

LinkedTV News: designing a second
screen companion for web-enriched
news broadcasts

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GENERAL SUMMARY

LinkedTV (linkedtv.eu) is a European research project that explores how to integrate television content with Web content in meaningful ways through the use of semantic relations for automatically generating links.

This report describes the process of design and evaluation of *LinkedTV News*, a second screen companion for interacting with hyperlinked television in the domain of newscasts.

Our primary goal was to obtain knowledge about potential users of LinkedTV's technology regarding their information needs and an indication of the reception that this technology could have among them.

We performed two initial studies: a focus group and a series of interviews with 19 participants. These allowed us to identify our target group, context of use and requirements with which we created the concept of the application.

The design of the application was refined through a series of design iterations and a hi-fi prototype was produced.

After creating the *LinkedTV News* prototype, we evaluated it with a task-based study performed with 8 participants of the initial studies who matched the target profile closely.

The main characteristics of *LinkedTV News* are:

- It runs on a tablet PC.
- It targets users between 25 and 45 years of age; highly-educated; who like to be up to date about the international news; watch news broadcasts regularly; and own a tablet computer or share it with someone in their household.
- It proposes the integration of two activities that are related by subject, but currently often take place through different devices and at different times namely, watching TV newscasts and consulting online newspapers and videos.
- It allows synchronous as well as asynchronous interaction with the television (interacting with the application while watching TV as well as bookmarking news and postponing their in-depth exploration).
- It offers two interaction modes represented by two main screens: lean back and lean forward.
- The lean back mode presents condensed information related to the objects, places, persons, and events in the news continuously in the form of slides (a paragraph of text illustrated by an image). This mode is automatic and requires no user interaction, although interaction is possible if desired.
- The lean forward mode enables in-depth exploration of each news headline in the categories: different sources; opinions of different authors; in-depth articles; timeline; and from the point of view of geo-localized tweets.

We showed that *LinkedTV News* succeeds in fulfilling many of the user needs and requirements identified in the preliminary studies.

Overall, there seems to be interest from users in a hypermedia solution for the news that integrates online newspapers and video with television broadcasts.

The hi-fi prototype served as a tool for illustrating and sharing a future vision of hyperlinked broadcast news within and outside the LinkedTV project group.

We recommend testing the application with a different and larger group of users. If the study proves successful, we recommend considering the production of a service represented by *LinkedTV News* as a commercial application of the LinkedTV technology.

EXPLORATION RESULTS

- We performed a context analysis by means of two initial studies: a focus group and a series of interviews through which we identified main information needs of users who consume television newscasts regularly as well as their current habits and motivations with respect to news consumption in general (Section 3).
- We defined our target group, context of use and requirements taking into account the findings of the studies performed (section 4).
- We designed *LinkedTV News*, a second screen companion aimed for interacting with hyperlinked television in the domain of the television newscasts that integrates the activity of watching television newscasts with reading online newspapers or watching online video (Section 5).
- We evaluated the initial design using low fidelity prototypes and refined the design in subsequent iterations (Section 5.2).
- We produced a hi-fi functional prototype illustrating the look and feel of the application and simulating its functionalities. The prototype functioned as a tool for evaluating the application as well as a communication device within the LinkedTV project team (Section 7.1).
- We provided the prototype with contents taken from real news sources equivalent to 124 news articles intended to enrich an 8 minute mockup news broadcast (Section 7.1).
- We validated, through a task-based study, the ability of the application to fulfill the user requirements found in our initial study (Section 7.2).
- We obtained user evaluations of the application regarding perceived usefulness, ease of use, learnability and satisfaction with the interface (Sections 7.6.1 to 7.6.3).
- We obtained suggestions for the improvement of LinkedTV News in subsequent design iterations (Section 7.6.9).
- We specified actions to improve the usability of the interface (Section 7.6.10).
- We provided guidelines for future work and a further analysis of the role of a second screen in dealing with the challenges inherent to supporting hyperlinked broadcast video (Section 10).

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1 GENERAL INTRODUCTION

This report describes the process of design and evaluation of *LinkedTV News*, a second screen companion aimed for interacting with hyperlinked television in the domain of the television newscasts.

The motivation of the project is two-fold: to analyze the user's information needs in relation to hyperlinked broadcast video in the context of the news; and to investigate the role that a second screen could have in dealing with some of the challenges that emerge from the interaction with hyperlinked broadcast video.

Desired outcomes of the project are:

- to obtain knowledge about potential users of LinkedTV's technology regarding their information needs and an indication of the reception that this technology could have among them;
- to extract initial design guidelines for future work within LinkedTV and in the field of second screen interfaces for web-enriched television newscasts;
- to create a high-fidelity prototype to facilitate communicating a future vision of hyperlinked broadcast news.

1.1 Project context

The hypertext paradigm has been applied to written sources of information successfully for several decades. The possibility to reference and access diverse sources of information from within each other seems to be highly compatible with human thought, which is nonlinear and full of digressions. However, the media equivalent, hypermedia, is a promise not yet fulfilled. Hypermedia has been pursued as an extension of the hypertext approach towards video information, but its use is still not widespread.

The project LinkedTV¹ (Television Linked to the Web) provides a technological approach to this vision of future networked media. The main goal of LinkedTV is to seamlessly connect Web content with television content, so that they become interrelated through meaningful automatically generated links.

Technologically, this vision requires systems to be able to link audio-visual information at different granularities, with other textual or audio-visual information, in such a way that it becomes easily searchable and accessible. The process that LinkedTV uses for achieving this goal relies on automatic analysis and classification of objects depicted or mentioned in video content to drive semantic linking of external information sources. This requires preprocessing with automated techniques (such as speech detection, speech transcription, named entity recognition and disambiguation, and semantic linking).

An important objective of the LinkedTV project in its second year was to understand the requirements of potential users of Linked TV's technology, which up until this point had been mainly driven by technology concerns.

The *Linked TV News* application was created with this in mind not as a final product, but as a dialogue initiator between the LinkedTV technologies and users, and as a tool for research. It was guided and constrained by the LinkedTV project goals, but not limited by the current development of its technology.

1.2 Information needs in the context of the news

The genre choice of the project *LinkedTV News* corresponds to one of the LinkedTV project's use cases. It was chosen over the alternative use case, a cultural heritage related scenario, because of the reasons indicated below.

¹ <http://www.linkedtv.eu>

- The standard format of news broadcasts facilitates the adaptation of one interface to multiple programs with minimal modifications.
- The fragmented pace of news stories doesn't require continued attention to follow a story line (therefore allowing more opportunities for attention shifts).
- It requires no preservation of the suspension of disbelief (which would potentially be affected by second screen interruptions).
- Its informative nature lends itself to presentation of additional content, which is the focus of LinkedTV.
- Information about the news appears daily in diverse media formats, providing richness and variety to the hypermedia experience.

1.3 Challenges of Web-enriched broadcast video and the role of a second screen

Hyperlinked broadcast video implies combining content intended for a lean-forward medium (the Web) with a lean-back one (TV). It offers the advantage of providing smooth access to additional information associated with objects depicted or mentioned in the video. However, it also poses new challenges and motivates new requirements from the point of view of user system interaction.

Two challenges for supporting hypermedia are [1]:

- Tension between lean-forward content and lean-back consumption.
- Tension between multiple and single users.

We design *LinkedTV News* as a second screen interface, such as a smart phone or a tablet, used together with a main TV screen to investigate whether a second screen is useful for dealing with these challenges.

1.4 Method and structure of the report

Due to the user focused nature of the proposed research, we addressed the design of the intended interface, *LinkedTV News*, using a commonly employed user centered and iterative design model, namely that described in the international standard ISO 9241-210.

After an initial planning stage, iterative processes usually start by researching the context of use of the design product. From the results of this context research, requirements are extracted and design solutions are produced, Figure 1. Prototypes of diverse degrees of fidelity are created to illustrate these solutions and evaluated until the user requirements are met.

We follow this iterative design process structure. After a brief view of what could be considered related work (Section 2), we describe the method, process and results of two studies aimed at gaining knowledge about users and their requirements (Section 3), we define our target group, context of use and requirements (Section 4). We propose a design concept to satisfy a subset of these requirements

(Section 5). The interaction design and the process of improvement of the concept through prototyping are then explained (Section 5.3). Section 6 describes the user evaluation of the high fidelity prototype, and concludes by proposing a direction for future improvements. In the conclusion, the results obtained are briefly analyzed and guidelines for future work are proposed (Section 7).

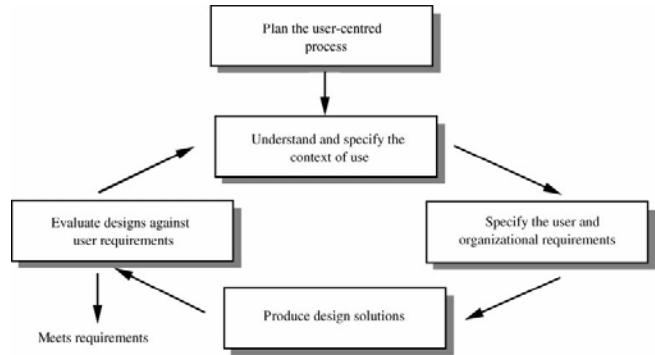


Figure 1 User Centred Design Cycle [19]

2 OVERVIEW OF RELATED WORK

2.1 Enhanced interactive news

Interactive news is a subject that has been researched as a use case in various studies concerned with hypermedia and information retrieval. In 1997, Hauptmann and Witbeck [2] presented News-on-Demand, an application that monitors news from TV, radio and text sources and allows the user to retrieve stories of interest. News-on-Demand employed speech and image recognition techniques for scene segmentation and automatic tagging of archival data. The interface was also based on speech recognition and the accuracy of this technology constituted the focus of the study's user evaluations. News-on-Demand can be seen as an early example of hypermedia and automatic linking to the topic of the news.

Another example of content augmentation of news broadcasts is the work of Dowman et al. [3]. Their system identifies individual stories in news broadcasts and annotates them with content from the World Wide Web. Annotations are used to produce summarized texts that can be employed potentially for enrichment of electronic programme guides. The focus of Dowman's study is the technology that enables annotation. It presents an interface aimed for the postproduction (curating and editing) phase of the enriched hypermedia. This work relates to *LinkedTV News* in its integration of television newscasts with Web content. However it differs in that *LinkedTV News* is concerned with news consumption and not news postproduction.

Ardissimo et al. [4] investigated personalization in the context of interactive news broadcasts through tracking and

inferring user content interests and media preferences. The authors describe the design and implementation of a broadcast news generator. This system combines automated video understanding and extraction together with user modeling to provide individualized *personalcasts*. We coincide with this work in that personalization should be an important ingredient in any an end-user hyperlinked news interface.

MyNewsMyWay, Lindstedt et al. [5], is a system for nonlinear and interactive news broadcasts with an emphasis on the user needs. With the intention of recreating the television experience that users are most acquainted with, MyNewsMyWay uses the remote control as input device and displays the system interface on a TV screen. A similar remote control, single screen set up was produced and evaluated by Olsen et al. [6] to enable users to access opinions over stories headlines, skip back and forth over stories and select stories from a playlist.

On of Lindstedt and Olsen's motivations to use the remote control for interacting with the news is the users' familiarity with this device [5]. It is reasonable to think that basing new technologies in old habits, such as the use of a remote control along with the TV, will promote a smooth adoption of these technologies. However, we believe that the remote control capabilities are too limited and don't meet the demands of Web enriched broadcast video in terms of interaction. Moreover, remote controls usually depend on TV screen overlays of hierarchical menus that may disrupt the TV viewing experience. We propose to take advantage of other more recent familiarity and more current habits: the familiarity of users with mobile devices and the recent habit of mobile multitasking. With this motivation, we would like to explore the role of a dual screen set-up (TV plus laptop, tablet or smartphone) in the delivery of Web enriched broadcast news.

2.2 Second screen

The use of mobile devices by viewers alongside TV is a typical behavior according to recent studies of users' habits. The Razorfish and Yahoo! survey [10], for example, found that mobile multitasking during TV watching is common practice among 80% of the 3000 participants. The idea of replacing these currently disconnected multitasking activities with integrated interaction through the coupling between the second screen and the TV screen has motivated various design driven research studies.

In [11] a prototype of a second screen web application running on a laptop was distributed to 11 households and evaluated for three weeks. Basapur et al. found that the adoption of second screen systems is facilitated by their resemblance to current behavior patterns inasmuch as they are perceived as natural extensions of these behaviors. They showed that users value the effortless information gathering and felt more connected with their TV shows through experiencing them with a second screen. They also found that the experience promoted engagement with the program

even after it was over by inspiring outside activities (e.g. attending a certain movie recommended by the system) and enriching sociality around TV (expanding the circle of friends with whom information is shared).

Prompting and control strategies for secondary devices were explored in [12] participants in this study showed a clear preference for a separation between content and control. They agreed that TV content belongs in the primary screen and activities demanding interaction in the secondary device.

The employment of secondary devices for control of TV content was also explored in [12], where four major usages of the secondary screen in interactive television are identified and discussed: control, enrich, share and transfer television content.

Second screen multitasking is a growing practice that has triggered the interest of industry and stimulated the proliferation of commercial applications for dual device set-ups. One of the best known examples is Yahoo's IntoNow [15]. IntoNow uses audio fingerprinting technology to automatically detect the program that users are watching and deliver related contents. Like many of its kind, IntoNow is mainly focused on delivering the experience of "social TV". It detects what friends are watching and connects them so that they can chat about the show.

LinkedTV News investigates the use of a second screen application as a companion to the newscast, with a focus on user information needs rather than the social aspects of interconnected TV viewing.

3 UNDERSTANDING THE CONTEXT OF USE

In order to gain understanding of users' current habits and requirements in relation to the news broadcasts and news consume in general, we conducted a focus group and a series of semi structured interviews. This activities relate to the first step "understand and specify context of use" in Figure 1 about user centred design cycles.

3.1 Focus group

We used an exploratory approach combined with a feature prioritization approach [16]. The exploratory approach was aimed at discerning general attitudes on TV news watching and relation of the users with the news in general, focusing on finding the user's information needs. The feature prioritization approach was aimed at determining the features that users would find important to have in the application and the reason for their preferences.

3.1.1 Focus group setting and method

The study took place in an experiment room that recreated an old-fashioned living room environment (Figure 2). The environment was provided with a large television screen, a clock, a center table, a couch and diverse decorative articles. The motivation behind using such a space was to reproduce a setting similar to where participants would most likely watch TV in real life.

