VR users in the content.</i>
R.1.1.6	<b>Limit the number of VR interactions</b>	<i>The number of VR interaction should be limited in order to limit the burden of switching devices while watching.</i>
R.1.1.7	<b>Avoid distraction from the storytelling</b>	<i>The VR interaction should not completely distract viewers from the storytelling.</i>
R.1.1.8	<b>Think about short VR fragments</b>	<i>Viewers seem to prefer short VR fragments (couple of minutes) and a maximum of 3-4 interactions/program.</i>
R.1.1.9	<b>Allow interactivity by zooming in and out</b>	<i>The user should be able to zoom in and out.</i>
R.1.1.10	<b>Adapt camera standpoint to the viewpoint</b>	<i>The camera standpoint should be adapted to the position or the viewpoint of the user. Eye height is recommended in several cases.</i>
R.1.1.11	<b>Allow navigation to select viewpoint</b>	<i>Different perspectives or positions should be possible. Users should be able to select their preferred viewpoint.</i>
R.1.1.12	<b>Give users control over camera perspective</b>	<i>Users should be able to choose when to change perspective themselves, or the transition should go more natural and not interrupt the experience.</i>
R.1.1.13	<b>Give control to the user</b>	<i>Viewers would like to select their own viewpoint (viewer as director).</i>
R.1.1.14	<b>Balance the viewer vs. director control</b>	<i>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.</i>
R.1.1.15	<b>Insert natural triggers</b>	<i>Natural triggers should provide anchor points to the user of where to watch or what content to explore.</i>
R.1.1.16	<b>Insert haptic feedback</b>	<i>Add haptic feedback to the experience, to make it even more tangible for users.</i>
R.1.1.17	<b>Adapt content to viewer</b>	<i>The offered content should have a clear added value for the user in terms of personal interest or originality of the content.</i>

*Overview of end-user requirements (second iteration) – M10*

R.1.2.1	<b>Inform people about health risks</b>	<i>Viewers have questions about health risks related to VR experiences and should be informed about them.</i>
R.1.2.2	<b>Create sequences that are long enough to make the switching between devices worthwhile</b>	<i>The length of the VR experiences should be sufficient to make the switching of the devices worthwhile.</i>
R.1.2.3	<b>Offer the option to preview the VR on a smartphone or tablet</b>	<i>The tablet or smartphone could be used for viewers to check whether the VR content is worthwhile, as a kind of preview.</i>
R.1.2.4	<b>Offer the option to replay certain parts in VR during and after the live broadcast</b>	<i>In live content, the fear of missing out could be countered by offering the option to replay content fragments during and after the broadcast.</i>
R.1.2.5	<b>Offer unfiltered reality in live content scenarios</b>	<i>In live scenarios, viewers should be able to experience the unfiltered reality, meaning live images without restrictions.</i>

## 5. REFERENCES

---

1. Sleeswijk Visser, F., Stappers, P.J., van der Lugt, R., Sanders, E.B.-N. (2005) Contextmapping: Experiences from practice. CoDesign: International Journal of CoCreation in Design and Arts, 1(2), 119–149. (Version of document available at: <https://isfcolombia.uniandes.edu.co/images/documentos/contextmapping.pdf>).

## 6. ANNEX I – DETAILED WORKSHOP OUTLINE AND PLANNING

---

### Part A. INTRODUCTION

#### 1) Intro & demo – 15 minutes

##### Informed consent

- The project scope and aim of the workshop is briefly explained
- Participants present themselves briefly (name, age, occupation, possible previous experience with VR)
- Participants can experience some VR examples:
  1. “I’m there experience”- for example formula 1 go pro
  2. Game, CGI, animation, created world
  3. Real production: Verse - clouds over sydra, heptatonic
  4. TV: demonstration portal (for example Music for live event) -> basic idea of portal, without interaction, showing there is another screen available
  5. An example of video with portals, if available already, would help a lot to focus the discussion (portal example VRT news studio (but not user-driven, but it does show the portal idea)
  6. An example of multi-platform content

#### 2) First feedback on VR experiences (= cR.1.rent situation) (25 min)

- Based on the examples they experienced, respondents will give their first reactions on the experience. This will be recorded on tape and summarised on a flipchart by the moderator.
- Respondents will first reflect their ideas, then the moderator will ask fR.1.ther on specific aspects:
  - Main opportunities and barriers they identified
  - Evaluation of HMD? (cardboard?) (+ how does it feel to watch TV with a HMD?)
  - For which type of content they see this best suited (from their own personal preferences and experiences)
  - What makes this experience unique to them?
  - What specific opportunities do they see for futR.1.e TV-experiences?
  - Willingness to pay/ pricing (devices, cR.1.rent available content)

### PART B: IDEA GENERATION AND FORMAT

#### 1) *Design of the experience – content ideation exercise* (= futR.1.e situation) (20 minutes)

In teams of 2, end-users will be asked to create their own ideal futR.1.e TV-experience.

They will receive a blank poster and an inspiration kit including different pictR.1.es (people watching TV in different settings), different genres, timeline (how would they map out their program in time, when do they foresee which interaction), stickers they can use,...

They will be guided to reflect on the content and the context (where, how, with whom,...)



Figure 15: Inspiration kit for the content ideation exercise

## 2) Presentation of the experience (20 minutes)

- The duos will present their designs to each other, they can also ask each other questions

## 3) Discussion (40 minutes)

This discussion builds further on the concepts they presented themselves. Important is also to look into whether they selected a specific social setting, a specific genre etc.

Questions that can be included:

- What do viewers see as the main opportunities for VR? (perceived usefulness)
- What do viewers see as the main barriers for VR?  
(- single viewer <-> multiple viewers? How does this change the viewing experience?)
- Implications for multitasking?
- usability (ease of use, navigation, HMD in combination with glasses, putting on and putting off the HMD,..)
- How do users see the interplay between TV, VR and mobile devices? (based on specific examples)
- How would this create a more engaging experience for them
- How do they evaluate the portal concept? Depending on whether they integrated it in their experiences or not: why did they integrate it, why not? How do they see this fitted in their future TV-experiences?
- How long should the VR interactions last,

- *How do they feel about switching between different devices,*
- *What kind of cues do they want to receive (-> also linked to the examples they provided themselves to make it very specific)*
- *How much control do they want and how much should still be in the hands of the director, in terms of storytelling (also linked to their own examples),..*

#### PART C: DISCUSSION END-USERS AND PROFESSIONAL USERS (30 minutes)

For this part of the workshop, the professional users and the end-users are gathered around the table.

First the moderators of the end-user workshop briefly present some of the main findings of the end-user workshop: what were the main opportunities and barriers they identified, how was the portal concept evaluated etc.

Then the professional users present their concepts to the end-users. The end-users can ask questions and there is a discussion on the developed concepts. In the discussion, we will focus on the professionals' view on the user (what kind of user experience and user expectations did they have in mind for their developed concept) and how users evaluate this.