Four groups of, in average, three participants were scheduled in four sessions that each lasted 45 minutes. After being welcomed in the living room and given relevant information related to their role in the study, participants were asked to complete a questionnaire on demographics and current news watching habits.



Figure 2 Example of focus group environment

On top of the center table, three stacks of paper were placed with printed mockup frames representing a laptop, a smartphone or a tablet. All the frames had blank space for writing in the center.

Once seated, participants were shown six reports from BBC's One Minute Online World News. The choice of video fragments was made trying to emulate the diversity of news categories included in popular news broadcasts, and was designed after careful observation of the latter. (A list of presented news items is given in appendix A.)

After each fragment, participants were asked to think whether the news piece had elicited any question or if there was any additional information that they would look up in a similar situation in real life. Then they were asked to choose a paper frame according to the device they would most likely employ to find the answer, if any, and write down the information need they had. Information needs were then discussed with the group and the moderator.

Following the news broadcast exercise; participants were asked to take part in a brainstorm session about the functionalities that they imagined would be nice to have in a second screen news companion. Their suggestions were written on a flip-board for the group to see.

Next, each participant was interviewed individually and asked to give his or her vision of how the activity of watching the news would change in the future.

Finally, participants were given a cinema voucher as a "thank you" gift for their help, and accompanied out of the room.

The focus group sessions were recorded on video, which along with the mockup frames containing the participants' notes and the flip-board pages were kept for later analysis. The main researcher, acting as a technical facilitator, and a

second researcher, acting as moderator, conducted the focus groups. A pilot session preceded the four group sessions.

A complete copy of the protocol can be consulted in appendix B.

3.1.2 Focus group participants

We had no requirements for demographic characteristics of the target group, because the product was unprecedented. Therefore we started with a diverse sample hoping that a secondary effect of the study would be to collect information that would be useful to further refine what the target audience should be. However, a necessary condition for participants to be included in the group was that they were regular viewers of news broadcasts.

The recruiting took place at a university and a research center. To ensure a range of participants representative of potential users, participants that were neither students nor researchers were included.

Eleven participants were selected. The mean age of participants was 43 with a standard deviation of 11.5 due to the inclusion of some young students.

According to PEW's 2010 Media Consumption Survey spectators of this age group consume in average more television news than younger audiences[17]. We wanted to investigate if these habitual consumers of television news would also be a good target audience for a news related application.

The population was gender balanced including 6 female and 5 male participants. All participants are residents of the Netherlands. Four of the participants live alone, two live with one other person; one lives with two other people; and the remaining four live with three more.

3.1.3 Data obtained from the focus group

The following were obtained from the focus group:

- Filled in demographics and user habits questionnaires
- Mockup frames with notes
- Brainstorm functionality lists on flip-board pages
- Video recordings of the participants discussion

The filled in demographic questionnaires were analyzed and averaged in quantitative terms. The rest of the material was brought together and then remarks and quotes were extracted and grouped according to similarity. Each group of quotes was given a descriptive name or code summarizing the subject of its contents. The groups were then categorized under the following broad headings:

- Information needs
- Actions triggered by information needs
- Sources currently used
- Desires functionalities and personalization preferences
- Perceptions about television and newscasts

3.1.4 Findings of the focus group and implications for the design of an interactive news companion

In this section findings obtained from the focus group are presented. The first subsection is dedicated to the questionnaire results (qualitative data), followed by the findings of the focus group discussions and brainstorming. The latter are divided according to the headings described in section 3.1.3 (above) and used for coding. Each finding is followed by possible related implications. To clearly denote the implications, they have been enclosed in tables.

3.1.4.1 Focus group questionnaire results

Devices owned and preferred

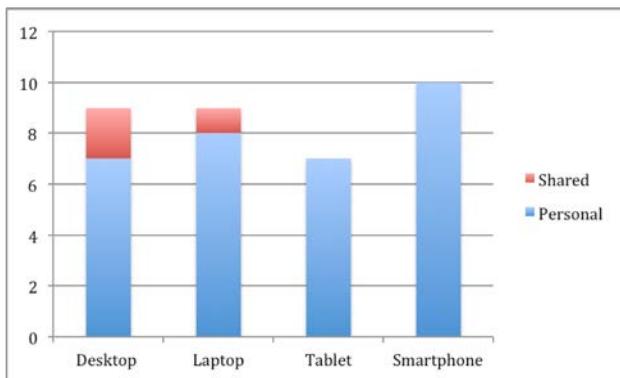


Figure 3 Shared and personal devices used by participant

Although smartphones are the devices that users most frequently own, when it comes to searching for additional information about the news while watching TV, half of the participants preferred laptops and half tablets. This corresponds to the findings of *Nielsen Connected Devices Study Q2 2012* [18], which suggest that second screen multitasking with smartphones is a practice of users 18-24 years old while older audiences prefer other devices.

Tablets and laptops would be the preferred devices to design for when designing a second screen companion for watching the news.

Location and time

9/11 participants watch the news in the evening and sitting in a living room.

Chances are that users will watch the news sitting on a couch, and therefore in a relaxing environment and that, if a table is present, it will not be at an adequate level to offer typing support. Most likely, users will be holding the device on their lap. This suggests that a tablet is a more suitable device than a laptop.

Social interaction

6/11 participants watch the news in the company of other people. 5/6 interact with their companions while they watch.

A second screen companion for watching the news should be able to adapt to group television watching as well as solitary television watching.

Multitasking

4/11 participants eat or drink while watching the news.

6/8 participants perform second screen multitasking (email reading and Internet browsing) while watching the news. (The remaining 3 participants didn't answer the question.)

A second screen companion should allow diverse levels of engagement in order to accommodate some of the tasks that people perform concurrently to watching newscasts. It should ideally have a “hands-free” mode to allow people to continue interacting with the application while eating or performing tasks that are unrelated to the use of the device.

The fact that some users are already employing their mobile devices to browse the Internet or check their email while watching the news indicates that there is an existing behavior that can allow a smoother adoption of second screen applications.

3.1.4.2 Focus group discussions and brainstorming results

Information needs

The following information needs were identified through the coding of the focus group transcriptions. Quotes have been included with the purpose of illustrating each need and the number of the participant who expressed it is indicated with a “P”. These information needs are the ones more frequently mentioned. A more comprehensive list of focus group findings is included in appendix C.

- Need for more in depth specific information.**
(11 comments / 7 participants + 1 brainstorm list)

P6 About the bird flu - *I was wondering just how expensive it is to make all those vaccines, you know? I was just wondering if it is a good idea to even make a lot of it or how hard it is to make.*

- Would like an overview of related events that occurred in the past.**
(5 comments / 3 participants + 1 brainstorm list)

P7 About North Korea's state of war - *my search would be something like "South Korea state of war ramp up" (...) I would like to know, what happened two years ago and how they solved it...*

- Search for different opinions.**
(3 comments / 3 participants + 1 brainstorm list)

P7 About North Korea's state of War - *I'd start with Wikipedia, probably, and then I always look at AP and Al Jazeera to get two different opinions...*

- Information about how this ends, updates when important changes occur**

(3 comments / 3 participants + 1 brainstorm list)

P8 About "Human parents for a baby gorilla" - *I would like to know if the story succeeded, if the gorilla was saved ...*

- **Local effect of global news – What is the impact in my life?**

(4 comments / 2 participants + 2 comments in 1 brainstorm list)

P1 About the bird flu - *Yes then I would look it up, what is the effect in the Netherlands... (of the bird flu virus)*

People have complex information needs that can't always be transparently traced back to a named entity (in LinkedTV the name of a location, person or organization). It is important to identify some of the most usual information needs and try to model the application's functionalities and the semantic linking accordingly.

Actions triggered by information needs

Different kinds of information trigger different actions. For example, the information about the weather may trigger warning a friend about the rain or comparing the weather in two locations while information about the cinema may stimulate users to buy tickets for the movies. However, in this study the overwhelming majority of times, the action that users executed in order to look for the answer to a given doubt or question was to look it up in a search engine.

We recommend looking at the tasks related to searching information on a search engine as some of the tasks that may be integrated and simplified or improved in the second screen interactive news companion.

Sources currently used

Although some sources, such as Wikipedia, seem to be very often consulted, different questions or information types are best answered by different sources. For example, participants mentioned using Buienradar for finding out about the weather or Pathé when they wanted to look for information about movies currently showing. Also, users typically have their set of preferred sources.

It would be advisable to have a certain flexibility or degree of personalization in terms of the sources of information included in the application.

Functionalities mentioned during the brainstorm sessions

Users seemed to expect a second screen application to include extended remote control functionalities, and one of the most frequently mentioned desires with regard the application was to be able to skip the part of the news that they don't like or go back to what they think is interesting. Other functionalities like bookmarking, electronic transactions, getting alerts or sharing information that are possibly inspired on the Internet, were also mentioned, although more sparingly.

In order to comply with user's expectation and to simplify television control, a second screen companion should include video control capabilities as one of its basic features. The possibility of adding of other Web related features should also be studied.

Perceptions about television and newscasts

Some users may be reluctant to adopt a technology that will require them to be active during TV watching, because they considered this activity as mainly relaxing.

Integrating different levels of engagement through the second screen, including some that are almost linear (not interactive), could be a strategy to promote smooth adoption.

Some users may be missing more interaction in TV. TV may be perceived as outdated because it is less flexible than other "newer" media.

Interactive applications for TV may help change the perception of television as outdated.

3.1.5 Study Limitations (focus group)

The focus group served as a general view on people's current habits while watching the video news broadcasts. It also gave an indication about what kind of additional information people would like to have while watching the news. However, some aspects were detected that could have been improved in favor of the flow of the discussion with the participants. The first one is the language. The focus group was held in English, and the news program shown was also in English. Although most Dutch people are fluent speaking it, apparently some members of our group of participants were not completely comfortable watching British television without subtitles. There was also room for improvement regarding the subject of the news. International news, used in the study, is not interesting for all audiences. Some of the members of the focus group had strong preference for national and local newscasts.

3.2 Interviews

Parallel to the focus group, a series of semi-structured interviews were conducted and complemented the study. This technique was chosen in order to gain a more individual in-depth view at users' habits and perceptions. The interviews were especially helpful in trying out a more specific target group with a smaller standard deviation within the ages of participants and a more specific profile in terms of skills and relation to the news.

3.2.1 Method of the interviews

The interviews were semi-structured. The same interviewer, the researcher, conducted all of them. They were loosely organized around a 45 items questionnaire. The questionnaire served as a script, but probes, or follow-up questions were improvised depending on the respondent's answers in order to promote a more fluid conversation about the relevant topics.

The main topics of the interview were:

- a. Second screen and multitasking user habits
- b. Habits and social context regarding news broadcasts
- c. Habits when searching for additional information (frequency, tools, processes)
- d. Opinions, suggestions and desires regarding the application and functionalities

Questions related to items b and c were defined in such a way that they could map to what Maguire [19] calls the five context factors: user goals and characteristics, tasks, technical environment, physical environment and social or organizational environment. In other words, what do people want to achieve (when watching the news or looking for additional information), what do they do to achieve it (steps that they currently take to find information), which tools do they use (which software and which devices), what is the setting where they perform these tasks, and what is their situation in social terms (do they perform these activities alone or with company).

An emphasis was made in dealing, not only with how participants relate to newscasts, but also in dealing with how participants relate with the news in general and thus, with other information sources and how these sources relate or differentiate from TV.

The interviews were conducted in an isolated room within the respondents' workplace. They were all digitally recorded with the interviewer's smartphone. The length of the interviews varied from 24 to 45 minutes.

Before starting the interviews, interviewees were asked to fill out a consent form and a demographics questionnaire. Once the interview had concluded the respondents were given a list of functionalities extracted from literature and previous findings to rate in accordance to their perceived usefulness.

3.2.2 Interviews participants

The number of participants interviewed was 8 with a gender distribution of 3 females and 5 males. The mean age of the participants was 33 with a standard deviation 5. All participants were university graduates or postgraduates. All participants were digitally skilled and acquainted with online media and digital technologies as well as mobile devices. All participants were regular viewers of newscasts and declared spending on average 30 minutes daily getting information related to the news through different means.

3.2.3 Interviews data analysis

After concluding all of the interviewing sessions, the eight interviews were transcribed with time code stamping using the software F5. Transcriptions of the interviews were then summarized. Data that could be translated into quantitative terms was translated to those terms. Qualitative data was extracted and grouped according to affinity of the remarks in the following broad categories: attitudes toward media (TV and newspapers) based on habits, desired

functionalities, and personalization. Some individual remarks that could not be clustered were also kept and reported because they are considered relevant to understand the users current habits, and perceptions regarding the news consumption.

3.2.4 Findings of the interviews and implications for the design of an interactive news companion

In this section findings obtained from the interviews are presented. The first subsection is dedicated to the quantitative data results. This subsection is comparable to section 3.1.4.1 about the focus group questionnaire results. It is followed by qualitative data (findings) obtained from the interviews. The latter are divided according to the categories described in section 3.1.3 (above) and used for coding. Each finding is followed by possible related implications. To clearly denote the implications, they have been enclosed in tables. Finally, the list of functionalities ranked by the users during the last part of the interview is presented.

3.2.4.1 Quantitative findings of the interviews related to users' current habits

Devices used by participants, Figure 4.

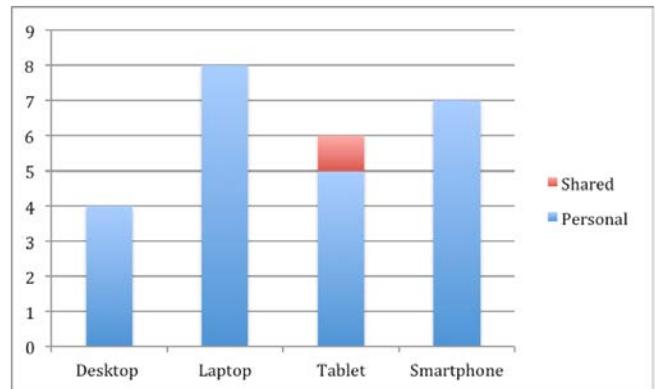


Figure 4 Personal and shared devices used by participants

Location

6/8 participants watch the news in a living room occasionally from the dining table. The remaining 2 watch the news in an office environment and a bedroom.

Social interaction

5/8 participants watch the news accompanied. 5/5 interact with their companions while they watch.

Multitasking

8/8 participants perform second screen multitasking (email reading and Internet browsing) while watching the news.

The interview's quantitative data findings about user's habits when watching the news, do not differ significantly from the findings obtained in the focus group (section 3.1.4.1) and therefore, the same implications apply.

3.2.4.2 Qualitative data obtained from the interviews

The following user perceptions, habits and preferences were identified through the coding of the interview transcriptions. One quote has been included at the end of each group of statements to serve as example. The number of the participant who expressed each quote is indicated with a “P”. This is a selection of the ideas that were more frequently expressed or seemed more relevant to our work. A more comprehensive list of qualitative interview findings and quotes is included in appendix D.

Attitudes toward media (TV and newspapers)

While reading online newspapers and watching TV broadcasts are different ways of consuming the news, these activities are not mutually exclusive. Our contextual research showed that users frequently perform both because they believe that each one of them offers different advantages, for example some users believe that:

- Broadcasts are useful in getting an overview of the news, and online newspapers are good for searching in-depth information about specific news.
- It is possible to be more selective and control time better when you are reading. (P3, P4, P8)
- Watching video news is a social act while newspaper reading is a solitary act (P2).

P2 - *So having the video footage, that you have more in the television news, I think adds value there, and maybe also the fact that you can watch it together, adds value, so when you read the news paper I think that you really read alone.*

Desired Functionalities regarding information

Users asserted that they believe that most media are biased and emphasized the importance of getting a complete factual view on a news topic as opposed to partial or predisposed ones. The strategy that some of them currently use to compensate for bias and to get a comprehensive view of the news is to contrast the news headlines or topics of their interest within different information sources and from the point of view of different people. In this sense, when asked about important functionalities for a second screen news companion, users stated that they would like to:

- be able to compare different opinions about a subject, different scenarios, and different sources (P8, P7);
- access and compare the international view on local news (P2);
- access opinions of locals, regular people, preferably friends that are where the news take place (P8).

P8 - *I think that the German news are still kind of OK, but still, I mean everybody is biased in their opinion, so no matter which news you read you always have some bias. It is good to have different and diverse opinions and first hand information.*

In order to facilitate this contrasting of information within different sources, and in order to fill in general information

gaps some users proposed the integration of the television with other sources such as Wikipedia or online newspapers. (P1, P2, P6)

P5 - *I think, I would expect that you would include like, the main links to what they're talking about like if it was about Hugo Chávez, links to Wikipedia or some articles about him, the country, and stuff like that because I think that's the thing that I would look for myself.*

Personalization

In general users prefer an effortlessly configurable user-controlled personalization that allows adding personal filters to categories or topics and sources. Personalization should not override the importance or diversity of the news. Users don't want to miss important information because of personalization. (P1, P2, P8, P3, P7)

P8 *So, not because in the past I always clicked on a specific news article, I want to have more of these, I would still want to have more diverse angles.*

An integration between media, mainly television newscasts and online newspapers, could be a suitable solution for providing an enriched and hyperlinked news experience because it would incorporate activities that users currently perform potentially simplifying them. Regarding personalization, it should be targeted at preserving users empowerment in making decisions about which media to consult.

Ranking of potential functionalities by interview participants

After the interview had ended, participants were given a list of functionalities and were asked to rank them on the following scale:

1= not useful, 5 = very useful

The results of the ranking match closely the opinions expressed in their during the open questions part of the interview.

The results of their rankings can be found below in Table 1.

3.2.5 Reflections about the interviews

The interviews allowed us to communicate with participants in a one to one basis, which lent itself to personalized explorations into specific habits and beliefs. Interviews were based on people's memories as opposed to the focus group where participants were asked to react on given contents. Therefore, people could more easily relate to the information needs they were expressing in the interview. However, participants may value information differently when confronted with real needs than they do when reflecting upon past needs. Complementing the interviews with more task-based studies such as the focus group but with the same group of participants of the interviews could be useful in comparing and matching participants reflections with their actions.

Only one researcher coded the interviews. In the future, it would be advisable to include more coders to avoid bias.

Functionalities	1	2	3	6	4	5	8	7	Average rating
Access different opinions about a topic in the news	4	4	4	4	3	4	5	5	4.1
Follow news about a particular subject throughout sources	3	5	3	4	5	5	5	1	3.8
Follow a news story throughout time	5	4	2	5	5	3	4	2	3.7
Track what a person said in the past about a certain subject	3	2	5	4	3	4	2	5	3.5
Share news with your friends or colleagues	2	2	4	3	3	5	3	4	3.2
Get more information about people in the news	3	4	1	4	4	4	3.5	1	3.0
Follow what an expert thinks about a topic	2	2	3	3	3	1	5	5	3
Look up archived and past news	2	2	2	4	3	4	3.5	3	2.9
Get an information guide about the program's contents	1	2	3	4	2	4	3	3	2.7
Follow what your friends think about a topic	1	2	4	3	2	1	4	2	2.3

Table 1 Ranking of potential functionalities by interview participants scale: 1=not useful 5= very useful

4 CONCLUSIONS ABOUT CONTEXT: CHOICE OF DEVICE, TARGET USER GROUP, CONTEXT OF USE AND REQUIREMENTS

4.1 Choice of device

The preliminary studies (focus group and interview) indicated that, although smartphones and laptops are the devices that most users own, the preferred devices for second screen multitasking are laptops and tablets (see 3.1.4 and 3.2.4). It was also shown that the setting where people watch the newscasts is mostly in the living room. Although from an distribution point of view, designing for a laptop could seem like the best option (more people own laptops than tablets), from the ergonomic point of view (users are sitting on a couch with the device on their lap) tablets seem to be a better choice. Furthermore, according to PEW's 2013 Tablet ownership report [20], tablet ownership has doubled within the past year and is on the rise. Therefore, developing for this kind of device seems to be a good investment. Finally, we consider that a touch screen based kind of interaction is better suited for second screen multitasking because it requires less focused attention than the mouse and pointer based one. These considerations led us to choose for a tablet as a target device to design *LinkedTV News*.

4.2 Target group

One of the objectives of conducting the preliminary studies was to define the target group for *LinkedTV News*, which was not known in advance due to the novelty of the application. After comparing the results of both context studies, the main target user group was defined as follows:

LinkedTV News is targeted at users between 25 and 45 years of age; highly-educated; who like to be up to date about the international news, watch news broadcasts regularly; and own a tablet computer or share it with someone in their household.

These conditions were defined on the following basis:

Education

According to PEW 2010 Media Survey, the highly educated spend more time with the news: in 2010 in USA an average of 81 minutes daily [17]. In addition, according to their 2013 Tablet ownership report [20], they constitute the group most likely to own a tablet computer compared to adults with lower levels of education.

Age

The age of 25 to 45 years corresponds to the age when users are "technology savvy" but also are most likely to have the financial means to buy the kind of technology in which our application would run (a tablet computer). According to the previously mentioned Tablet ownership report [20], 37% of adults 25-34 and 49% of adults 35-44 own a tablet. This percentage is higher than older and younger audiences.

Interest for the news

LinkedTV News is a tool intended to assess users' information needs regarding the news. It is meant for

people who want in depth information and it is a TV companion. Thus, our target group should be avid news consumers and regular newscasts spectators.

4.3 Context of use

According to sections 3.1.4 and 3.2.4 and the results of the qualitative interviews, the environment where users consume television broadcasts, and, therefore where they will use *LinkedTV News* is the following:

Physical Environment

A living room (home environment) with a couch where users lay or sit possibly in the company of another person (most likely partner) or a pet. Often users are eating or drinking. Occasionally, users sit in front of a dining table. Users also sometimes watch the news in a desktop environment (office or hotel).

Social or organizational environment

Users who live with others will most likely be in their company while they watch TV. Users will likely discuss the topics of the news program with the people they're watching with. Accompanied users tend not to pause or rewind the program even if the technology they use allows them to as opposed to users watching alone.

Users will often multitask while watching TV either alone or in company of others although the latter are more reluctant to multitask.

Technical environment

The preferred device for watching newscasts is television, although, occasionally, PCs, mainly laptops with or without external screens are also used.

4.4 Personas

Based on the ethnographical data obtained during the studies, and in our defined target group, two personas, Gina and Alonso were created as a communication strategy and in order to give a name and a face to our users. Gina was adapted from *LinkedTV*'s deliverable D3.1 [21] While Alonso is a completely new creation. See Appendix E for a description of these personas.

4.5 Scenarios

Scenarios were modeled after the context of use described above. They were written taking into account the characteristics, behaviors and preferences of the users and, therefore, the personas. Their intention was to envision the role of *LinkedTV News* in the persona's environment (current users' environment) in order to extract requirements. See Appendix F for a description of these scenarios.

4.6 User requirements

The second phase of the user centered design methodology, after the analysis and definition of the context design, is the specification of system requirements (Figure 1). This specification is a product of the observation that took place during the first phase and will guide the next phase, the production of design solutions.

Information about users' potential requirements was gathered from the initial exploratory studies (sections 2.1.4 and 3.1.4). Some of them were directly expressed by participants and some of them were deduced as implications of their current practices. Requirements related to information needs were given priority while requirements about social networking or commercial transaction were not always taken into account because they are not within the scope of the LinkedTV project at this stage. The following list of requirements summarizes the findings that serve as constraints and guides for the design of *LinkedTV News*. This list of requirements with an indication of the findings that originated them can be found in Appendix G.

Requirements about information needs

1. Give in depth information about the news on TV
2. Give an overview of past-related news
3. Illustrate a multiplicity of opinions about the news
4. Allow users to consult news in diverse sources
5. Build a link between TV and user's habitual newspapers
6. Update users about important changes in news
7. Give contextual information about setting of the news
8. Give information about people and organizations mentioned in the news
9. Allow to access opinions of locals

General requirements

10. Programmed and designed for running in a tablet PC
11. Automatically synchronized to user's program choice
12. Allow for group or single television watching
13. Enable synchronous and asynchronous modes of interaction (bookmarking)
14. Allow some hands free mode of viewing or interacting
15. VCR capabilities pause, replay, skip
16. Portable
17. Share information through the application
18. Notifications turned on/off on demand

Requirements about personalization

19. User-controlled personalization
20. Easy configurable with a couple of clicks
21. Selection of preferred sources or influence the ranking of sources
22. Selection of preferred categories
23. Personalization does not override the importance of the news

In the next section we will indicate the requirement that motivated each design decision with an "R" enclosed within parenthesis.

5 DESIGN SOLUTIONS

After requirements have been gathered, and the context of use is defined, the next step in the user centred design cycle is to propose design solutions for the intended application, Figure 1. This section describes the design of *Linked TV News* from the point of view of the concept (Section 5.1), the process of refinement of its interface (Section 5.2) the look and feel of its UI (Section 5.3), and the distribution of its contents (Section 5.4).

5.1 *LinkedTV News, the design concept*

LinkedTV News is a second screen application for tablets that acts as a companion to viewers when watching the news broadcasts (R10, R16). Its main goal is to enrich television newscasts by integrating them with other media thus, integrating and concentrating the different activities related to getting informed about the news in one interactive multiple screen, and potentially mobile experience (R5). It is designed to accommodate two viewing modes in terms of interaction: a lean back mode and a lean forward mode.

The lean back mode

In this mode, the application presents the user with summarized additional information about elements of the news, for example, basic information about the location or people involved (R7, R8). This happens in the form of a slideshow with short texts and images that acts as a sort of news ticker to the broadcast appearing in the main screen. It automatically synchronizes with the TV (R11), and requires no action from the user, but allows the user to browse slides, save them or bookmark news for later exploration (R13). This lean back mode of the application intends to be as close as possible to a free hand, and passive experience (R14). The slides are presented without need for user interaction, so the user can relax, share with her company and pay attention only to that which really calls her interest while easily bookmarking her favorite news for later reading (R12). This favors an asynchronous mode of interaction that respects a passive mode of TV watching, and allows postponing the more attention demanding activities by using the TV program as an index for deciding what to explore in a more suitable time.

The lean forward mode

The lean forward mode of the application acts as a hub where the user can access different news sources at different levels of information depth and communicated through different media formats (video, text, audio) This mode offers the following browsing alternatives:

- Follow a news story throughout time (R2).
- Follow news throughout sources (R4).
- Access different opinions about a topic in the news (R3).
- Geo-localized information (common people's remarks, tweets, according to their country of origin) (R9).
- In depth curated information about a subject (R1).

Some simple manual configuration of preferences (personalization) is possible, and the user can choose her favorite news categories and her preferred authors or news sources (R19, R20, R21, R22). The application counts with an alert about important updates in users' bookmarked news and about other relevant events (R6). Alerts can be turned on and off at user's will (R18). The application is loosely linked with social media through geo-localized twitter comments in the "global to local" section, and the possibility to share slides or articles through diverse means like email, Facebook or twitter (R17, R9).

The application *LinkedTV News* synchronizes its content automatically with the television without any action required from the users (R11). It has television remote control functionalities (R15), so it is possible to use it for pausing or browsing the television program as well as for skipping news sections or news stories.

LinkedTV News is different from news aggregators because it is structured around news headlines other than a news category, a source or trends in the news. Every headline can be explored from different levels, in the lean back mode by dissecting the headline in its actors and settings, and in the lean forward mode by showing it from different viewpoints.

Main Assumptions (obtained through the studies conducted)

- TV viewers value the possibility to decide whether to multitask while they watch TV or simply sit and relax.
- TV newscasts viewing is regarded as a potentially social activity, while online newspaper reading is an act best performed individually.
- The television newscasts are useful for the users in that they present a panoramic view about the most important recent happenings, while online newspapers are better suited for in depth information searching.

How LinkedTV News addresses the challenges inherent to supporting hyperlinked media

In the introduction section 1.3 three challenges of web enriched broadcast video are mentioned. *LinkedTV News* addresses the first two of these challenges through the use of a second screen as follows:

- *Tension between lean-forward content and lean-back consumption.* By allowing synchronous as well as asynchronous interaction, through the use of bookmarks, and by including two interaction modes, *LinkedTV News* gives its user freedom to decide about how to distribute their attentive resources and which level of engagement they want to have towards the enrichments of the TV contents. This facilitates a smooth transition that will ease this tension between contents and the habits related to the context and medium where they are consumed (Web contents in a living room – television environment).
- *Tension between multiple and single users.* By presenting enrichments in a second screen, *LinkedTV*

leaves the main screen free from overlays thus keeping the experience of multiple viewers undisrupted. It delivers a personalized version of the TV contents and a personalized experience without directly affecting the shared one. Through the use of bookmarks, users can choose to delay online newspaper reading related to the broadcasted news, for a later more solitary moment and meanwhile enjoy the social experience.

5.2 Prototyping

As part of the iterative design phase of the process, prototypes are created, for communication with the team and stakeholders as well as for initial user testing.

5.2.1 Wireframes

Wireframes were created using balsamiq mockups. The mockups were used in presentations within the different partners. Figure 5 below shows an example.

As a result, the concept and browsing routes were approved and the overall look of the application was given an updated appearance more suitable for tablet browsing.

5.2.2 User testing with screenshots and Paper prototyping

Paper prototypes were produced in In-Design by printing draft version of screenshots of the different sections. These prototypes were informally tested with 4 users who were asked to perform simple tasks: select a slide, swipe a slide, bookmark the current news, share a slide, play pause and browse the video and browse the in depth information.

Although small changes were made after this iteration, the basic navigation metaphors were well understood. However it was hard to reproduce the conditions that happen simultaneously when interacting with moving images and multitasking. These aspects would be much better experienced for evaluation in the functional hi-fi prototype.



Figure 5 Example of Balsamiq wireframes for *LinkedTV News*



Figure 6 The five areas of the *LinkedTV News* lean back mode screen: the menu area (A), the slide navigation or thumb strip area (B), the main slide or information area (C) and the television area (D) *

5.3 LinkedTV News UI design

This section contains detailed descriptions of the UI and interaction design of *LinkedTV News*.

Lean back mode (slideshow screen)

When a user launches *LinkedTV News* and once the application has automatically synced to the chosen program, the first thing that she sees is the lean back screen, Figure 6.

The lean back mode presents bits of information about key elements of the news item in the form of slides, in a similar way to a photo carrousel. The elements of this screen are distributed in 4 main areas: the menu area (A), the slide navigation or thumb strip area (B), the main slide or information area (C) and the television area (D).

At the bottom of the screen, the television area (D) is where the information about the show can be found, for example, the name of the program (1), and the news heading or story

currently being told (2). The TV control (3) is also in that TV area. Moving the slider control or tapping at any point in the line can advance the TV back or forth. The TV can also be paused with the play pause button. The bookmark button (4) is placed inside the TV area to the right of the news heading to indicate that when it is pushed, the whole news heading or episode is bookmarked (Figure 7). The bookmark icon was placed in this corner of the screen in order to facilitate bookmarking with the thumb while holding the tablet with the hands. Thus making it possible users to bookmark without need of looking at the app's screen.

The information is mainly taken from Wikipedia and it corresponds to the first lines (short summary) that is standard in most Wikipedia pages and the facts that appear in the main fact rectangle at the right of the Wikipedia entries. The image frame is intended for displaying an illustration representative of the entity.

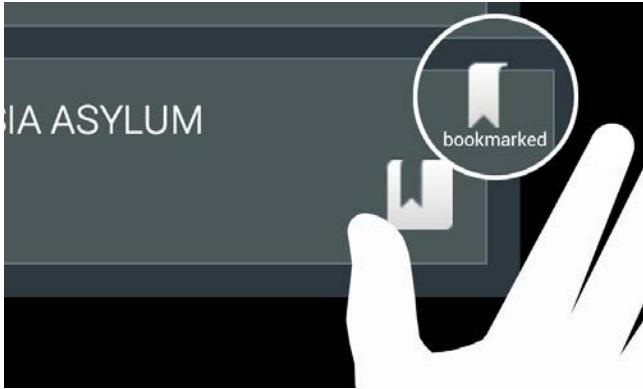


Figure 7 Bookmarking a news story with the thumb

The slides in the carrousel change automatically. The transition between one slide and the next is a horizontal push transition where the new slide “pushes” the old one from right to left and takes its place. It is also possible to browse through the slides manually and this is done either swiping the slides or selecting slides in the thumbnails strip.

The pace at which the slides change depends on the number of slides available and the duration of the news item, and it varies between 12 and 16 seconds. When users select a slide, the slideshow pauses for 15 seconds, and then, if the system senses no activity from the user, the carrousel advances to the slide coinciding with the current moment in the video.

The main slide area contains its own controls at the bottom right of the slide (8). These controls are from left to right: the timer, that shows how much time a slide will be shown in the automatic mode of the slideshow, the pause/play button which can be activated to stop the movements of the slides, the share button, used to access the send email, post in Facebook or tweet options, and the save icon, used for saving the slides within the application.

The thumbnail strip area (B) consists of a series of thumbnails that correspond to all the available entities in the news story or chapter (9). It counts with a marker (10), which indicates the title of the news story that the slides correspond to (usually current story). The thumbnail strip acts as a navigation and selection device, selecting a slide’s thumbnail, advances the carrousel to the point where the corresponding slide is shown. The selected slide is indicated with a blue rectangle (11). The thumbnail strip shows one news story at a time and thumbnails are loaded into it only when the beginning of the story is playing on TV. When a news story has ended, new thumbnails substitute the corresponding thumbnails through a push animation, as in Fig 10. The thumbnails and slides remain in the left section of the thumbnail strip and can be browsed. In other words, it is possible to see slides from past news stories but not future news stories. The navigation and selection in the thumbnail strip happens through swipe and tap motions.



Figure 8 Lean back screen slide selection

The menu area (A) is a bar on the top of the screen. It contains the menu icon (12), the application’s name (13), the date (14), and the settings icon (15).

When tapped, the menu item [Figure 9] displays a contextual menu with the following options:

- Slideshow mode
- Explore current program
- Explored bookmarked news
- Explore saved slides

This menu enables the user to change screens from the lean back mode to the lean forward mode (“slideshow mode” to “explore current program”) and gives access to the bookmarked news and to the saved slides.

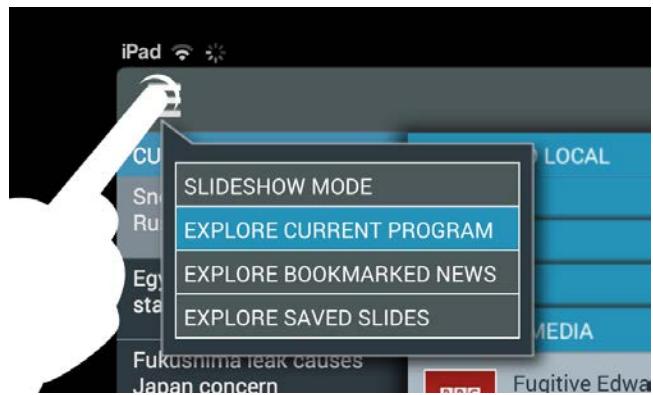


Figure 9 LinkedTV News contextual menu

Lean forward mode (in depth browsing routes)

Figure 10 below shows the Lean Forward mode. Once the user has chosen the option in the menu to browse more in depth information (by selecting “explore current program”) she switches to the lean forward screen from where she can access all of the program’s news through five different browsing routes or in five different sections. The lean forward screen has a standard design through all its sections except from some variations in the “global to local” section, explained in detail later in this report.

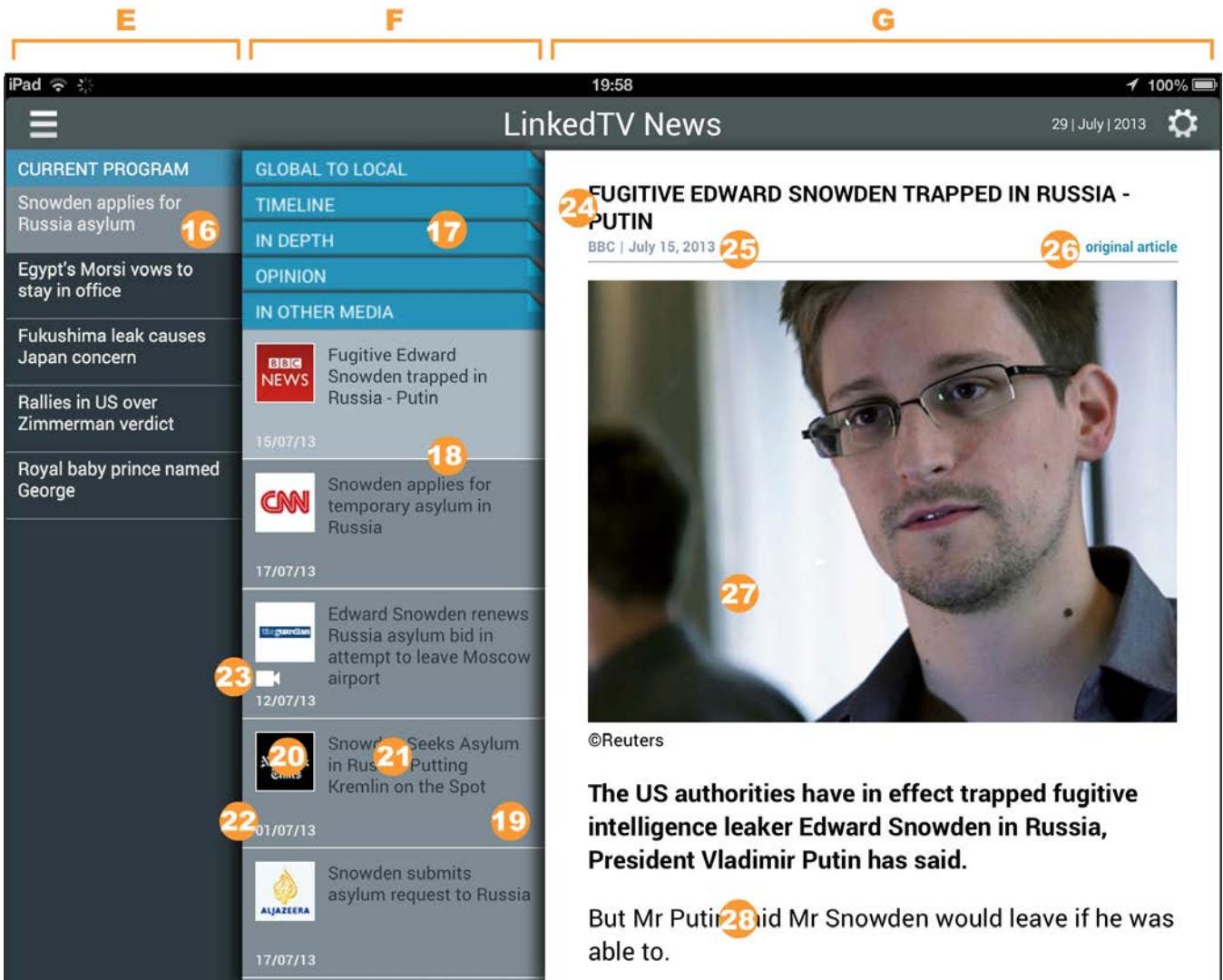


Figure 10 *LinkedTV News* lean forward screen: the news item column E, the article selection column F, and the contents column G

The structure of the lean forward screens is based in a three-column design Figure 10. The left column (E) presents a list of the news headings. When exploring the current program, these headings correspond to the program now playing. When exploring bookmarked news, those headings correspond to the bookmarked news. To select an item of this column the user taps on it. Selected items are highlighted (16). The column contents scroll vertically when needed with a tap and drag gesture.

The center column (F) is formed by two main sub-sections: the menu tabs (17) and the article selection list (18). The menu tabs present the 5 browsing routes. When the user taps on one of the sections, the menu tabs below that section slide down to the bottom of the page to uncover the selected section's article list, Figure 11. When user taps a menu tab that is already at the bottom of the page, the menu tab slides up to show its contents.

The contents of the articles list vary depending on the selected section and the selected news. However, all article cells (19), have a similar basic structure. This structure is composed of a square thumbnail icon representing a person or the logo of a media source (20), a short text (21) (usually containing the name of the article and the author or author's details) a date (22), and a video or audio icon when the contents of the article are in one of those media formats (23). Identical to the news item column, to select an item of this column the user taps on it. Selected items are highlighted. The column contents scroll vertically when needed with a tap and drag gesture.

The third column of the lean forward mode (G) presents the articles and media content. This column has a title area (24) for the name of the article, the date and author of the article (25) and a link to the article in its original source (26). When clicking this link, the external source is opened

within the application. The apps menu remains visible and a “close” button appears to go back to the lean forward screen.

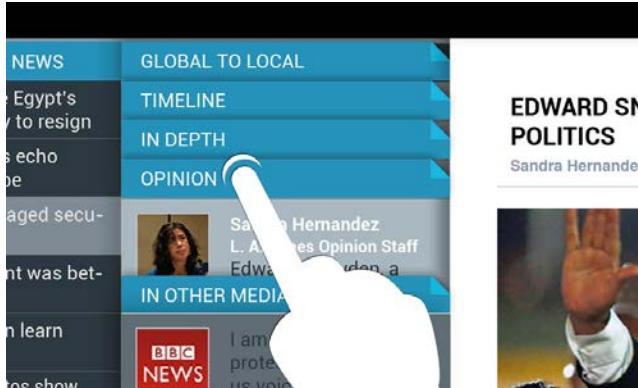


Figure 11 Menu tabs sliding down upon selection through tapping

The articles and media content column also contains an area for the media where video, audio representations, or images illustrating the contents appear (27). This media frame or container has a space for caption text when the caption is available.

When video or audio material is presented in this media container, playing controls appear including an “airplay” button, Figure 12. When the “airplay” button is tapped, a contextual menu offers the option of showing the media content on the main TV screen. Selecting this option (by tapping the TV icon) interrupts the program being shown on the TV and replaces it with the content of the tablet’s media frame. Tapping the button again and selecting the tablet icon, returns the media content to the application’s media frame and the TV returns to the point of the video where it left.

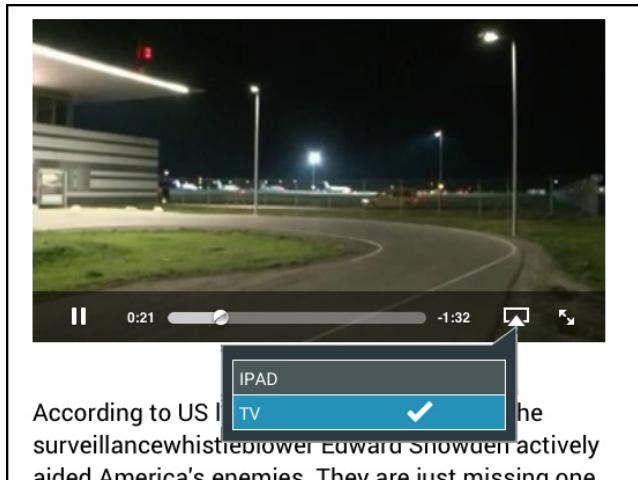


Figure 12 Example of airplay and video controls

The last area of the right column (G) is where the body or main text of the article is presented (28). This area extends beyond the bottom of the screen as much as needed to

adjust to the length of the article and the user can scroll vertically to access the hidden parts of the text.

The whole article column can also be swiped horizontally. Swiping horizontally to the right will show the next article on the list and to the left the previous one.

5.4 Explanation of the five browsing routes by contents



Figure 13 In other media

In other Media

The “in other media” section of the interface is dedicated to showing the selected news as it was reported in other newspapers, radio, or TV programs, Figure 13. This section should be devoted to the narration of facts rather than the presentation of opinions. The system should, for this reason, look for close coincidence between all the terms in the news headline itself and the articles to be included here.

In the implementation of the application, users should be able to decide which sources they want to include or influence their ranking in case that the broadcaster uses a predefined list of sources. This section is different from the “opinions” section in that it doesn’t emphasize the author of the news, but its source.

Opinions

This section is devoted to gathering opinions from different authors about the selected news, Figure 14. In this section the most relevant element is the author. In the implementation of the application, users should be able to decide which authors they want to include or influence their ranking in case that the broadcaster uses a predefined list of authors. It should be possible to include public figures like politicians as well as bloggers. This section correlates with the “opinion articles” section included in many newspapers.

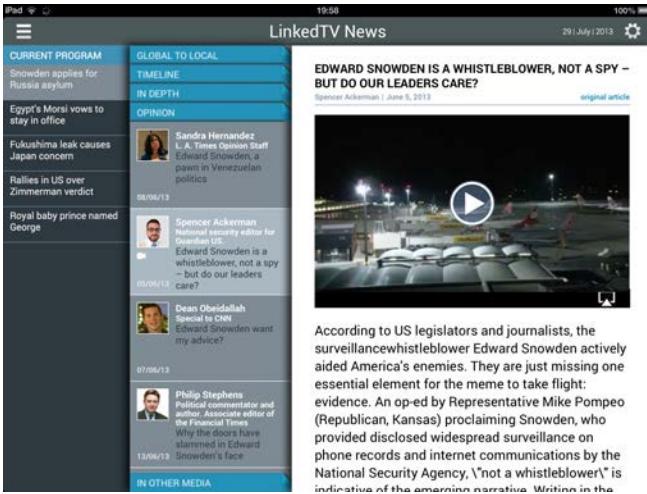


Figure 14 Opinions

In Depth

The “in depth” information includes in depth coverage articles related to the selected headline that could form part of the lean back mode “entities”, but offer a more extensive view. It also includes archive articles. In depth covers the details of the facts: background, actors and their backgrounds, context, and prediction about possible future outcomes. It also includes profiles of the persons involved in the events.

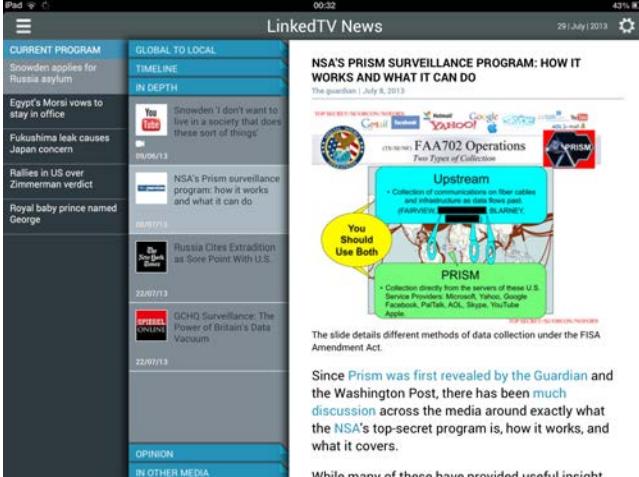


Figure 15 In-depth

Timeline

The timeline section, Figure 16, shows an overview of the events related to the selected news chronologically. Ideally, the timeline should support different degrees of zooming (years, months, days, or minutes) depending on the type of event. Sources and authors are not relevant for this section. Timelines are often presented in well-known newspapers or posted by lay authors.

Global to local (geo-localized tweets)

This section includes live feeds from twitter, Figure 17. The tweets included here, however, are filtered by subject and by geo-location. The intention of this section is to show

people’s opinion in the place where the news happens as well as near the user’s current location.

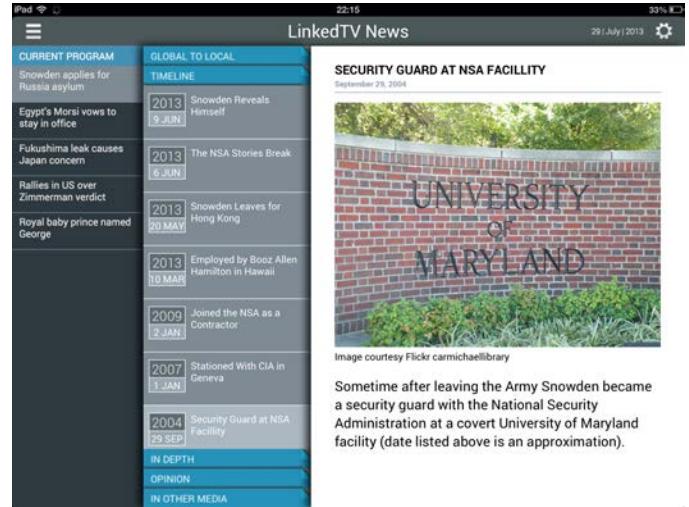


Figure 16 Timeline

The underlying motivation is to give an overview of the perceived local effect of the international news in the users locality as well as a first-hand opinion of people located where the story takes place.

This section is different from the rest in terms of interaction design because instead of the article, the right column contains a map that can be zoomed and panned. The selection of the information can be made by tapping on the center column or by tapping on the twitter icons. Balloons with the tweets then appear as overlays to the map. Two buttons on the bottom of this section with the legend “near me” and “near the news” serve as shortcuts to navigate the map with one click to the current’s user location (near me) and read tweets of neighbors about the subject of the news; or to the place where the event in the news occurs (near the news), and read the testimonies and opinions of locals.

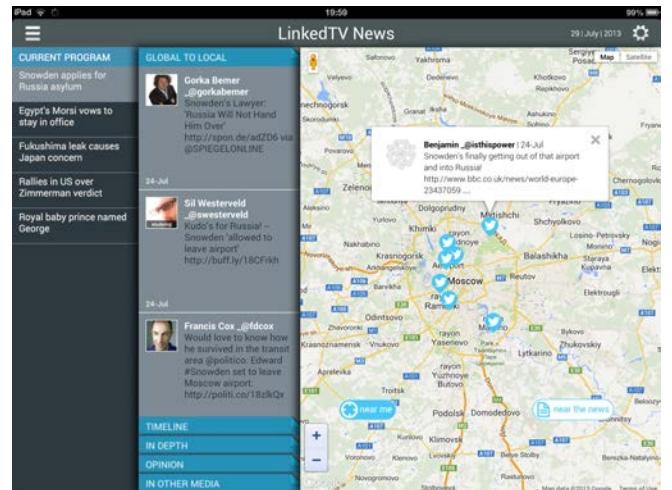


Figure 17 Global to local

6 EVALUATION OF EFFICIENCY FULFILLING USERS' INFORMATION NEEDS AND USABILITY OF THE APPLICATION

Evaluating design solutions against user requirements is the last step of the user centred design cycle before deciding whether to consider the cycle concluded or restart a new iteration, Figure 1. This section describes a task-based evaluation of the *LinkedTV News* hi-fi prototype conducted with the aim of testing its usability, perceived usefulness, appeal and most importantly its ability to fulfill users demands in terms of information needs. Section 6.1 discusses the implementation of the hi-fi prototype. Section 6.2 the objectives of the evaluation; Section 6.3 its setup; Section 6.4 the method; Section 6.5 its participants; and Section 6.6 the results obtained.

6.1 Hi-fi prototype implementation

A hi-fi prototype was implemented reproducing the look and feel illustrated in Section 5.3 and based on the design and interaction there described.

Five short news videos were selected and edited to form an eight and a half minutes long newscast. An HTML5 functional website was created according to the InDesign screenshots and specifications. This website was adapted so that it could seamlessly pass for a native IOS application seen in full screen. Contents were added manually through json and HTML coding to each of the news stories and each of the browsing routes. This resulted in 84 html pages containing articles, 40 summarized descriptions and 467 image files. The look and feel of the application obtained was very realistic except that the contents are not live and therefore, not updated. The experience of feeding the interface with real contents helped to adjust some of its characteristics such as space in the diverse text fields. Overall, the interface adapted well to the information of diverse sources.

Due to time and technology constrains, not all the functionalities intended for a final application were implemented and the ones implemented worked only for the horizontal screen position. However, core functionalities were all included.

A list of the functionalities implemented in the hi-fi prototype can be found in Appendix H.

6.2 Objectives

The objective of the study was to investigate the user information needs, their interaction with the application and the pertinence of the elements of the interface. The following 12 points were used as items of interest to design the study:

Information needs

- How well does the system meet the user's information needs and how can it be improved?

- Is the choice of information elements in the slides adequate?
- Is the information contained in the slides interesting?
- Are the five browsing routes of the lean forward mode useful and suitable?

Interaction

- How do users perceive the experience of having additional information presented in a second screen while viewing a television newscast?
- Is the pace at which slides are shown adequate for users to decide whether to consume the information that they contain?
- Is the amount of information contained in the slides adequate?
- Do users prefer synchronous or asynchronous interaction with the application?

Interface

- Are the elements of the interface clear to the user?
- Are they adequate for achieving their intended goals?
- Is it easy to learn to navigate the interface?
- Is the application perceived as useful?
- Do users find interacting with the application pleasant and satisfying?

Tasks

In order to investigate the points described above, a task based study format was chosen. Three basic types of tasks were included: exploratory tasks, simulated information needs tasks, and free formulated question tasks. For an overview of the task types and examples see Appendix I.

Participants were asked to perform some of the tasks synchronously and some asynchronously in order to assess their experience in both conditions. The actual study was preceded by a pilot study that was used to adjust the wording of the tasks, the length and other aspects of the protocol.

6.3 Set up

The user study was conducted in the same setting as the focus group, reported in Section 3.1.1, a living room like experiment room provided with a sofa a center table and a large television. The television was used to broadcast the news program and an iPad was given to participants as a second screen. The application was installed and functioning in a full screen mode in the tablet. Two cameras were included in the set-up: one situated on top of the participant pointing at the second screen device and transmitting live feed to the researcher's computer and one on top of the television recording the general setup. The first was intended for direct observation and creation of usability logs by the observer and the second one will be used in future research (out of the scope of this report) to

analyze the direction of the gaze while interacting with the application.

6.4 Method

After being greeted, users were given a task-book. This task-book contained consent forms and demographic questionnaires in its first part and the rest were instructions for completing 6 tasks. Many of the tasks were followed by ASQs (after scenario questionnaires) to assess the ease of fulfilling the task, the pertinence of the time demanded and how realistic the task seemed to the user in terms of resembling real tasks that she would perform outside the studio environment.



Figure 18 Participant interacting with *LinkedTV News* during the evaluation

Each task and its corresponding instructions were explained in one page and participants were asked not to turn the page until they were done with the task. Tasks were loosely timed, there was no limit as to how soon a task could end, but participants were asked to stop solving a task after having invested five minutes in it. At the end of the task-book two questionnaires were added: the SUS (System Usability Scale) [22] and the USE [23] (Questionnaire for User Interface Satisfaction). These assess perceived usefulness and ease of use, learnability and satisfaction. Only a partial portion of the USE was employed (perceived usefulness and satisfaction) in order not to overload users with questions and considering that the SUS already measures learnability and ease of use and is a more widely employed and validated tool. After finishing the questionnaires a follow up interview about the experience was conducted by the researcher and recorded for analysis.

At the end of the study, participants were rewarded with *Pathé* cinema vouchers. Each study session lasted approximately one hour.

6.5 Participants

In section 0, reflections about the interviews performed during context analysis, we concluded that a task-based follow up study with the same participants was desirable. Furthermore, participants of the interviews match closely our defined target group. Therefore this study constituted a

follow up to the initial interviews, and the participants are the same. (See Section 3.2.2)



Figure 19 Researcher's view of participant (usability study)

6.6 Results

6.6.1 Usability and ease of use (SUS scores)

SUS, System Usability Scale is a widely validated test. It was designed to measure one single dimension, ease of use. However, recent studies have suggested that it assesses also learnability. [24]

SUS yields a single number representing a composite measure of the overall usability of the system being studied [22]. The scores for individual items are not meaningful on their own. The scale of the averaged items ranges from 0 to 100.

The mark obtained by *LinkedTV News* in the SUS questionnaire is 83 with a standard deviation of 10.

The individual participant's average rating can be seen in the table below:

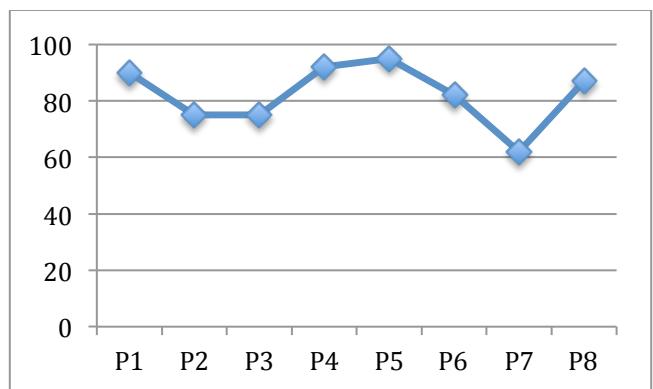


Figure 20 individual participants' SUS score

The average SUS systems grade is 68% [24], and therefore the obtained grade of 83 is above average. Furthermore, it corresponds to the highest grade, a letter A in a letter scale. (For a complete table with details about the SUS scores in the evaluation see Appendix J).

6.6.2 Perceived usefulness (USE scores)

The perceived usefulness of the system was assessed through 6 items of the USE questionnaire graded through a

7-point Likert scale where the highest values are the most positive. The resulting score was 5.6 with a standard deviation of .7. This would correspond to a percentile of 80. Table 2 shows the questions and the user's averaged responses.

USEFULNESS		
1	It helps me to find information more efficiently.	6.2
2	It is useful.	6.2
3	It makes the things I want to accomplish easier to get done.	5.8
4	It saves me time when I use it.	6
5	It meets my needs.	5
6	It does everything I would expect it to do.	4.5

Table 2 Usefulness

As can be seen the higher marks are for the efficiency of the system that is perceived as time-saving.

The lowest scores, although still tending towards the positive side of the scale are the ones related to users' expectations regarding the system and its functionalities.

(For a complete table with details about the USE usefulness scores in the evaluation See annex K).

6.6.3 Satisfaction (USE scores)

The user satisfaction with respect to the system was assessed through 7 items of the USE questionnaire graded through a 7-point Likert scale where the highest values are the most positive. The resulting score was 5.5 with a standard deviation of .5. This would correspond to a

percentile of 78%. Table 3 shows the questions and the user's averaged responses.

SATISFACTION		
7	I am satisfied with it.	5.7
8	I would recommend it to a friend.	6.3
9	It is fun to use.	6
10	It works the way I want it to work.	5.1
11	It is wonderful.	4.7
12	I feel I need to have it.	5
13	It is pleasant to use.	5.7

Table 3 Satisfaction

(For a complete table with details about the USE satisfaction scores in the evaluation See annex L).

6.6.4 Assessment of the slides

In order to assess the suitability of the slides and their components, the participants completed a questionnaire composed by opposite adjectives after a task where they were presented with additional information in the slides of the lean back mode while they watched the newscast. The following are the averaged results of the questionnaire. In this questionnaire a 6-point Likert scale with no neutral or "undecided" position was used.

The information contained in the slides was found to be useful, interesting and easy to browse, Figure 21. On the other hand the simultaneous presentation of TV newscast and the slides was found to be distracting and the pace in which the slides appeared was described as somewhat fast.

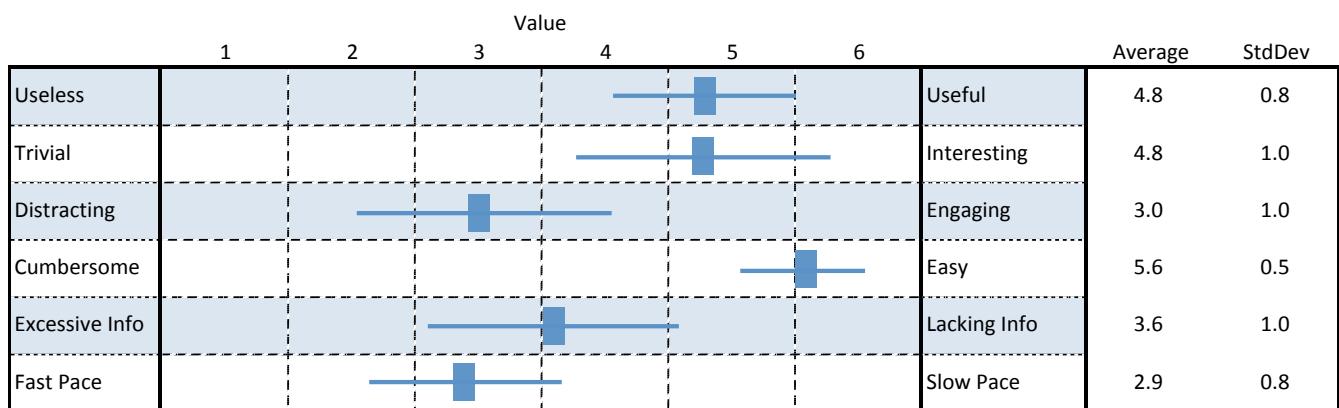


Figure 21 Averaged results of the slideshow questionnaire

6.6.5 Perceived mental effort

Task number 3 was a simulated need task where users were requested to look for certain information while at the same time watching the television program. After completing the task, they were asked to rate the activity through 2 pairs of

opposites in a 6-point Likert scale.

It should be noted that participants found it easy to browse the information, but at the same time they tend to describe the activity as distracting, Figure 22.

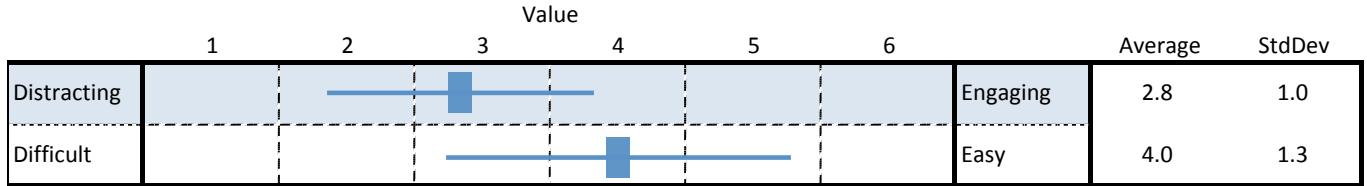


Figure 22 Evaluation of the multitasking search task

6.6.6 Ability to answer freely formulated questions
In the free formulated question tasks every participant formulated a question about 2 topics voluntarily selected from the ones included in the study's newscast. Sixteen questions were formulated, and participants found answers for ten of them within the application. This means that 62% of their questions were found without the need to consult the Internet in the given amount of time. From the

remaining six questions, four were found with ease through Google, and one was partially answered by a Google suggested link and one was not found in the given time. Table 4 shows a list of the questions and indicates whether *LinkedTV News* answered them according to the participants.

Participant Number	1	2	3	4	5	6	7	8
News choice 1	Snowden	Fukushima	Snowden	Snowden	Snowden	Snowden	Fukushima	Fukushima
News choice 2	Zimmerman	Zimmerman	Fukushima	Zimmerman	Fukushima	Egypt	Royal baby	Fukushima
Question 1	Short overview of what happened. What kind of person was the preacher? What are his political positions (also on other past events)	More technical background	More NSA related story	Who is Anatoly Kucherena?	Where else did he apply for asylum?	Details about extradition treaties between US and Russia	When did the leak start?	Map of current radioactive levels of Japan
Q1 answered?	no	yes	yes	yes	yes	yes	yes	no
Question 2	Snowden: Legal conditions for applying for an asylum in Russia?	More opinions	How big is the leak	Where is Zimmerman's family from?	How do they think to solve the problem?	What were Morsi's political decisions that made the process start	What is the baby's name?	Interviews with Japanese living in Japan about the situation
Q2 answered?	yes	no	yes	yes	no	no	yes	no

Table 4 Free formulated questions

6.6.7 Realism of the tasks

Participants' evaluation of the tasks in terms of their realism was very positive, on average 5.5 of realism on a 6-point scale, representing 91% of perceived realism.

6.6.8 Time completing tasks

The average satisfaction with the time that it took to solve the tasks using *LinkedTV News* was 4.9 on a 6-point scale equivalent to 81.8%.

6.6.9 Usability findings

According to the usability logs, and observations, the following findings were extracted from participant's behaviors related to the interface. These findings will be taken into account as opportunities of improvement:

- The difference between the concept "save" and "bookmark" is not clear, and users are not always sure of whether their bookmarking will affect the entire news item or just a slide.
- Some users would like to have the VCR controls for the TV present at all times, also when exploring the in depth information.
- It is not clear to many users what the wording in the title "global to local" refers to.
- The buttons in the "global to local" section are not clearly visible and therefore not often used.
- Some users expect the slide thumbnails to act as markers to navigate the video.

6.6.10 Results of the interviews

Each user evaluation session of *LinkedTV News* ended with an open interview guided by a 15-item questionnaire. The interview assessed participants' general impressions after interacting with the application as well as their suggestions for improvement. The main goal of the interviews was to recognize whether user requirements identified in the preliminary user study had been fulfilled. The fact that the participants were already acquainted with the researcher and some of the research goals due to the previous interview facilitated their involvement in a dialogue that resembled a co-creation exercise.

The interviews were summarized and transcribed, and comments were clustered according to affinities. We present some of them.

Positive aspects

- Overall, participants' reception of the application was very positive. It was described as useful and easy to use. 7 out of 8 participants declared that it had met or surpassed their expectations (all but P7).

P8 *I like it, it's useful. It's so much better to have this tool than not to have this tool. The best is the easiness, it's easy to use; it gives you easy access to different kinds of information with just one click.*

- 7 out of 8 participants stated that would use it if it were available (P1, P2, P3, P4, P5, P6, P8).

P8 *Yeah I would download it for sure and use it if it's matched to my news channel I would definitely use it.*

- Users appreciated the timesaving quality of the interface (P3, P5).

P3 *The list with limited options is of course much better because its quicker. Something with limited options, It limits you, but on the other hand it's quicker so there is a balance, it's your choice.*

- They were satisfied with the density of the information that it contains (P1, P4, P6).

P6 *It really covers most of the things that, usually, the things that you can look for when you look up a news item.*

- All participants in our study appreciated the overview of the temporal background of the news through a timeline, and the opportunity to have multiple views and multiple opinions of a subject gathered in one place.

P4 *The timeline I found very interesting. Sometimes we hear about the news late, and miss things in between. The timeline updates you about the process of the news.*

- Users indicated that they would be likely to use the bookmark functionality to be able to postpone browsing during the advertisement break or after the show. They also said that they would browse during the show if the

following news was not interesting (P1, P2, P3, P4, P5, P7).

P7 *I would bookmark, both things at once are not compatible. I second screen multitask only when I am not interested.*

- Many participants described the presentation of short fragments of information through slides simultaneously with the broadcast as useful and interesting (P4, P5, P8).

P5 *I liked the additional information. Sometimes information is needed to understand or go in depth in the news. I saw a person in the Snowden story and I didn't know who he was, but I clicked the slide and found basic information to calm my curiosity and help me understand.*

Negative aspects

- Overall, participants perceive interacting with the application simultaneously with watching the news as distracting (P1, P2, P4, P5, P7).

P2 *I like the functionalities but not the distraction.*

P2 *I prefer a screen where nothing moves and I request info. If something moves you have to watch.*

- Global to local (geo-localized tweets) was found to be the least useful functionality (P1, P2, P3, P4, P5, P6, P7, P8).

P5 *Least useful functionality for me: tweets though for other people might be good.*

- Some participants felt that the time to view the slides was too short (P5, P6, P7, P8).

P8 *I don't like to have a specific amount of time to read if I select something.*

- The difference between "save" and "bookmark" is not clear (P1, P2, P4, P5, P6, P7).

P1 *Had confusion at the beginning between bookmark and saving.*

Suggested functionalities and improvements

- Use static slides or use a more subtle transition for the slides (P1, P2, P7).
- VCR TV controls visible at all times (P6, P8).
- Control the video with the slides (P2, P6).
- Allow user to deviate in multiple directions (like the related articles in the newspapers) (P3, P4, P5).
- Read people's comments (as in online newspapers) (p6, p7).
- Map to place the news geographically (P5, P6).

6.6.11 Proposed changes

- In a future version of LinkedTV news, in order to improve the interaction, the following changes should be performed:
- The TV area should become permanently visible and easily accessible in both main screen modes (lean back and lean forward).
- The difference between “save” and “bookmark” should be clarified, also possibly through card sorting; and more widely understood icons should replace the current. Otherwise, a label should reinforce the icon meaning.
- The functionalities of the VCR controls of the television area should be expanded to “skip chapter” or to navigate by chapter.
- The thumbnails should allow two modes of interaction, one where selecting a thumbnail affects only the second screen slide show, and one where selecting a thumbnail advances the main TV program to the point where the object depicted on the thumbnail is mentioned. Such double functionality should be thoroughly tested.
- “Related articles” should be added as a browsing route or embedded as a sidebar or footnote to the articles.
- The section “global to local” should be renamed. A good strategy would be to use a card sorting evaluation to find consensus among participants. The buttons of this section should be relocated for clarity. If further evaluations prove that this section is still not used despite the changes, the section should be eliminated.
- The possibility of adding a “search” field or button for performing searches outside the application with the help of it should be considered.

7 CONCLUSION

This project was driven by two motivations: our primary goal was to design a communication "device" to understand user needs and integrate them in a technology driven process. A secondary aim was to explore the role of a second screen interface in coping with the challenges that are inherent to the presentation and consumption of hypermedia.

The *LinkedTV News* companion is an example of the application of hyperlinked video and LinkedTV's technology to the news. It integrates two activities that are related by subject, but currently often take place through different devices and at different times: watching TV newscasts and consulting online newspapers and videos. These activities are not mutually exclusive. Our contextual research shows that users frequently perform both because they believe that each one of them offers different advantages, for example, some of them watch TV broadcasts to get an overview of the news, and read online newspapers when they want to get in-depth information about specific news.

Our task-based study with a hi-fi prototype showed that the proposed integration is appealing to users who are interested in the news and dedicate a certain amount of time daily to getting updated.

Participants in the study were generally enthusiastic to have different types of information related to the news concentrated in one application and considered that, in this sense, the interface would be timesaving with respect to their current equivalent practices (e.g. consulting several independent sources). The proposed interface sections were described as very thorough in covering possible users' information needs. In particular, the most valued sections were:

- the chronological overview of the news delivered through a timeline
- the opportunity to read the same news headline as it was presented in different media sources
- Participants also valued the possibility of bookmarking the news in order to postpone the more cognitively demanding tasks related to in-depth exploration of the information for after watching the television program.

The possibility of accessing geo-localized information through tweets was, unexpectedly, the functionality that participants liked the least.

In terms of understanding users needs, evaluation with a hi-fi prototype showed that the application succeeds in fulfilling many of the needs identified in the preliminary study. Overall, there seems to be interest from users in an integrated hypermedia solution for the news that resembles the one we proposed, and there is reasonable evidence (see Section 6.6.10) to expect that an application like this would have a good reception.

Furthermore, through *LinkedTV News* a continuing dialog was established with the members of the LinkedTV team about what types of links users would be interested in and how to deal with choosing relevant subsets of them, thus, contributing to guiding the next technological steps of the research project.

With respect to understanding the role of a second screen interface in hypermedia presentation, the goal was partially fulfilled. From the two challenges of web-enriched broadcast video presented in the introduction, *consuming active contents through a passive medium* was most influential in designing the application. The lean back mode of the application was conceptualized to accommodate the passive mode of interaction that is usual when watching TV. The intention behind this was to allow users to choose which level and type of engagement (active or passive) they want employ in interacting with the hypermedia enrichments.

Though most users valued the additional information presented through a slideshow during the program, and

understood that they could use the application to delay the in-depth exploration, they complained about being distracted by the spontaneous movements that occurred on their second screen. These movements forced them to look at the second screen involuntarily, thus introducing an element of disturbance in their peripheral views and their experience of media consumption.

8 DISCUSSION OF CURRENT WORK

The initial contextual studies were performed with nineteen participants in total. However, we decided to continue working only with the eight who more closely matched our target audience. We performed in-depth open interviews with each of them, and gathered information about their experiences and their information needs. They suggested functionalities and helped envision an application that would potentially fulfill those needs. In a second iteration, they assessed to what extent the application met their initial motivations and validated our proposal.

This iterative approach with one group of users lent itself to in-depth exploration bordering on a co-creation exercise. The in-depth and, to a certain extent, longitudinal character of the study was intended to compensate for the small number of participants. There is a possibility, nonetheless, that the familiarity of the users with the project might cause some bias. Therefore we recommend testing the application with a group of independent participants in order to compare results.

Another element that could be improved is the temporal aspect of the news used in the study. The news articles were manually fed in the system by a process that took a few weeks, and thus they were dated when the study was performed. Ideally, the study should be repeated with “fresh” up to date news.

9 FUTURE WORK

In order to explore further the role of a second screen and the cognitive load that a dual screen set-up demands, the lean back mode screen should be studied separately in a series of controlled experiments. The number of enrichments, length of the information contained, pace in which they change, topics to which they refer, colors and animations they use should be studied in order to prevent overload of users’ attention.

Group evaluations should also be performed in order to test the performance of the second screen application when watching the news collectively. This refers to the second challenge of supporting Web-enriched broadcast mentioned in the introduction (Section 1.3).

LinkedTV News could be turned into a valuable commercial application if the following conditions are met:

- Lean back and lean forward modes are both available and switching between them is easily possible.
- The cognitive load of the lean back mode with respect to peripheral vision is reduced.

- Necessary link types are implemented and high quality information is provided.
- Accurate synchronization of the second screen with the television is achieved.
- Easily configurable user controlled personalization is enabled.

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APPENDIX A: NEWS ITEMS PRESENTED IN THE FOCUS GROUP

NEWS SECTION	TOPIC / TITLE	Track	Length
International News Summary	One-minute World News	1	0:01:00
International News	Floods wreak havoc in Mauritius	2	0:01:15
	Bird Flu in China		
Politics	N Korea in 'state of war' with South	3	0:01:26
Local News	'Psychedelic' tulip show in the Netherlands	4	0:02:33
Arts and Entertainment	Iran planning to sue over Argo	5	0:01:44
Science and Technology	Touchscreen 'that reacts even without touching'	6	0:01:08
Sport	Messi UEFA Best Player of the Year	7	0:01:30
Finance/business	Why do banks go bust?	8	0:01:10
Human interest story	Human parents for a baby gorilla	9	0:01:17
Weather	Europe weather forecast	10	0:01:20
		TOTAL	0:14:23

APPENDIX B: FOCUS GROUP PROTOCOL

WORKSHOP/FOCUS GROUP APRIL 5, 2013 @CWI – BY LILIA PÉREZ AND KRISTINA ANDERSEN

- **Goal:** gathering input and inspiration for formulating a concept design (high-level functionalities for a seconds screen companion intended to deliver additional information while watching the news broadcasts.)
- **Total duration:** 45min
- **Location:** living room setting, Pampus room M366 at CWI
- **Reward for participants:** digital voucher for Pathé movies.
- **Date and time:** 5 of April from 13 to 17h.
- **Target user profiles of focus group participants:**
 - 12 users (4 groups of 3) or 16 users (4 groups of 4). At least 60% of them should be TV newscasts viewers. The other 40% can be on-line news readers even if they don't regularly watch the news.
- **Who:** two moderators, one acting as host (Kristina) and the other one as technical facilitator (Lilia)

PROTOCOL

INTRODUCTION / COLLECT PARTICIPANTS OUTSIDE ROOM (5 MIN PREVIOUS TO START)

(KRISTINA + LILIA)

- 1) A poster is placed outside the room to indicate that participants have reached the right location. It indicates that they should wait there for the others to arrive.
- 2) Participants wait outside the room or are collected at the entrance of CWI (external visitors).

START OF WORKSHOP

FILLING OF QUESTIONNAIRE AND CONSENT FORM (10 MINUTES)

- 3) Once all participants have been gathered outside the room, they are introduced in the living room (by both researchers) and given:
 - a) Consent form (annex A).
 - b) Brief questionnaire (annex B).

- Documents obtained: filled questionnaires and consent forms

WELCOME AND INSTRUCTIONS (2 MINUTES)

KRISTINA

- 4) After collecting the questionnaire, participants are shortly briefed by the host. They are then given a pack comprised by pens, colored post-its and a folder with the following documents:
 - a. Blank A4 sheets of paper with mock up frames of ipad, iphone and laptop, labeled according to the videos (annex C, D, E)

VIDEO + ADITIONAL INFORMATION EXERCISE (15 TO 20 MINUTES)

KRISTINA AS HOST + VIDEO DOCUMENTER / LILIA AS VIDEO JOCKEY AND TECHNICAL FACILITATOR

- 5) Participants are asked to seat on the sofa in front of the TV with the pens and the blank mock up frames ready. They then receive the following instructions: You will now watch 6 to 10 blocks of news (see annex F for a specification of the video news fragments). Each one lasts between 1 to 3 minutes.
 - a. Please think about the additional information that you would like to have about each piece of news. Feel free to ask, it doesn't matter how difficult or how strange the request for additional information seems.
 - b. Choose the blank sheets with the mock up frame corresponding to the device that you think you would more likely use in real life to look for the answer to your questions.

- c. Write down the question on the blank paper. For each video, use the paper labeled with the corresponding number.
 - d. After the video has finished playing, you will be given a couple of more minutes to finish writing the questions, so don't worry if you don't finish before the video does. You can also choose to first watch and then write.
 - e. Rate the video from 1 to 5 stars according to your preference (1 low 5 is high).
 - f. If you have things that you would like to be able to do with the video besides looking for information (for example, you would like to be able to bookmark the video) write down those ideas too.
- 6) After each video host approaches the participant with a camera and asks him/her to explain, in a mode similar to the think aloud method, what they wrote and why. Whenever a participant does not feel comfortable with her face being shown on video, only her hands will be recorded.
- Documents obtained: lists with set of questions (types of additional information desired) and an indication of second screen devices and sources used. Videos rated according to preference. Video + audio documentation of the whole process and video shots with people explaining their choices and needs aloud.

HOSTED BRAINSTORM : FUNCTIONALITIES (10 MINUTES)

KRISTINA AS HOST – VIDEO DOCUMENTER

- 7) Participants remain seated on the sofa. A flip board and markers are introduced into the living room space. Participants are given the following instructions:
- a) Reflect on the previous exercise and think about functionalities that you would like a second screen companion for the news broadcasts to have. The functionalities should not be constrained by what is possible in the present, by existing applications or by what you know about technology.
 - b) Make a brainstormed list of functionalities with your group.
 - c) Vote within the group for your favorite functionality.
- Documents obtained: rated lists of desired functionalities.

WILDCARD : TELEVISION OF THE FUTURE (5 MINUTES)

KRISTINA AS HOST

- 8) Participants are asked to speak to the camera and briefly explain how the news of the future look like for them, or how we will access the news in the future (Head shot, vox –pop, blue sky thinking).
- Documents obtained: video snapshots of futuristic views on the news.

END OF WORKSHOP

APPENDIX C: EXTENDED LIST OF FOCUS GROUP FINDINGS

1. Need for more in depth specific information.

(11 comments / 7 participants + 1 brainstorm list)

P6 About the bird flu - *I was wondering just how expensive it is to make all those vaccines, you know? I was just wondering if it is a good idea to even make a lot of it or how hard it is to make.*

2. Would like an overview related events that occurred in the past.

(5 comments / 3 participants + 1 brainstorm list)

P7 About North Korea's state of war - *my search would be something like "South Korea state of war ramp up" (...) I would like to know, what happened two years ago and how they solved it...*

3. Search for different opinions.

(3 comments / 3 participants + 1 brainstorm list)

P7 About North Korea's state of War - *I'd start with Wikipedia, probably, and then I always look at AP and Al Jazeera to get two different opinions...*

4. Information about how this ends, updates when important changes occur

(3 comments / 3 participants + 1 brainstorm list)

P8 About "Human parents for a baby gorilla"- *I would like to know if the story succeeded, if the gorilla was saved ...*

5. Local effect of global news – What is the impact in my life?

(4 comments / 2 participants + 2 comments in 1 brainstorm list)

P1 About the bird flu - *Yes then I would look it up, what is the effect in the Netherlands... (of the bird flu virus)*

Secondary information needs expressed by participants:

6. More information about people in the news - the ones provoking the events (2 comments / 2 participants)
7. Information about watching a film (2 comments / 2 participants)
8. How can I help? (1 comments / 1 participants + 1 comment in 1 brainstorm list)
9. Access related publications, documentaries and news from that time. (1 comments / 1 participant + 1 comment in 1 brainstorm list)
10. Opinion from a specific expert-thinker (1 comments / 1 participant + 1 comment in 1 brainstorm list)
11. Access related information selected by experts and suggested by broadcasters. (1 comments / 1 participant + 1 comment in 1 brainstorm list)
12. Information about who is behind the news (1 comments / 1 participant)
13. Where is that location? (1 comments / 1 participants)

Actions triggered by information needs

14. Google the information (12 comments / 6 participants)
15. Consult different sources (4 comments / 4 participants)
16. Look it up (no specified source) (3 comments / 3 participants)
17. Check the newspaper (printed) (2 comments / 2 participants)
18. Make a note for later sharing (2 comments / 2 participants)
19. Go to Wikipedia (2 comments / 2 participants)
20. Compare weather in two locations (2 comments / 2 participants)
21. Look up movie schedule (2 comments / 2 participants)
22. Wait to see the outcome (2 comments / 2 participants)

Sources currently used

23. Google (6 participants)
24. Wikipedia (3 participants)
25. BBC (2 participants)
26. US government (1 participant)

27. AP (1 participant)
28. Al Jazeera (1 participant)
29. Volkskrant (1 participant)
30. Buienradar (1 participant)

Functionalities mentioned during the brainstorm sessions

31. VCR capabilities, pause, replay skip (5 comments / 2 participants + 3 brainstorm lists)
32. Bookmark for later viewing (2 comments/ 1 participant + 2 brainstorm lists)
33. Get an alert or update when something changes in that particular news (2 comments / 2 + 1 brainstorm list)
34. Buying tickets, reserving (1 comment/ 1 participant + 1 brainstorm list)
35. See longer versions of stories that I like / or make playlist of similar stories – to keep on watching (2 comments / 2 participants)
36. Share information like warnings (about bad weather) (1 brainstorm list)
37. Recommender system (1 brainstorm list)

Perceptions of technology

38. Perception of TV as a passive medium that will remain so (3 comments / 2 participants + 2 in 1 brainstorm) P9 - <i>TV works very well because it sort of blocks you out. Second screens just distract from just watching the TV. So although it's news it's also sort of a relaxing moment if you don't have to do anything, don't have to think about it.</i>
39. News in the future will not be linked to a certain space and time (2 comments/2 participants) P1 - <i>I think that it's more that when you want to look the news you can everywhere see the news and not at a specific time or place...</i>
40. TV is outdated (2 comments/2 participants) P6 - <i>I think that television in itself is kind of outdated</i>

APPENDIX D: QUALITATIVE INTERVIEW FINDINGS

(Numbering continues from focus group findings)

Attitudes toward media (TV and newspapers) based on habits

41. It is possible to be more selective and control time better when you are reading. (P3, P4, P8)

P4 - *When you read, you manage your time and read what interests you versus when you watch a video you have to watch all the video, and you cannot select video stuff. When you see a report [...] one look and you can know what you need, and then it is much faster to find information...*

42. TV is sometimes perceived as a way to get a general overview of the news, and newspaper a medium that goes go more in-depth. (P1, P6)

P1 - *I think the main difference (between news on TV and online newspapers) is that when I read it I only read the articles that I am really interested in and I watch it on TV to get a general overview on what is happening in the world.*

43. Some users consider that watching video news is a social act while newspaper reading is a solitary act (P2).

P2 - *So having the video footage, that you have more in the television news, I think adds value there, and maybe also the fact that you can watch it together, adds value, so when you read the news paper I think that you really read alone.*

44. Newscasts lend themselves to a passive behavior and relaxation. (P8)

P8 - *I guess this is one of the benefits of having just this 50 minutes newscast, that you can have a really passive behavior, right? You can just be in bed, listen to everything and you don't have to concentrate, just focus in what they are talking about. This is also nice.*

Desired Functionalities regarding information

45. Some users would like to have a link between TV and other sources (P1, P2, P6)

P5 - *I think, I would expect that you would include like, the main links to what they're talking about like if it was about Hugo Chávez, links to Wikipedia or some articles about him, the country, and stuff like that because I think that's the thing that I would look for myself.*

46. Some users would like to be able to compare different opinions about a subject, different scenarios, and different sources. (P8, P7)

P8 - *I think that the German news are still kind of OK, but still, I mean everybody is biased in their opinion, so no matter which news you read you always have some bias. It is good to have different and diverse opinions and first hand information.*

47. To access and compare the international view on local news. (P2)

P2 - *Typically I will look up for some confirmation I think sometimes I'm interested for instance on national news, how international news would cover the same thing.*

48. Access opinions of locals, regular people, preferably friends that are where the news take place (P8)

P8 *When I think about this now, about this communication aspect, what really is interesting for me is to talk with people preferably friends who are in the situation. For example in Korea if there is this tension between north and south, I want to talk with someone from there, to see like the real opinion of people there, because it's very different if you have a news reporter talking about this and if you just have an ordinary people talking about it.*

Other desired functionalities (not related to information needs)

49. Notifications and the app itself should be turned on and off on demand. (P3, P1, P5)

P1 - *I think I would like to open it for myself and request information. I am a control freak.*

50. Bookmark news and delay reading. (P1)

P1 - *Maybe, ahh some sort of bookmark, so that just like a red button that I could hit in the moment that I think something is interesting and that I could get back to it later. And then maybe, in the meantime it could collect some information for me.*

51. P5 would like to follow a story through time, but would also like it to contain an indication about what he has already seen. (P6)

52. When watching with others through Skype, P6 would like to have video synchronization to be sure both persons are watching exactly the same. (P6)

53. Having a small lateral screen showing short information pieces about what appears in the text. For example the context.

Personalization

54. Users prefer pull and user controlled instead of push.

55. In general a user-controlled personalization that is easy configurable and doesn't personalize regarding political inclinations, only categories or topics and sources

56. Personalization, but easy to configure, general categories and known sources.

57. People don't want to miss important information because of personalization.

APPENDIX E: PERSONAS



Nina (Mother of Lisa)

Occupation: teacher

Age: 32

Nationality / place of residence: German / Prenzlauer Berg

Digital literacy: interested in new media and “hip” technology

Nina is a typical inhabitant of Berlin's hippest quarter, Prenzlauer Berg. She is a well-educated and well-informed young mother. She really likes discussing things. She especially likes to talk about politics and culture. Therefore, she likes to get deeper and not just superficial information. When a subject is interesting for her, she will take the time to understand it properly. She likes Berlin with its constant changes and she feels very much at home in her family-friendly neighborhood. She likes to visit exhibitions and also to go to the theatre and readings. Because she is very interested in culture, she would like to be informed about the city life, current events and new galleries. She does not like it at all when things are complicated and take a long time to understand. She can get impatient very quickly, so every application or service has to be smooth and easy. Nina is not interested in technological background information on how a system works, it should just work well and adapt to her life.

Time-independence is also very important for her, because of her little girl. She only has time to watch infotainment programs whenever her daughter is asleep.



Alonso (Maria's husband)

Occupation: civil engineer

Age: 42

Nationality / place of residence: Spanish / Amsterdam, the Netherlands

Digital literacy: loves gadgets, has some knowledge of programming

Alonso is a civil engineer specialized in hydraulic systems. He lives in the Pijp quarter in Amsterdam. He has a postgraduate degree in engineering and an MBA. He works for an international company in the Netherlands. His job is well paid, and he likes it very much although he really misses Spain. Alonso lives with his wife, Maria, who is also Spanish and studied art history. Alonso is a workaholic and stays in the office until late. He uses a car as a means of transportation when going to work. In Spain, Alonso used to listen to the news on the car's radio, but he can't understand Dutch, so he can't do that in his new place of residence. Instead, every night at nine, he watches the Spanish news in TVE. He likes that moment when he can relax and sit with Maria watching as they both have dinner.

Alonso is crazy about gadgets; he buys and tries them all. He also likes to read about tech news in blogs like End Gadget or Gizmodo. He doesn't have time to read his blogs or twitter during his working hours, so he does so at home, mainly multitasking while he watches a TV series. Alonso is also interested in politics and likes political satire, he reads El País daily in the morning, while Maria is taking a shower. He secretly loves this time for himself.

Alonso and Maria have no kids. They like going to the movies together and like to travel a lot. They both are fond of building things so often they get involved in *bricolage* projects and decorate the house together.

APPENDIX F: SCENARIOS

The numbers within parenthesis indicate the requirement that each part of the scenario relates to. The user requirements are found in section 4.6 of the report.

Urban mom

Nina's baby has fallen asleep after feeding, so Nina switches on the TV to be informed. Browsing the television guide in her tablet EPG (electronic program guide), she sees that "rbb AKTUELL" evening edition is available and starts the program.

She sits comfortably on her favorite couch with her tablet on her lap . LinkedTV News knows what she has chosen and loads the enrichments for rbb AKTUELL (11). The first news is, again, about the failed construction of the Berlin Brandenburg airport. While she listens to what the anchor says, a picture of Willy Brandt shows up automatically in the LinkedTV News enrichment screen (8). He is the Nobel Prize winner after whom the airport will be named. There are a few things about him that she didn't know and finds out with one quick look at the short information on her tablet screen. He was a city mayor in the sixties, she wasn't aware, that was before her time, but now she knows. The next enrichment tells her about the new company taking over the construction (8); she gets a nice and quick overview of whom these people are and what they did before. Nina is amazed at how new this old news feels when she uses her second screen companion.

Watching a news spot about Berlin's Green Party leader, Volker Ratzmann, who withdrew from his office yesterday, Nina is kind of frustrated as she voted for him and feels her vote is now "used" by someone she might not have voted for. She would like to know what other politicians and people who voted for him think about Ratzmann's decision to resign. She uses LinkedTV News to pause the TV (15), because she doesn't want to lose any detail of this story that concerns her a lot and looks for such information in her LinkedTV News application sitting on her lap (13). She goes to the "opinion" section and checks what is available there (3). She chooses to read one article from a special contributor for De Spiegel and watches a selection of video statements of politicians and voters. She finds all kinds of opinions that help her understand better what is happening.

Watching a news spot about a debate on the mandatory change of uniform for police officers, Nina wonders why the usual green uniform should be changed. Out of interest, she looks at the application and browses the in-depth section (1) where she quickly finds the answer. In the news over time overview (2) of the app she even finds out how German uniforms looked before being green and who the designer of the current uniforms was. Some of the uniforms are very classy. This makes her think of her friend Gama who is a fashion designer, so she decides to share the article with him. She clicks "share" in the LinkedTV News app and chooses to send him an email with the link (17).

Technology savvy couple

On Monday, Alonso comes back as always around 8:00PM in the evening. After greeting Maria, who has also just arrived, they start cooking dinner together. Soon it's time for the evening news. They set the table in front of the TV and sit in order to eat and watch. Next to them they place a tablet with the LinkedTV News application they use the smart cover so that the tablet stands on the table within sight while they eat (14,12,16). The app synchs automatically with the TV (11). Soon, his mood changes while he listens to the anchor speaking about how king Juan Carlos got injured while hunting elephants during an expensive trip to Botswana. The injury hadn't been serious, but the trip for Alonso was a serious matter. How can the king go on luxury vacations with his lover while the country is in recession? Alonso wants to know what people in Spain think about this, and if anyone is as angry as he is, but he is busy eating now, so he bookmarks the news and continues watching (13).

The following news is interesting for Maria, it speaks about a movie that they both watch together: Argo. The makers of the movie are being sued by the Iranian government who claims that the film distorts the facts and the country's image. Maria asks Alonso to bookmark this news for her (13).

After dinner, Alonso starts his usual multitasking while the TV plays some comedy show. He does so by browsing the LinkedTV News application's twitter feed where he filters the tweets in relation to a location: Spain (9). Because he is already browsing his bookmarked news, he doesn't need to filter the subject. There he finds many that think like him. He also consults other media, and what they are saying about this news (4). He expects El País to agree with him, but El Mundo for sure will be trying to speak in favor of the king (5). He always compares those two newspapers of opposed tendencies that represent the two main political parties. He used to do this before by going to the online versions of the papers, but know it is much easier and faster. He configured EL País and El Mundo in his personal list of sources (20,21,22) with a couple simple steps and now it is all already there in LinkedTV News. He has also included some international newspapers in his configuration, so he can even read about how the rest of the world sees this royal scandal.

Maria postpones reading about Argo until the next day after work (13), but activates alerts because she wants to know if anything changes while she's distracted with other things (18). When she is waiting for Alonso to come home, she gets a message alerting her of an update in this bookmarked news (6). Apparently Isabelle Coutant-Peyre, a lawyer of a very questionable reputation who also represented Venezuelan terrorist Illich Ramírez Sanchez, will act as Iran's lawyer. "This is getting serious" she thinks, and sits to read as she waits. Maria wonders to what extent the movie was really lying. She browses the in depth information in the application (1,2) and checks the timeline, and that allows her to decide for herself.

APPENDIX G: REQUIREMENTS RELATED TO PARTICIPANTS' COMMENTS

The following list shows the user requirements of *LinkedTV News* on the left column and on the right column it states which comment or report section originated the requirement. The letter A stands for Appendix, it is followed by the Appendix letter (e.g. Appendix C = AC) the number refers to the number of item in that appendix that corresponds to the relevant remark.

<i>Requirements about information needs</i>	<i>Related user comment</i>
1. Give in depth information about the news on TV	AC1
2. Give an overview of past-related news	AC2
3. Illustrate a multiplicity of opinions about the news	AC3
4. Allow users to consult news in diverse sources	AC15, AD46, AD47
5. Build a link between TV and user's habitual newspapers	AD45
6. Update users about important changes in news	AC4
7. Give contextual information about setting of the news	AC13/AD53
8. Give information about people and organizations mentioned in the news	AC6
9. Allow to access opinions of locals	AD47

<i>General requirements</i>	
10. Programmed and designed for running in a tablet PC	Report Sections 3.1.4 and 3.2.4
11. Automatically synchronized to user's program choice	Report Sections 3.1.4 and 3.2.4
12. Allow for group or single television watching	Report Sections 3.1.4 and 3.2.4
13. Enable synchronous and asynchronous modes of interaction (bookmarking)	Report Sections 3.1.4 and 3.2.4
14. Allow some hands free mode of viewing or interacting	Report Sections 3.1.4 and 3.2.4
15. VCR capabilities pause, replay, skip	AC31
16. Portable	AC39
17. Share information through the application	AC36
18. Notifications turned on/off on demand	AD49

<i>Requirements about personalization</i>	
19. User-controlled personalization	AD54
20. Easy configurable with a couple of clicks	AD55
21. Selection of preferred sources or influence the ranking of sources	AD55
22. Selection of preferred categories	AD55
23. Personalization does not override the importance of the news	AD57

APPENDIX H: LIST OF THE FUNCTIONALITIES IMPLEMENTED IN THE HI-FI PROTOTYPE

Functionalities implemented in the hi-fi prototype:

Lean back mode

- VRC type controls for the main screen (TV or PC) through a second screen controller interface.
- Presentation of additional information in the form of thumbnails and slides synchronized to the main screen program.
- Browsing through the slides
- Bookmark news
- Slide timer (to update slides when there is no activity after selection)
- Pause slide presentation
- Save slides (partially implemented)
- Menu

Lean forward mode

- Browse bookmarked news
- Browse current program
- The browsing routes:
 - In other Media
 - Opinions
 - In Depth
 - Timeline
- Global to local (geo-located tweets)
- Manually browse map and select tweets
- Browse map through buttons
- “Near me” and “near the news” buttons
- Select a news heading
- Select a browsing route
- Go to original article
- Swipe through articles
- Airplay videos
- Menu

At this stage functionalities were implemented only in the horizontal screen mode though it is contemplated to use also vertical in the future.

APPENDIX I: EXAMPLE OF TASK TYPES INCLUDED IN THE TASK-BASED STUDY

Exploratory tasks

The purpose of exploratory tasks was to allow participants to get acquainted with the system, and to experience it freely without being directed. These tasks were combined with small subtasks intended to evaluate specific elements of the interface.

...Today you are in a relaxed mood so you decide to sit and watch the television program and postpone other activities.

- Watch the first three news items of the program without stopping or leaving the “slideshow” screen.
- Bookmark at least one news item that you consider interesting.
- Feel free to browse the slides, if you wish and to save the ones that you would like to explore later.
- When the three first news items are over, please press “pause” then return to this booklet and turn the page. The researcher will remind you when to do this.

Please press play to start the task

Simulated information needs tasks

The purpose of simulated information need tasks was to evaluate whether the browsing route's purpose was clear and whether they match participants' structure of thought when performing an information seeking related task. Also whether participants could find their way through the interface in a given amount of time.

Find out the opinion of a local about the riots in Egypt:

You have heard a lot in the news about riots going on in Egypt. You know that there are two main groups of people in conflict: those that are in favor of the president, and those who are against. However, you mistrust the information presented by foreign media and would like to have some first hand information and testimonies from common people living in Cairo.

See if you can find such information with the help of the application.

Return to this booklet and turn the page when you have completed the task. You have 3 to 5 minutes to find information.

Free formulated question tasks

The purpose of free formulated question tasks was to approach as much as possible a real life (non-study) situation in which the participants would have an authentic, self motivated, doubt about the news and the need to solve it, and to determine to which extent the application would be useful to solve such doubts in a given amount of time. A secondary intention of these tasks was to observe the sequence of actions that participants would take to search for an answer on the Internet in case that they couldn't find it in the application.

From this list of the news that you have just watched, please mark the two that you find more interesting.

- [] Snowden applies for Russia asylum
- [] Egypt's Morsi vows to stay in office
- [] Fukushima leak causes Japan concern
- [] Rallies in US over Zimmerman verdict
- [] Royal baby prince named George

Which additional information would you like to have about these news items?

For each of the chosen news items, please write down a question or information need that you have:

Please turn the page when you finish the task.

(Next page) Please search the application for an answer to your first question.

APPENDIX J: SUS SCORES OF INDIVIDUAL PARTICIPANTS

	Question	P1	SUS	P2	SUS	P3	SUS	P4	SUS	P5	SUS	P6	SUS	P7	SUS	P8	SUS
1	I think that I would like to use this website frequently:	5	4	5	4	4	3	4	3	5	4	4	3	3	2	4	3
2	I found the website unnecessarily complex:	1	4	1	4	2	3	1	4	1	4	1	4	2	3	1	4
3	I thought the website was easy to use:	4	3	4	3	4	3	4	3	5	4	4	3	3	2	4	3
4	I think that I would need the support of a technical person to be able to use this website:	1	4	1	4	2	3	1	4	1	4	1	4	2	3	1	4
5	I found the various functions in this website were well integrated:	5	4	2	1	4	3	4	3	4	3	3	2	3	2	3	2
6	I thought there was too much inconsistency in this website:	1	4	4	1	2	3	1	4	1	4	2	3	1	4	1	4
7	I would imagine that most people would learn to use this website very quickly:	4	3	4	3	4	3	5	4	5	4	4	3	3	2	5	4
8	I found the website very cumbersome to use:	1	4	2	3	2	3	1	4	1	4	1	4	2	3	1	4
9	I felt very confident using the website:	4	3	4	3	4	3	5	4	4	3	4	3	3	2	4	3
10	I needed to learn a lot of things before I could get going with this website:	2	3	1	4	2	3	1	4	1	4	1	4	3	2	1	4
	Individual SUS Score		90		75		75		92.5		95		82.5		62.5		87.5

P = participant scores

SUS = SUS value

APPENDIX K: USE USEFULNESS SCORES

USEFULNESS		1	2	3	4	5	6	7	8	Average
1	It helps me to find information more efficiently.	6	6	6	7	6	7	6	6	6.3
2	It is useful.	7	6	6	6	7	7	5	6	6.3
3	It makes the things I want to accomplish easier to get done.	6	6	6	6	6	6	5	6	5.9
4	It saves me time when I use it.	7	7	4	6	6	6	6	6	6.0
5	It meets my needs.	5	5	4	5	6	6	4	5	5.0
6	It does everything I would expect it to do.	7	5	3	4	4	5	3	5	4.5

APPENDIX L: USE SATISFACTION SCORES

SATISFACTION		1	2	3	4	5	6	7	8	Average
7	I am satisfied with it.	7	5	5	6	6	6	5	6	5.8
8	I would recommend it to a friend.	7	6	5	7	7	7	6	6	6.4
9	It is fun to use.	6	6	6	7	7	5	6	5	6.0
10	It works the way I want it to work.	7	5	4	5	5	6	4	5	5.1
11	It is wonderful.	6	4	5	6	6	4	3	4	4.8
12	I feel I need to have it.	6	4	5	6	6	5	4	4	5.0
13	It is pleasant to use.	7	5	5	5	7	6	5	6	5.8